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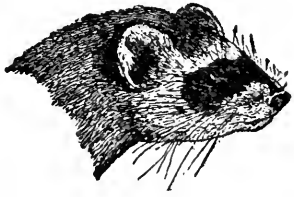
NORTH AMERICAN FAUNA

No. 49

[Date of publication, December, 1926]



A BIOLOGICAL SURVEY OF NORTH DAKOTA

I. PHYSIOGRAPHY AND LIFE ZONES
II. THE MAMMALS

BY

VERNON BAILEY

BIOLOGIST
DIVISION OF BIOLOGICAL INVESTIGATIONS
BUREAU OF BIOLOGICAL SURVEY

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1926

NORTH AMERICAN FAUNAS

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No. 8. Monographic Revision of the Pocket Gophers, Family Geomyidae (exclusive of the species of *Thomomys*). By C. Hart Merriam. Pp. 258, pls. 20, figs. 71, maps 4 (colored). 1895.—[*Out of print.*]

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No. 10. Revision of the Shrews of the American Genera *Blarina* and *Notiosorex*. By C. Hart Merriam. The Long-tailed Shrews of the Eastern United States. By Gerrit S. Miller, jr. Synopsis of the American Shrews of the Genus *Sorex*. By C. Hart Merriam. Pp. 124, pls. 12, figs. 3. 1895. [*Out of print.*]

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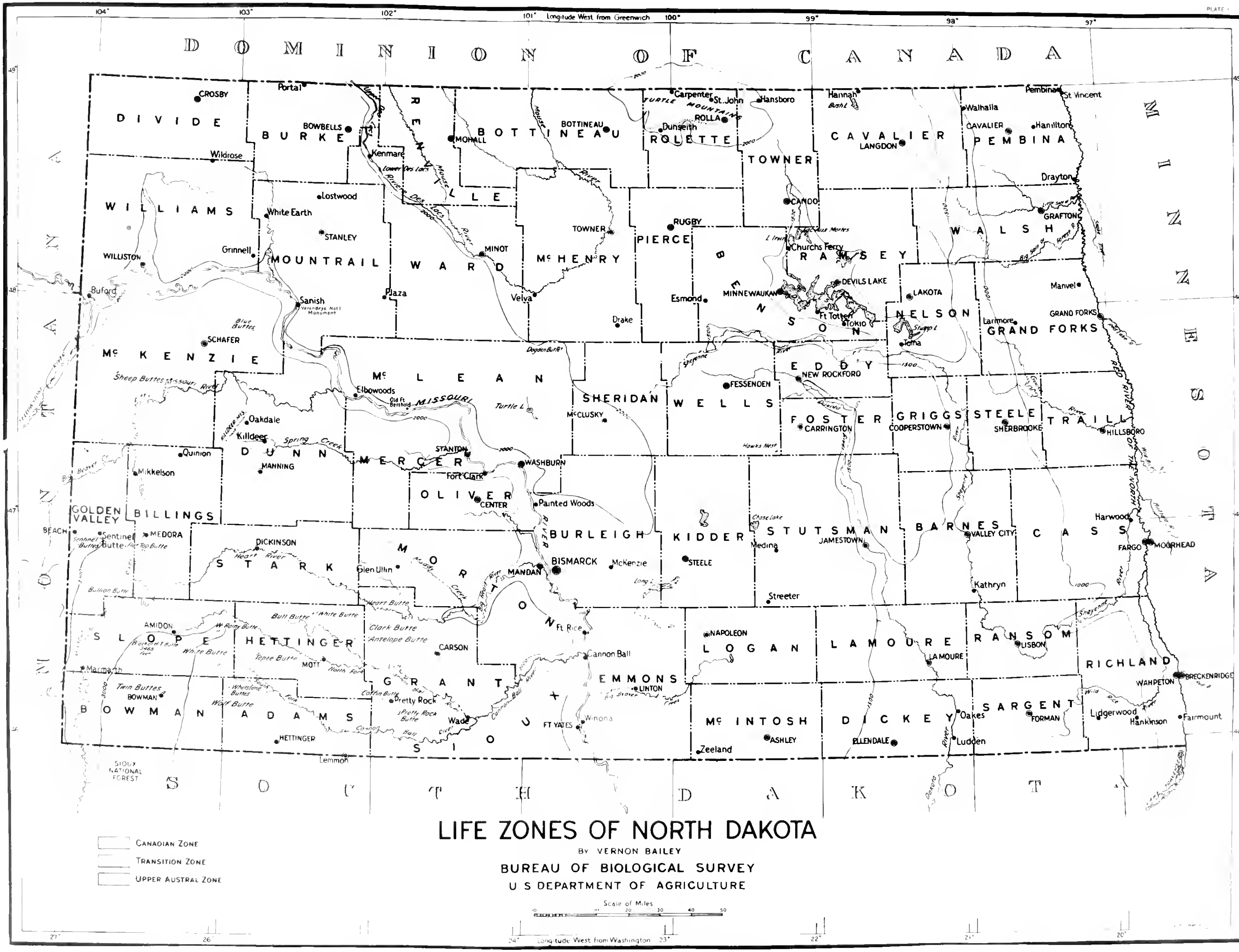

LIFE ZONES OF NORTH DAKOTA

BY VERNON BAILEY

BUREAU OF BIOLOGICAL SURVEY

U S DEPARTMENT OF AGRICULTURE

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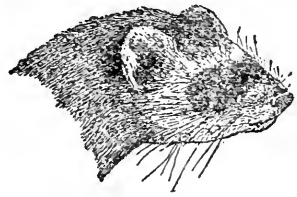

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1926

LETTER OF TRANSMITTAL

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., December 11, 1925.

SIR: I have the honor to transmit herewith, recommending that it be published as No. 49 in the series of the North American Fauna, a report on the biological survey of North Dakota, prepared by Vernon Bailey, biologist of this bureau. This report is in two parts, the first treating of the physiography and natural life zones of the State, accompanied, as in similar reports, by a map of the life zones; and the second, the mammalian life, consisting of notes on the distribution, abundance, and habits of the mammals of the State. Both are based on natural-history explorations conducted by the bureau and cooperating State organizations in North Dakota over many years, the work on the mammals having begun in 1887, and preliminary reports thereon having been published in the annual report of this bureau in 1888, when it was known as the Division of Economic Ornithology and Mammalogy, and in a circular of the North Dakota Agricultural Experiment Station, in 1914, the latter being in the nature of a cooperative report of progress and an appeal for additional local detailed information. The present report comprises a valuable contribution to knowledge and will be useful to farmers, students, and others interested in the distribution, habits, and economic relations of our wild-animal life.

Respectfully,

E. W. NELSON,
Chief of Bureau.

Hon. W. M. JARDINE,
Secretary of Agriculture.

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A BIOLOGICAL SURVEY OF NORTH DAKOTA

By Vernon Bailey

INTRODUCTION

In the preliminary survey of the wild life of North America information has been gathered on the birds and mammals of the country at large, and provisional maps of the life zones of the continent and subdivisions of it have been published. Much of the general information gathered on birds and mammals has been given in bulletins, circulars, and annual reports. The present publication is prepared in accordance with the general plan of providing for definite subdivisions more detailed information on the natural life zones and on the distribution and habits of the native species of birds and mammals. Part I discusses the life zones of North Dakota and Part II the mammals of the State. The publication of the report on the birds will be arranged for separately.

The field work on which this report is largely based has been carried on in North Dakota by the Biological Survey at intervals from the year following its first organization as the Division of Economic Ornithology and Mammalogy in 1886. In 1912 a definite plan of cooperation for covering the State comprehensively by field work and for gathering the specimens and notes necessary for a better understanding of the animal life was entered into between the Biological Survey and organizations in North Dakota, including the State university, the agricultural experiment station, the agricultural and geological survey, and other State educational institutions. Under this plan field work was carried on each season during the subsequent four years.[1] In addition to the Biological Survey material, the collections of specimens at the agricultural college at Fargo and of those at the biological laboratory at Devils Lake, with the many field notes and reports gathered in connection with these, have been freely drawn upon in the preparation of this report.

The Flora of North Dakota, by Herbert F. Bergman (1918), published in the Sixth Biennial Report of the North Dakota Soil and Geological Survey, has been of great assistance in the preparation of the life-zone report and the map. Also, free use has been had of

[1] The field work of the Biological Survey was carried on with the assistance of H. E. Anthony, Alfred Eastgate, Stanley G. Jewett, Remington Kellogg, J. Alden Loring, Edward A. Preble, H. H. Sheldon, and H. V. Williams. In 1893 A. K. Fisher made a trip across the State and collected specimens and important mammal notes. The field work of the agricultural college was done by W. B. Bell, assisted by U. S. Ebner, H. V. Williams, and other students at the college. At the State university the work was begun by M. A. Brannon, with the assistance of Alfred Eastgate, and later continued by R. T. Young.

a manuscript report on the Geographical Distribution of North Dakota Plants, by O. A. Stevens, of the agricultural college.

Important material was obtained from notes and records from the private collections of Morris J. Kernall, of the normal school, at Valley City; of Alfred Eastgate, of the fish and game commission, at Devils Lake; of H. V. Williams, taxidermist, at Grafton; of O. J. and M. C. H. Murie, of Moorhead, Minn.; and of other local naturalists. Much valuable information has also been gathered from ranchers and other residents of the State, and especially from early settlers familiar with conditions during pioneer days.

Of published reports consulted, there may be mentioned the following: The journal of Alexander Henry, the Younger (1897), in charge of the Northwest Company's trading posts in the Red River Valley from 1800 to 1808, edited by Elliott Coues and published in 1897; Lewis and Clark's (1893) journals of their trip up the Missouri River through North Dakota, in 1803 and 1804, edited by Doctor Coues in 1893; Maximilian's (Wied, 1839–1841) journal and notes made during his trip up the Missouri River through North Dakota in 1833, his wintering at the Mandan villages, and his return journey in 1834; John James Audubon's journals of his trip up the Missouri River to Fort Buford in 1843, edited in 1897 by his granddaughter, Miss Maria Audubon, and Doctor Coues; and also Audubon and Bachman's Quadrupeds of North America, in which many of Audubon's North Dakota notes were first published in 1851.

Elliott Coues, naturalist of the Northern Boundary Survey, in crossing the northern part of the State in 1873, collected many specimens and has included his records in various monographs and publications. J. A. Allen (1875, pp. 33–44), as naturalist of the North Pacific Railroad Expedition of 1873, traveled from Fort Rice, on the Missouri, west to the Yellowstone River in Montana and returned by nearly the same route, and published a list of the mammals observed. Col. Theodore Roosevelt (1900, 1919), from his cattle ranch in the Little Missouri Badlands (1884 to 1886), gave a full and delightful account of the game and natural history of the region in his "Hunting Trips of a Ranchman," "Hunting Trips on the Prairie," and "Hunting the Grisly." Ernest Thompson Seton, in his "Mammals of Manitoba" (1886), and later in his "Life-histories of Northern Animals" (1909), has included many important notes from the State. All these publications have been consulted.

In C. Hart Merriam's Report of the Ornithologist for 1887, there is a summary of Bailey's (1888) field notes of the year, taken on a trip from Fargo to Pembina, Devils Lake, the Turtle Mountains, and Fort Buford. In 1914 a brief preliminary report on the Mammals of North Dakota, by the writer (1914), collaborating with W. B. Bell, then of the agricultural college, and Melvin A. Brannon, of the State university, was published as Circular No. 3 of the North Dakota Agricultural Experiment Station. This was largely in the nature of an appeal for additional information on the mammals of the State.

PART I.—PHYSIOGRAPHY AND LIFE ZONES OF NORTH DAKOTA

CHANGING CONDITIONS

North Dakota, like other great prairie States, has rapidly changed in character from a country of native grassland and abundant wild life to one of rich grainfields unsuited to wild life and from which much of it is being banished. With the ever-increasing diversity of crops and livestock and with more intensive methods of agriculture, the new conditions are being advanced, and some of the most desirable native species of both animals and plants are disappearing, while many of the undesirable are holding their own or increasing in numbers. These conditions are accompanied by many problems of animal protection and control, the wise solution of which depends largely upon our knowledge of the species in the past and present, and especially of their habits, distribution, and environment.

GENERAL PHYSIOGRAPHIC FEATURES

The surface of the State, while generally classed as prairie or plains, varies from vast level stretches and rolling hills to buttes, badlands, and mountains.

Glacial Remains

In the Red River Valley, formerly occupied by the waters of Lake Agassiz, the prairie is comparatively level and often stretches away beyond the horizon without a ripple on its surface (Pl. 2). Over much of the State, however, the prairie is irregular, hilly, and undulating, forming what in the common phrase of the country is called "rolling prairie." This hilly configuration is due to the enormous deposits of glacial drift made during the advance and recession of the great ice sheets, which at different times covered a large part of the State. The ridges, hills, hollows, and lake basins formed by the ice sheets where they dumped their moraines of soil and bowlders in scattered heaps and long ridges, have been subjected to the rounding and leveling influence of the elements until the surface often suggests the billowy swells of midocean. Great numbers of marshes, sloughs, and lakes occupy the basins scooped out by the ice and often are left without possible drainage. The extensive inland lakes thus formed have disappeared in some cases and have left level areas of rich alluvial bottoms.

The later ice sheets stopped before reaching the Missouri River, piling up great terminal and lateral moraines along the northern and eastern margin of the river valley, still marked by the series of buttes and ridges known as the Coteau de Missouri, but one of the earlier sheets pushed across and unloaded its bowlders and débris

well up the valleys to the west. This sheet was evidently of no great duration, for the course of the river was not materially changed. Over most of the country west of the river there is little trace of ice action, and the water-carved buttes of the Badlands stand high and sharp, with their flat tops dating back far beyond the glacial period.

While the great Missouri River flowing through the State defied this early continental ice sheet, resuming its course when this receded, and not being reached by the later ones, the streams east of it were greatly modified, and some were wiped out of existence by ice action. Those flowing northward were first blocked by the ice and forced to overflow to the south. Then, after deep channels had been cut and the sheet had receded, some returned to their old northward courses and drew back old tributaries, while others cut new channels in other directions or were blocked and filled until only chains of lakes remained.

Lowered Water Levels

The country east of the Missouri River is generally well watered, but the greater part of the surface water is standing in numerous lakes and sloughs rather than flowing in the limited drainage system. Many of the smaller sloughs and marshes have been drained and converted into rich agricultural land and many have dried up in recent years. Since the cultivation of the soil a great shrinkage of the lakes and streams has taken place. Where formerly the water ran quickly from the firm prairie turf into the streams and hollows, both the rain and snow water are now absorbed by the mellow surface of the plowed land. This absorption distributes a greater quantity of water through the soil, and at the same time the more extensive evaporation surface increases the humidity of the climate. A striking illustration of the decrease in the water levels is shown at Devils Lake, which at the time of the early settlement of the region in 1887, had a steamboat landing close to the town of the same name. In 1920 the water had receded about 2 miles from the town, and since 1879 the level has fallen approximately 18 feet. Many of the smaller lakes have disappeared, and the smaller streams are shrinking. The disappearance of the prehistoric glacial lakes, Agassiz (now the Red River Valley), Souris (now the Mouse River Valley), and Sargent (now the general district of the county of the same name), was due not to a decrease in humidity nor to absorption of rainfall, but to the opening of a direct drainage into Hudson Bay after the recession of the last ice sheet.

Drainage Systems

The present drainage of North Dakota lies mainly in four well-defined systems (see map, Plate 1): (1) In the southwest, the Missouri River, with its main western tributaries, the Yellowstone, Little Missouri, Heart, and Cannonball, pouring its waters eventually into the Mississippi and the Gulf of Mexico; (2) in the southeast, the Dakota, or James, River, which joins the Missouri in Nebraska; (3) in the east, the Red River of the North with its main western tributaries, the Sheyenne and Pembina, flowing northward into Lake Winnipeg and eventually reaching the waters of Hudson

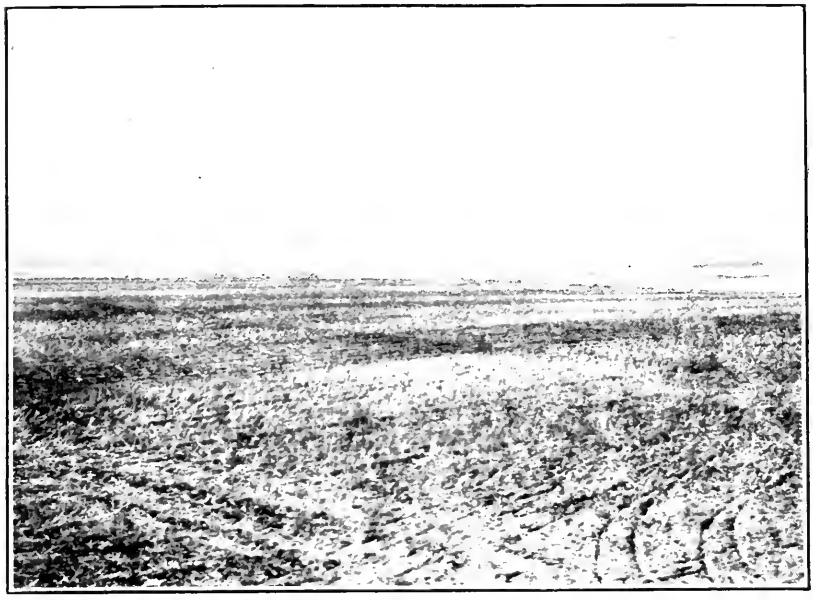

FIG. 1.—SHORT GRASS PRAIRIE OF WESTERN NORTH DAKOTA, SHOWING GRAINFIELDS AND PRAIRIE GRASS TO THE FAR HORIZON

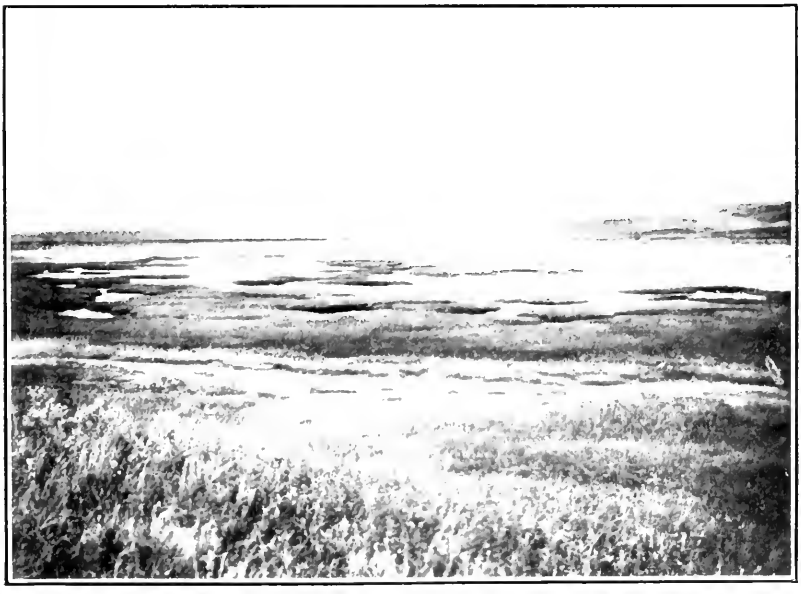

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FIG. 2.—PRAIRIE SLOUGH AND GLACIAL RIDGE OF CENTRAL NORTH DAKOTA, CHOICE BREEDING GROUNDS OF NATIVE WATERFOWL AND HOME OF THE MUSKRAT

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FIG. 1.—YELLOW PINES ON BUTTES SOUTH OF MEDORA

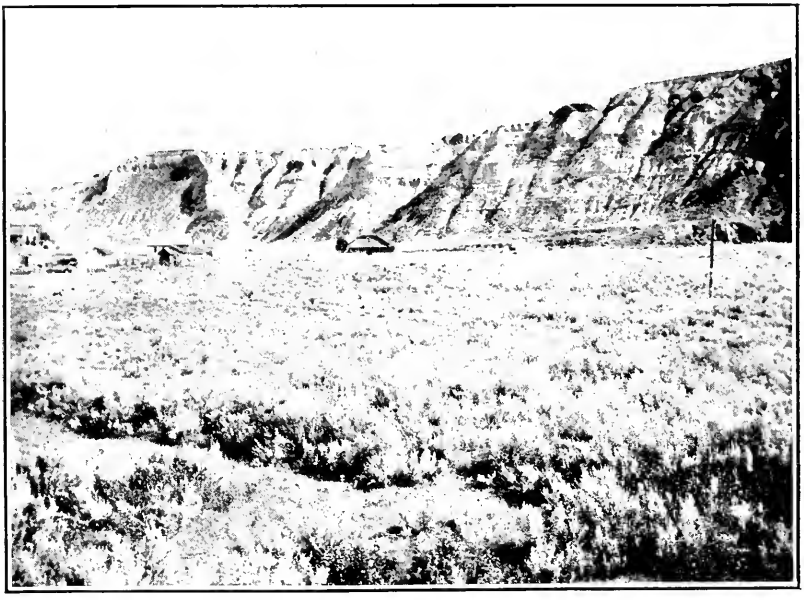

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FIG. 2.—BADLANDS AND SAGEBRUSH AT MEDORA

Bay; and (4) in the north, the Mouse or Souris River, with its chief tributary, the Riviere des Lacs, making a deep loop into the State and then turning north and east to join the Assiniboine in Manitoba.

Elevations and the Badlands

The variation of altitude within the State is comparatively slight and gradual, ranging from 753 feet above sea level on the Red River at Pembina, in the northeastern corner, to 3,463 feet on Black Butte, in the southwestern corner. The Turtle Mountains, midway of the northern boundary, are merely high moraine-covered hills, the greatest altitude being about 2,500 feet, while the highest point of the Pembina Hills, to the east, is given as 1,660 feet. West of the Missouri River, with a high-water mark near Bismarck of 1,646 feet, the country rises to a prairie level at Dickinson of 2,411 feet; at Sentinel Butte, 2,711; at Beach, 2,759; and at Summit, between the last two localities, 2,830 feet, while numerous buttes over the surface of the prairie rise only a few hundred feet higher. The Killdeer Mountains, a group of rounded hills with timber and brush in the gulches, lying in the bend of the Little Missouri northeast of Medora, are but a part of the Badlands plateau, rising about 700 feet above the surrounding prairie.

The great stretches of prairie west of the Missouri River show their age in the flat-topped ridges and wide sloping valleys of a lakeless and deep and well-worn drainage system. The greater part of this area is composed of level prairie or gentle slopes well suited to agriculture, but there are great numbers of sharp or flat-topped buttes or groups of buttes rising above the general surface, numerous deep ravines cutting through to lower levels, and brush or tree fringed streams tracing the bottoms of the valleys (Pl. 3). For a long time the region was considered too arid for uses other than stock raising, but with the improved farming methods of recent years demonstrating its value for grain and other crops, it has rapidly filled up with enterprising farms and towns. Most of the area is good farmland, but there are some parts so rough and steep that they can never be cultivated, and these will long remain in a primitive condition. These are the "Badlands" (Pl. 3).

The Badlands of the Missouri Valley and westward are not only a striking feature of the landscape, but they are of interest to the student of wild life, as they have had a marked influence on the distribution of species. They are most conspicuous and picturesque along the Little Missouri River Valley, but also occur in marked form along the banks and bluffs of the Missouri above the mouth of the Little Missouri, and especially from Little Knife River westward.

The presence of the Badlands is due to the reduced rainfall in this western part of the State, together with peculiar geological formations, soft rock, beds of lignite coal, the bright-colored scoria, and mineral-laden beds of clay with generally a dry, baked surface, which quickly sheds the little rain that falls. In texture as well as in form the land is in striking contrast with the glacier-plowed rolling prairies east of the river. Underneath the surface soil the older strata are generally impervious to water.

In form, the Badlands are characterized by flat-topped or rounded buttes, abrupt walls, benches, terraces, and bottomland flats. In their most typical and picturesque form they are found along the steep slopes of the stream valleys, where their bare walls are carved and eroded into grotesque and striking shapes, suggesting ancient ruins. In many places the Badlands banks are too steep to be climbed even by mountain sheep, except on well-known and well-worn trails leading from shelf to shelf. When wet the alkaline slopes are as slippery as a piece of wet soap, and are then of necessity avoided by man and beast.

The steep slopes are generally devoid of vegetation, but the benches and flat tops are usually covered with the finest grasses, and many of the gulches are filled with dense tangles of brush and scrubby timber. The colors in the Badlands are in places as brilliant as those of the Painted Desert of Arizona, ranging from broad black bands of lignite coal, through the grays, browns, and yellows of various clay formations, and the bright brick-red and pink beds of scoria, to the brown or gray or chalky white of sandstone and limestone cliffs. Usually from the top of the cliffs and walls the level prairie stretches away to the far and treeless horizon.

Geologically the Badlands are ready-made cross sections of the earth's surface. For untold ages their strata were deposited in deep or shallow waters, along shores and estuaries, or in marshes and forests, layer after layer, each of which embedded and preserved in some form the plant and animal life of its time. Great logs and stumps of petrified trees crop out in places along the banks or lie scattered over the flats below, while fossil bones, teeth, and shells of ancient types of animal life are often found in abundance. Even at the present day the cliffs, caves, and gulches, and the sheltered valleys, warm nooks, and corners of these Badlands harbor many species of native animals that otherwise would not be found within the borders of the State.

Probably no area in North Dakota is better suited for game refuges and parks than the Killdeer Mountains. The need is not so great for the present as for 20, 50, and 100 years hence. The mountains stand on the edge of the Badlands like a cool, green, rugged island in the midst of a great prairie region of rich soil, good farms, good roads, and a good beginning toward a future teeming population. On pleasant Sundays 50 to 100 automobile parties even now visit the mountains for picnics in the cool shade, for drafts of pure, cold water, the sight of strange flowers, plants, trees, birds, and mammals, rugged climbs, and a glorious view over wide country. With greater attractions of native animals, well-selected picnic and camping grounds, and trails to the points of interest, the visitors would to-day number thousands instead of hundreds, and in a few years hard-working farm people and tired city people from all over the State would find an easily available health and pleasure ground.

The Turtle Mountains represent another type of country with a strong bearing on the distribution of animal life. Although merely a group of high, rough, glaciated hills, alternating with hollows and lakes, they stand up from the surrounding prairie dark and timbered in inviting contrast with the boundless open expanse. Their charm is not so much in height or roughness as in the oasis of forest and the

beautiful forest-bordered lakes which they offer in the midst of a great prairie region (Pl. 4). This timber body is practically isolated except for a scattered and broken connection eastward along the streams and hills to the strip of timber along the Red River. Fortunately much of the land is rough, steep, and stony, and so covered with scrub timber that it is not likely to be cleared off in the near future. Its chief value is for game refuges and for fishing and recreation grounds.

Prairie

The one striking feature of the country is the original boundless grassland prairie, which at the present time is largely under cultivation in almost equally boundless fields and crops. Over much of the State the uncultivated areas are coming to be so restricted that game birds have difficulty in finding suitable nesting places outside of the fields, while some of the mammals are equally shut out and others have taken up quarters within the cultivated areas, where they cause serious damage to crops.

Forest

The native forest of North Dakota may be placed in three groups—the Minnesota type, the Missouri-River type, and the Rocky-Mountain type.

The eastern or Minnesota type borders the streams in the Red River Valley, covers the Pembina Hills and Turtle Mountains, and skirts the snowdrift borders of the larger lakes, such as Devils Lake, Stump Lake, and the Sweetwater Lakes. (Pl. 5.) This consists mainly of a moderate growth of deciduous trees, such as American elm, red elm, white ash, boxelder, bur oak, ironwood, basswood, aspen, balsam poplar, and cottonwood, and such shrubs as hazel, alder, serviceberry, chokeberry, pin cherry, cornel, and rose.

The Missouri-River type is found along the Missouri and Little Missouri River bottoms and consists largely of the broad-leaved cottonwood, many willows, and scattered boxelder, elm, ash, buffaloberry, shrubby dogwoods, and flowering currants. (Pl. 6.)

A trace of the third type of forest is found in the Badlands and over the higher buttes along the Little Missouri River, where in places the Rocky Mountain yellow pine and Rocky Mountain juniper grow in considerable abundance and the western birch and shrubby cinquefoil come into the Killdeer Mountains.

Though more or less mixed, these three groups indicate types of climate and soil conditions that to some extent govern the distribution of the animal life. The forest growth is very restricted, covering only a small part of the surface of the State, lying mainly in narrow strips along the banks of streams, on the edges of lakes, in the gulches and on the steep slopes of the mountains and bluffs, where deep snowdrifts lie late into the spring. It is of great importance, however, not only for the use of the present inhabitants, but for the influence it has had on animal life, in the shelter, protection, and food afforded, without which many of the species would have been excluded from the State.

In its restricted range along the immediate stream courses and in gulches and valley bottoms, the native forest is often hidden, and at a distance is less conspicuous than the planted groves scattered over the prairie. At the present time the artificially planted plots far exceed the native forests of the State both in abundance and in value. These, too, are beginning to show a marked influence on the distribution of species, attracting to the vicinity of homes many birds and mammals that otherwise would be absent. Thus physiography, forest and plant distribution, soil, and climate all bear a vital relation to the problems involved in a study of the animal life of the State.

LIFE ZONES OF NORTH DAKOTA

In a comparatively level prairie country there are no striking contrasts in the distribution areas, and the life zones blend almost insensibly into each other. The greater part of North Dakota lies in the Transition Zone, which, in crossing the continent as a broad band between the warm Upper Austral (Sonoran) and the cold Boreal Zones, spreads to its greatest width over the northern prairies of the Dakotas, Montana, and Saskatchewan. (See Plate 1.) It so nearly covers North Dakota that many of its species are found scattered over the limited areas of both the Canadian Zone of the Turtle Mountains on the north and the narrow tongues of Upper Austral Zone thrusting into parts of the Missouri River Valley from the south and west. These restricted areas of the Austral and Canadian Zones, however, are sufficiently marked to be of importance in giving to the State a wider range of crop, timber, and animal adaptations, and an interesting diversity of living conditions. For the best development of a State, it is necessary that every climatic and physiographic advantage be fully understood.

Upper Austral Zone

The Upper Austral Zone, the Upper Sonoran, or semiarid subdivision of which penetrates only into the warmest corners of the State, is in no part sufficiently extensive to be marked by entirely characteristic mammals, birds, or plants. In its narrow strips along the Missouri Valley below Bismarck, down the Missouri and Yellowstone Valleys to Williston, along the Little Missouri Valley above the Killdeer Mountains, and on many dry, warm slopes between these areas, it is strongly characterized. So near the edge of a zone, however, the slight inclination of a slope to the north reduces the heat received from the sun's rays sufficiently to change the flora and fauna in part or wholly to that of the colder, higher zone, while a steep slope facing the direct rays of the sun will attract many species of the warmer, lower zone above their normal limits. Hence, in a rough and broken country on the border of the two zones, conditions are so complicated and often confusing that the areas can be mapped in only a very general way.

In a study of the zones in this region the slope exposure and the heat-absorbing qualities of the surface (surface cover) are found more important than actual altitude, since the gradual increase in base level westward does not tend to lower the zones and nowhere is the altitude above base level sufficient to reduce noticeably the general temperature except by slope exposure.

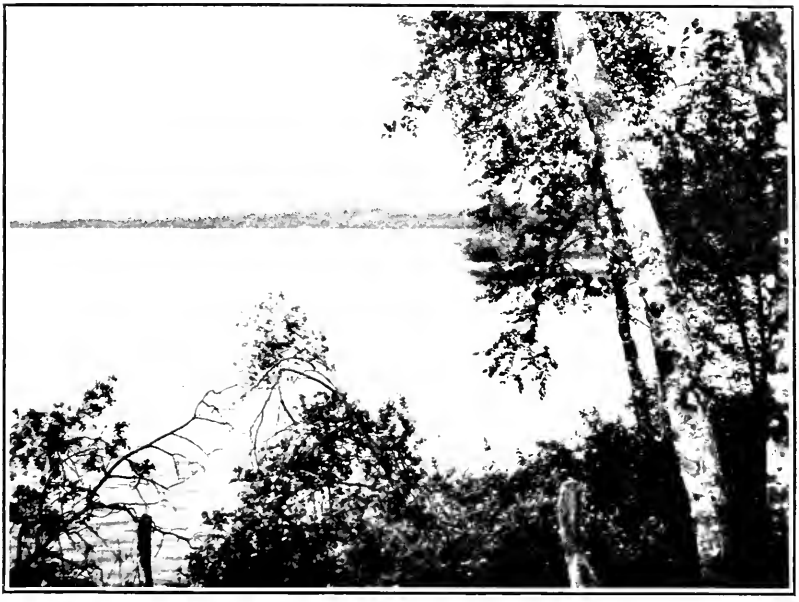

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FIG. 1.—A TYPICAL LAKE OF THE TURTLE MOUNTAINS

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FIG. 2.—TYPICAL ASPEN FOREST OF THE TURTLE MOUNTAINS

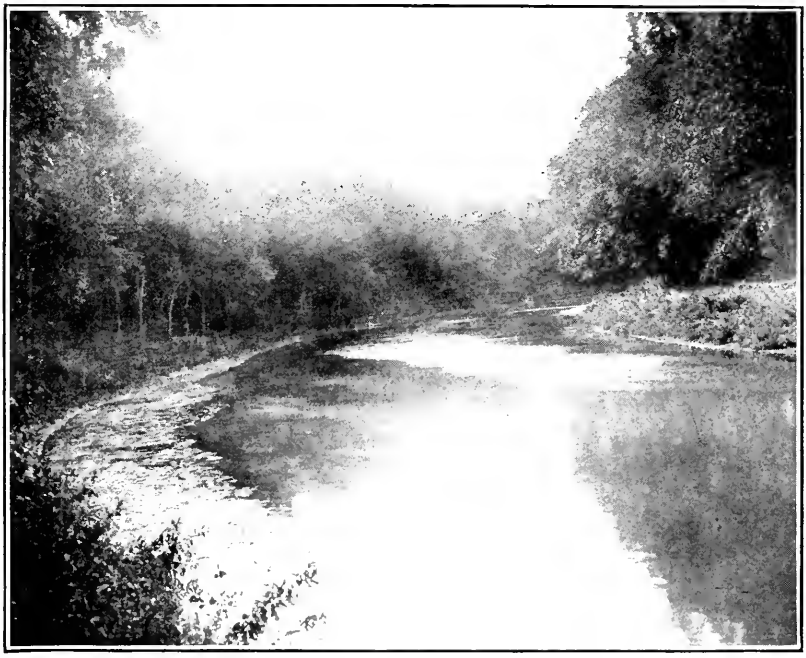


FIG. 1.—RED RIVER WITH ITS FORESTED SHORES, NEAR FARGO

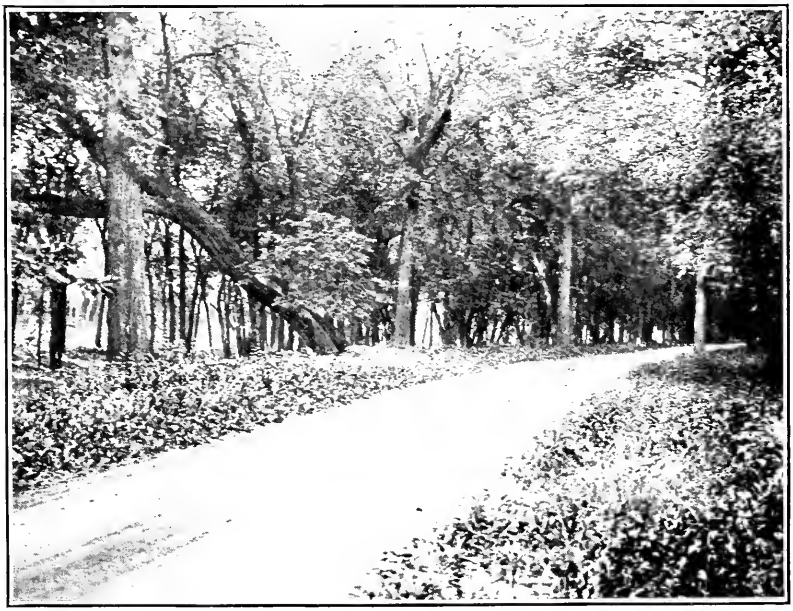


FIG. 2.—TYPE OF FOREST ALONG THE RED RIVER, NEAR FARGO

COTTONWOOD TIMBER ALONG THE MISSOURI RIVER BOTTOMS NEAR MANDAN IN EARLY WINTER AFTER THE LEAVES HAVE FALLEN

Some of the very highest parts of the State, in the extreme southwestern corner, lie mainly within the Upper Austral Zone. The Little Missouri Valley above and below Medora (2,270 feet above sea level, and almost as high as the tops of the Turtle Mountains) is the nearest to pure Upper Austral and zonally the lowest point in the State. The aridity, causing scanty soil cover and thus allowing the greatest absorption of heat by the soil, adds to the purity of the zone here, as also may the warm western winds.

Along the Missouri River Valley from Bismarck to Williston many Austral species have a continuous range, but seem generally to be secondary to the Transition Zone or neutral species. The broad-leaved cottonwood and the long-tailed chat have a practically continuous range along the river valley, but other species, such as the little chipmunk and dwarf lupine, seem to drop out of sections of it.

Farther east local traces of Upper Austral Zone species may be found on the warm slopes of the sand dunes near Hankinson, and in the Dakota and Maple River Valleys at Ludden and Ellendale. These are mere traces overlapping from the zone farther south in the Dakota River Valley. The zone is indicated at Hankinson by the harvest mouse, little dusky pocket mouse, and sand cherry, and at Oakes and Ludden by at least the harvest mouse.

Following are characteristic species of the Upper Austral Zone in North Dakota:

Characteristic Mammals—Upper Austral Zone

Badlands mountain sheep (*Ovis canadensis auduboni*).
Badlands chipmunk (*Eutamias pallidus pallidus*.)
Pale thirteen-lined ground squirrel (*Citellus tridecemlineatus pallidus*.).
Black-tailed prairie dog (*Cynomys ludovicianus ludovicianus*).
Osgood white-footed mouse (*Peromyscus maniculatus osgoodi*).
Badlands white-footed mouse (*Peromyscus leucopus aridulus*).
Pale bushy-tailed wood rat (*Neotoma cinerea rupicola*).
Prairie harvest mouse (*Reithrodontomys mcgalotis dychei*).
Western upland mouse (*Microtus ochrogaster haydenii*).
Maximilian pocket mouse (*Perognathus fasciatus fasciatus*).
Dusky pocket mouse (*Perognathus flavescens perniger*).
Kansas pocket mouse (*Perognathus hispidus paradoxus*).
Richardson kangaroo rat (*Perodipus montanus richardsoni*).
Sagebrush pocket gopher (*Thomomys talpoides bullatus*).
Black Hills cottontail (*Sylvilagus nuttalli grangeri*).
Black-footed ferret (*Mustela nigripes*).
Merriam shrew (*Sorex merriami*).

Characteristic Breeding Birds—Upper Austral Zone

Western mourning dove (*Zenaidura macroura marginella*).
Burrowing owl (*Speotyto cunicularia hypugaea*).
Poor-will (*Phalaenoptilus nuttallii nuttallii*).
Say phoebe (*Sayornis sayus*).
Bullock oriole (*Icterus bullockii bullockii*).
Lark sparrow (*Chondestes grammacus grammacus*).
Western lark sparrow (*Chondestes grammacus strigatus*).
Indigo bunting (*Passerina cyanea*) (also Transition).
Lazuli bunting (*Passerina amoena*).
Dickcissel (*Spiza americana*).
Long-tailed chat (*Icteria virens longicauda*).
Rock wren (*Salpinctes obsoletus obsoletus*).
Long-tailed chickadee (*Penthestes atricapillus septentrionalis*).

CHARACTERISTIC PLANTS—UPPER AUSTRAL ZONE

Broad-leaved cottonwood (*Populus deltoides*).[2]
Sand cherry (*Prunus pumila*).
Flowering currant (*Ribes aureum*).
Skunk bush (*Rhus trilobata*).
Gray shadscale (*Atriplex canescens*).
Low shadscale (*Atriplex confertifolia*).
Nuttall shadscale (*Atriplex nuttallii*).
Greasewood (*Sarcobatus vermiculatus*).
Winterfat (*Eurotia lanata*).
Gray sagebrush (*Artemisia cana*).
Rabbitbrush (*Chrysothamnus graveolens*).
Tipsin (*Psoralea esculenta*).
Prairie-clover (*Psoralea tenuiflora* and *Psoralea lanceolata*).
Dalea (*Parosela enneandra*).
Dwarf lupine (*Lupinus pusillus*).
Painted milk-vetch (*Astragalus pictus*).
Slender milk-vetch (*Astragalus gracilis*).
Bird's-foot trefoil (*Hosackia americana*).
Winged abronia (*Tripterocalyx micranthus*).
Snow-on-the-mountain (*Euphorbia marginata*).
Mentzelia (*Mentzelia decapetala*).
Bee plant (*Cleome serrulata*).
Spiny solanum; buffalo-bur (*Solanum rostratum*).
Indian plantain (*Plantago purshii*).
Large-flowered beardtongue (*Pentstemon grandiflorus*).
Prickly-pear cactus (*Opuntia polyacantha*).
Slender cactus (*Opuntia fragilis*).
Spanish bayonet (*Yucca glauca*).
Low evening primrose (*Pachylophus caespitosus*).
Sand verbena (*Abronia micrantha*).
Wild sunflower (*Helianthus annuus*).
Dropseed grass (*Oryzopsis micrantha* and *Oryzopsis cuspidata*).
Grama grass (*Bouteloua gracilis*).
False buffalo grass (*Munroa squarrosa*).

CROP ADAPTATIONS OF THE UPPER AUSTRAL ZONE

The variation in climate in North Dakota is so slight and gradual, and the greater part of the State lies so fully within the Transition Zone, that the raising of a comparatively limited variety of crops has been customary over most of the State. The great success of the small grains has encouraged their production to the exclusion of many others that might be cultivated in certain sections with equal success. The early explorers found the Indians raising an abundance of corn (Will and Hyde, 1917), squashes, beans, and native tobacco on the fertile bottoms along the Missouri River, where also the comparatively mild climate rendered living conditions comfortable for these poorly equipped and half-housed people. Many of these long-tested and thoroughly acclimated varieties of vegetables have been adopted into general cultivation and have helped to increase the crop resources of the State; varieties from other parts of the Upper Austral Zone have also been found to thrive in these mild valleys.

Although no attempt is made in the present report to indicate the particular kinds and varieties of crops adapted to the different life zones and their subdivisions in the State, it is evident from the distribution of native species and the climatic areas which they dominate that certain crops will thrive in one part of the State and not in others. Only by careful study of local conditions and by careful testing of different varieties of seeds can safe recommendations be made and the best results obtained from diversified agriculture. With the increasing necessity of bringing the producing quality of

[2] This upper Missouri form is so different in characters and growth from the Carolina cottonwood that the necessity of calling it *deltoides* is regrettable.

the land to the highest standard, and the more intelligent study being given to farm problems, the value of a reliable map of the life zones and subdivisions of these zones is apparent.

The intrusion of narrow areas of a southern zone into a northern one, as pointed out by Doctor Merriam (1898, p. 15) many years ago, adds a distinct advantage in marketing the crops by saving long transportation and thus increasing their value. The possibility of raising southern crops and fruits within an area of unusually rich grain production is self-evident. Although not always the richest in soil and natural resources, the warmest sections of the State, with their climatic advantages, should, if wisely used, be of special value.

Transition Zone

The Transition Zone covers the whole of North Dakota with the exception of the Turtle Mountains and various cold slopes and gulches in other elevated areas, where Canadian Zone conditions prevail, and the warmer Upper Austral valleys of the Missouri and Little Missouri Rivers. Its range of climate shows no marked variation over the State, except for a slight decrease in temperature northward and a gradual decrease in rainfall westward. The annual rainfall, as given in the Climatology Report of the Weather Bureau (U. S. Dept. Agr., 1919) for 1918, a nearly typical year, varies from 25 inches in the eastern to 15 inches in the western part of the State. The westward decrease is so gradual that no sharp line can be drawn between the humid eastern and semiarid western subdivisions of the zone. Doctor Merriam (1898, map) places the dividing line a little east of the one-hundredth meridian.[3] The change from humid to semiarid is noticeably marked by the shortening of the prairie grasses and the appearance of western drought-resistant species.

The humid Transition Zone covers practically all of the State west to and including the Dakota (James) and Mouse (Souris) River Valleys. It is generally characterized by a heavy growth of prairie grasses, by strips of timber along the streams, and by thickets of brush in protected locations.

The semiarid Transition Zone covers most of the western half of the State, including the high country on both sides of the Missouri River Valley and much of the Badlands region. It is generally characterized by short-grass plains and a limited mixture of Rocky Mountain species of mammals, birds, and plants.

The following lists contain the chief characteristic animals and plants of the Transition Zone in North Dakota:

Characteristic Mammals—Transition Zone

(a) Both Eastern and Western Divisions

Richardson ground squirrel (*Citellus richardsoni richardsoni*).	Prairie jumping mouse (*Zapus hudsonius campestris*).
Loring red-backed mouse (*Evotomys gapperi loringi*).	White-tailed jack rabbit (*Lepus townsendii campanius*).

[3] See also Fourth Provisional Zone Map of North America, by the Biological Survey, 1910 (included in A. O. U. Check-List of Birds).

Yellow-red fox (*Vulpes fulva regalis*).
Long-tailed weasel (*Mustela longicauda*).
Bonaparte weasel (*Mustela cicognanii cicognanii*).
Minnesota mink (*Lutreola vison letifera*).
Northern skunk (*Mephitis hudsonica hudsonica*).
Hayden shrew (*Sorex cinereus haydeni*).
Large brown bat (*Eptesicus fuscus fuscus*).

(*b*) *Eastern (Humid) Division*

Minnesota gray squirrel (*Sciurus carolinensis hypophaeus*).
Gray chipmunk (*Tamias striatus griseus*).
Thirteen-lined ground squirrel (*Citellus tridecemlineatus tridecemlineatus*).
Gray ground squirrel (*Citellus franklinii*).
Rufescent woodchuck (*Marmota monax rufescens*).
Northern white-footed mouse (*Peromyscus leucopus noveboracensis*).
Baird white-footed mouse (*Peromyscus maniculatus bairdii*).
Eastern meadow mouse (*Microtus pennsylvanicus pennsylvanicus*).
Little upland mouse (*Microtus minor minor*).
Mississippi Valley pocket gopher (*Geomys bursarius*).
Dakota pocket gopher (*Thomomys talpoides rufescens*).
Nebraska cottontail (*Sylvilagus floridanus similis*).
Brush wolf (coyote) (*Canis latrans latrans*).
Short-tailed shrew (*Blarina brevicauda brevicauda*).
Little brown bat (*Myotis lucifugus lucifugus*).
Say bat (*Myotis subulatus subulatus*).

(*c*) *Western (Semiarid) Division*

Pale mouse (*Microtus pallidus*).
Drummond meadow mouse (*Microtus pennsylvanicus drummondi*).
Northern bobcat (*Lynx uinta*).
Kit fox, swift (*Vulpes velox hebes*).
Plains coyote (*Canis latrans nebracensis*).
Yellowstone bat (*Myotis lucifugus carissima*).

CHARACTERISTIC BREEDING BIRDS—TRANSITION ZONE

(*a*) *Both Eastern and Western Divisions*

Franklin gull (*Chroicocephalus pipixcan*).
Forster tern (*Sterna forsteri*).
Canvasback duck (*Aristonetta valisineria*).
Redhead (*Nyroca americana*).
Ring-necked duck (*Perissonetta collaris*).
Wilson phalarope (*Steganopus tricolor*).
Marbled godwit (*Limosa fedoa*).
Upland plover (*Bartramia longicauda*).
Ferruginous rough-leg (*Buteo ferrugineus*).
Bobolink (*Dolichonyx oryzivorus*).
Chestnut-collared longspur (*Calcarius ornatus*).
Baird sparrow (*Centronyx bairdii*).
Nelson sparrow (*Ammospiza caudacuta nelsoni*).

(*b*) *Eastern (Humid) Division*

Woodcock (*Rubicola minor*).
Broad-winged hawk (*Buteo platypterus platypterus*).
Yellow-bellied woodpecker (*Sphyrapicus varius varius*).
Yellow-shafted flicker (*Colaptes auratus luteus*).
Whip-poor-will (*Setochalcis vocifera vocifera*).
Blue jay (*Cyanocitta cristata bromia*).
Baltimore oriole (*Icterus galbula*).
Vesper sparrow (*Pooecetes gramineus gramineus*).
Swamp sparrow (*Melospiza georgiana*).
Chewink, towhee (*Pipilo erythrophthalmus erythrophthalmus*).
Rose-breasted grosbeak (*Hedymeles ludovicianus*).

(c) Western (Arid) Division

Avocet (*Recurvirostra americana*).
Sage grouse (*Centrocercus urophasianus*).
Red-shafted flicker (*Colaptes cafer collaris*).
Magpie (*Pica pica hudsonia*).
Arctic towhee (*Pipilo maculatus arcticus*).
Black-headed grosbeak (*Hedymeles melanocephalus papago*).
McCown longspur (*Rhynchophanes mccownii*).
Western vesper sparrow (*Pooecetes gramineus confinis*).
Sprague pipit (*Anthus spragueii*).

CHARACTERISTIC PLANTS—TRANSITION ZONE

(a) Eastern (Humid) Division

Bur oak (*Quercus macrocarpa*).
Basswood (*Tilia americana*).
Ironwood (*Ostrya virginiana*).
White ash (*Fraxinus pennsylvanica*).
White elm (*Ulmus americana*).
Red elm (*Ulmus fulva*).
Hackberry (*Celtis occidentalis*).
Red maple (*Acer rubrum*).
Sugar maple (*Acer saccharum*).
Hawthorn (*Crataegus chrysocarpa* and *Crataegus succulenta*).
Wild plum (*Prunus americana*).
Hazel (*Corylus americana*).
Alder (*Alnus incana*).
Missouri willow (*Salix missouriensis*).
Cornel (*Cornus femina*).
Black haw; nanny-berry (*Viburnum lentago*).
Sumac (*Rhus glabra*).
Honeysuckle (*Lonicera dioica glaucescens*).
Red raspberry (*Rubus strigosus*).
Prairie rose (*Rosa pratincola*).
Pale rose (*Rosa blanda*).
Bittersweet (*Celastrus scandens*).
Black currant (*Ribes americanum*).
Smooth gooseberry (*Ribes gracile*).
Prickly ash (*Xanthoxylum americanum*).

(b) Western (Semiarid) Division

Yellow pine (*Pinus scopulorum*).
Rocky Mountain juniper (*Juniperus scopulorum*).
Creeping juniper (*Juniperus horizontalis*).
Western birch (*Betula fontinalis*).
Silver-leaf (*Elaeagnus argentea*).
Buffaloberry (*Lepargyrea argentea*).
Sagebrush (*Artemisia tridentata*).
Silver sage (*Artemisia frigida*).
Yellow willow (*Salix lutea*).
Green ash (*Fraxinus lanceolata*).
Shrubby cinquefoil (*Potentilla fruticosa*).
Bearberry (*Arctostaphylos uva-ursi*).
False lupine (*Thermopsis rhombifolia*)

Bergman (1918, p. 162) has made essentially this same division under *mesophytic* and *xerophytic* prairie, well characterizing each by its grasses and "more abundant secondary species" as follows:

(a) Mesophytic, or Andropogon, Prairie (Eastern)

Forked beardgrass; Big blue-stem (*Andropogon furcatus*).
Broom beardgrass; Little blue-stem (*Andropogon scoparius*).
Indian grass (*Sorghastrum nutans*).
Porcupine grass (*Stipa spartea*).
Sedge (*Carex festucacea*).
Yarrow (*Achillea lanulosa*).
Gray false indigo; Lead-plant (*Amorpha canescens*).
Cylindric wind-flower (*Anemone cylindrica*).
Cut-leaved wormwood (*Artemisia caudata*).
Harebell (*Campanula rotundifolia*).
White-flowered avens (*Drymocallis arguta*).
Closed gentian (*Gentiana puberula*).
Maximilian sunflower (*Helianthus maximilianus*).
Alum root (*Heuchera hispida*).
Blazing star (*Lacinaria pychnostachya* and *Lacinaria scariosa*).
Lobelia (*Lobelia spicata*).
Evening primrose (*Meriolix serrulata*).
Slender beardtongue (*Pentstemon gracilis*).
Ground cherry (*Physalis lanceolata*).
Black-eyed susan (*Rudbeckia hirta*).
Spiderwort (*Tradescantia bracteata*).
Ironweed (*Vernonia fasciculatis*).

(*b*) *Xerophytic, or Bouteloua, Prairie* (*Western Short-grass*)

Grama grass (*Bouteloua oligostachya*).
Buffalo grass (*Bulbilis dactyloides*).
Loco plant (*Aragallus lambertii*).
Silver sage (*Artemisia frigida*).
Buffalo pea (*Astragalus crassicarpus*).
Brown-eyed susan (*Brauneria angustifolia*).
Indian paintbrush (*Castilleja sessiliflora*).
Golden aster (*Chrysopsis villosa*).
Treacle mustard (*Erysimum asperum*).
Prairie marigold (*Gaillardia lanceolata*).
Scarlet gaura (*Gaura coccinea*).
Yellow flax (*Linum rigidum*).
Narrow-leaved puccoon (*Lithospermum linearifolium*).
Skeleton plant (*Lygodesmia juncea*).
Orange-red false mallow (*Malvastrum coccineum*).
Yellow Indian paintbrush (*Orthocarpus luteus*).
Pale beardtongue (*Pentstemon albidus*).
Silver clover (*Psoralea argophylla*).
Groundsel, paintbrush (*Senecio plattensis*).
Yellow violet (*Viola nuttallii*).

Crop Adaptations of the Transition Zone

The crop adaptations of the Transition Zone and its subdivisions make it the most important in the State because of the extent of the zone and the enormous quantity of its products. Every slight advantage in variety of grain or other crop under different climatic conditions should be utilized so far as these conditions prevail. Different crops and varieties are being constantly tested and the more resourceful farmers are quick to adopt any that offer even a slight advantage in quality, yield, or price.

Canadian Zone

The Canadian Zone, which sweeps across the continent mainly north of the United States and is generally characterized by forests of spruce, fir, hemlock, aspen, and birch, is only lightly represented in a few restricted areas in North Dakota. Its largest area lies within the Turtle Mountains, where Canadian-Zone species dominate the flora and fauna, although by no means unmixed with Transition species. Other districts with still less representation of the zone are the Pembina Hills, the Killdeer Mountains, and numerous cold slopes and cold gulches in the high bluffs and buttes along the western side of the Mouse River Valley. On many steep northeast slopes, on high buttes, and in the Badlands, where in winter drifting snows fill shaded gulches to such a depth as to remain until late in spring or to the beginning of summer, a trace of Canadian Zone species may be found.

The aspen (Pl. 4, fig. 2) is one of the most widely distributed and abundant of the Canadian Zone trees, and from its habit of reproduction from myriads of widely blown, cotton-tufted seeds, it not only fills its zone, but lodges and grows wherever climatic conditions are possible for it. For this reason it is often found in spots far from its regular range, where even such local conditions as late snowbanks, cold springs, cold underground waters, or well-shaded slopes reduce the summer temperature. Thus, the aspens, with a few other Boreal plants and animals, often form little islands far out in the Transition Zone, in places even to its lower edge, that carry Boreal species whose presence is very confusing unless the conditions are thoroughly understood and the existence of the zone recognized.

Cold slopes and gulches facing the north or northeast and missing much of the heat from the sun's rays are also important factors in carrying local traces of zones far below their real borders. Often cold gulches contain springs or streams of cold water in addition to the snow which accumulates in winter and which helps to keep their summer temperature low. In the Turtle Mountains the cold slopes and gulches are practically pure Canadian Zone, as are mainly the moist bottomlands and all but the more open slopes facing the south. Although the temperature in these hills may be no lower in winter than that of the surrounding prairies, the more important growing temperature of summer is noticeably cooler than that of the open prairies where the sun's rays are more readily absorbed by the ground and returned to the surface layer of air.

The Turtle Mountains at their highest rise less than a thousand feet above the prairie base level, and the actual altitude of the highest hills is only approximately 2,500 feet. Although their elevation is not such as to lower perceptibly the general temperature, it is sufficient to attract an unusually heavy precipitation. This, in the form of rain and snow, produces not only a cooling effect on the surface, but a heavy growth of vegetation, largely arboreal and shrubby, the only extensive openings in which are lakes and marshes. The timber is largely aspen mingled with balsam poplar, white birch, and a few oaks, elms, and boxelders. The forests have been frequently swept away by fires, which fact undoubtedly accounts for the complete absence of conifers. Even the tamarack, which would find ideal conditions in the marshes, is not known to occur in this region. The preponderance of aspens also indicates frequent fires, as these trees, more than any other in this region, quickly reforest burned areas. Owing to the fact that heavy winter snows remain late in spring on the cold slopes, and to the difficulty of clearing the brush and timber-covered soil, the settlement of the hills has lagged behind that of other parts of the State.

Though much modified, the Canadian Zone area is here of special importance and interest in carrying a comparatively well-forested area in the midst of an extensive treeless region. The forest is happily associated with numerous beautiful lakes, originally well stocked with fish. The whole region was once famous for its game and fur-bearing animals, and at present it affords a delightful resort for fishing and camping, and is steadily growing in importance as a summer recreation ground.

Characteristic Mammals—Canadian Zone

The principal Canadian Zone mammals of the Turtle Mountains and Pembina Hills at the present time are the red squirrel (*Sciurus hudsonicus*), northern chipmunk (*Eutamias borealis*), varying hare (*Lepus americanus*), Canada lynx (*Lynx canadensis*), Richardson shrew (*Sorex richardsoni*), and silver-haired bat (*Lasionycteris noctivagans*). Formerly there occurred also the caribou, moose, marten, fisher, and wolverene.

Characteristic Breeding Birds—Canadian Zone

The typical Canadian Zone birds of this region are not strongly represented, but the white-throated sparrow (*Zonotrichia albicollis*) is a common summer songster in the Turtle Mountains, and the slate-colored junco (*Junco hyemalis*) occurs and probably breeds.

Characteristic Plants—Canadian Zone

The number of species of Canadian Zone plants in North Dakota is not great, but the forest is dominated by a few of them, as the aspen (poplar), balsam poplar, and white birch. The following characterize the zone in the State:

Aspen poplar (*Populus tremuloides*).
Balsam poplar (*Populus balsamifera*).
White birch (*Betula papyrifera*).
Shrubby birch (*Betula pumila glandulifera*).
Pin cherry (*Prunus pennsylvanica*).
Autumn willow (*Salix serissima*).
High-bush cranberry (*Viburnum opulus americana*).
Beaked hazel (*Corylus rostrata*).
Rabbitberry (*Leparyrea canadensis*).
Bunchberry (*Cornus canadensis*).
Canadian serviceberry (*Amelanchier canadensis oblongifolia*).
Red currant (*Ribes triste*).
Winter-lettuce (*Pyrola asarifolia*).
Miterwort (*Mitella nuda*).

The Killdeer Mountains, lying just south of the Little Missouri River, about 30 miles directly west of its junction with the Missouri, are another group of high hills of a different type, but with only a slight trace of Canadian Zone in their cold gulches. They are about 900 feet higher than the surrounding prairie, with the main ridge about 12 miles long and from 2 to 3 miles wide. Their slopes are steep and rocky in places and at the southern end form limestone cliffs 100 feet high. The top of the ridge is a level, grassy plateau, but there are many deep gulches with springs and small streams of cold water. All the deep gulches and about half the area of the mountains are covered with a growth of deciduous trees and shrubs. The principal trees are oak, aspen, ash, elm, boxelder, white birch, and western birch; the shrubs are mainly willow, serviceberry, chokecherry, red cherry, pin cherry, plum, rose, gooseberry, wild currant, raspberry, thorn apple, cornel, beaked hazel, buffaloberry, rabbitberry, and shrubby juniper. Of these plants the aspen, white birch, pin cherry, beaked hazel, rabbitberry, and shrubby juniper are mainly Canadian Zone species. This element, however, is not sufficiently pronounced to warrant mapping the Killdeer Mountains as Canadian Zone.

Similar but even less strongly marked elements of Canadian Zone may be found in the deep gulches west of the Mouse River, and on some of the high ridges and cold slopes over the northwestern part of the State.

Crop Adaptations of the Canadian Zone

Although pure Canadian Zone is of comparatively limited agricultural value, it has other advantages, as forest, fur, and game production. Its representation in North Dakota is so limited and so mixed with Transition-Zone conditions that most of the hardy crops of the Transition Zone thrive in it except on pronounced northerly slopes or cold bottomlands. The clearing of the land gives a slight advantage to the lower zone conditions, especially on open areas and southerly slopes. The main area of the Canadian Zone lies in the Turtle Mountains, but even the more limited spots in the Pembina Hills, the Killdeer Mountains, in the gulches, and on the cold slopes of other elevated areas may prove of special value for timber and fur production.

PART II.—THE MAMMALS OF NORTH DAKOTA

INTRODUCTION

Present and Former Abundance

In the economy of the area now known as North Dakota the mammalian fauna has played an important part, not only since the separate State was created in 1889, and when it was a Territory with South Dakota in 1868, or a part of Nebraska in 1854, or of the Louisiana Territory in 1804, but still earlier, before the Louisiana Purchase added it to the United States. The fur-bearing animals first attracted white men to take up shifting residence within what are now the borders of North Dakota, where abundance of game insured their support and lured them on to new fields of profit and adventure. The rich soil and the luxuriant vegetation of the region originally supported vast numbers of the most important large game animals of the country, and these naturally attracted many predatory species. The rivers, streams, and lakes teemed with beavers and muskrats, and the limited forest areas supported many other valuable fur-bearing animals.

The region was exceptionally rich in the number of individuals, if not in the species, of large game. Of the abundance of small animals before the settlement of the region, there is little record, but probably in most cases there has been comparatively slight change. Many of the larger species have entirely disappeared, or have become very scarce or local in their distribution, owing to the change from a limited Indian population with crude weapons to the occupation of the country by hunters, trappers, and traders, and later by a well-armed, well-equipped, energetic, and sport-loving people. Before any thought of game protection or conservation influenced the destructive methods of the early settlers, much of the game had disappeared. Only in comparatively recent years have wise and effective laws been enacted for the protection of the game that remains, and there are not enough protected areas to insure the maintenance of this remnant. Some of the vanished species are being reintroduced in areas of little value for other purposes, and it is hoped that still others that are no longer found within the State may thus be preserved for the interest of future generations.

In many cases the disappearance of the game before the settlement of the country was necessary and can be regretted only on the ground that the methods employed were wasteful and the rate of depletion was unnecessarily rapid. With better control the buffalo, elk, deer, antelope, and mountain sheep would have lasted much longer, and could have been of value to great numbers of people for several generations, instead of being largely squandered by a few skin hunters. It is futile to waste time in regrets over what can no

longer be helped, but future loss to the State can be prevented by a fuller knowledge of the species which should be preserved and those which can well be spared.

Useful and Harmful Species

At the present time the mammals of the State may be divided into two groups, the useful and the harmful. The clearly useful species may be grouped under game animals, fur-bearing animals, certain rodent destroyers, and insectivorous animals. The harmful species may be classed broadly as predatory animals and rodent pests. Each of these groups has an important place in the economy of the State, but without a thorough knowledge of the abundance, distribution, and habits of each it is impossible to employ intelligently successful methods of protection, propagation, control, or destruction of a species or a group of species. To supply the needed information, the present report has been prepared, the information being based on facts gathered in field work of the Biological Survey, supplemented by data from all available reliable sources.

Indian Names of Mammals

The Indian names given for many of the mammals have been collected for the sake of perpetuating those longest in use for the species, and in the hope that in cases where other names are not available or well established, some may be generally adopted. Names of many of the conspicuous species from several different tribes are found in the reports of Maximilian and other ethnologists, but most of those used have been contributed by Melvin R. Gilmore, formerly curator of the State Historical Society, at Bismarck, now of the Museum of the American Indian, New York City, who has obtained them directly from the Indians through his own knowledge of their language or by showing skins of the species with which they are familiar. Many of the Mandan names have been supplied by George F. Will, of Bismarck, in cooperation with Doctor Gilmore.

The following phonetic key is used except in names from Maximilian, where the German spelling is retained:

a, as *a* in father.
e, as *e* in they.
i, as *i* in marine.
o, as *o* in go.
u, as *u* in rule.

c, as *ch* in chin (*k* and *s* are used for the ordinary sounds of *c*).
ch, as guttural *ch* in German ich, ach.
zh, as *z* in azure.
[a] (elevated) nasalizes the preceding vowel.

Measurements and Weights

In most cases the usual three measurements are given: *Total length*—from tip of nose to tip of tail vertebrae in a straight line; *length of tail*—from base at right angle with back to tip of skin at end of tail; and *hind foot*—from point of heel to tip of longest claw. Most of the measurements are, as originally taken, in millimeters.[1] Weights are given, when available, in grams for the smaller and in pounds for the larger animals.

[1] For the convenience of those not familiar with the metric scale it may be stated that 25 millimeters make approximately 1 inch, and 304.8 millimeters are equivalent to 1 foot.

Class MAMMALIA: Vertebrate Animals That Nurse Their Young

Order ARTIODACTYLA: Hoofed Animals—Cattle, Sheep, Goats, Antelope, and Deer

Family BOVIDAE: Cattle, Sheep, and Goats

Bison bison bison (Linnaeus)

American Bison; American Buffalo

Te of the Omahas (Gilmore); *Pte* of the Dakotas (Gilmore) and Mandans (Will); *Mitĕ* of the Hidatsas (Matthews); *Tanaha* of the Arikaras (Gilmore).

[*Bos*] *bison* Linnaeus, Syst. Nat., ed. 10, t. 1, p. 72, 1758.

Type locality.—Indefinite.

General characters.—The American buffalo, or bison, is so well known as a feature of all western description and travel and from picture, statue, and the currency and coin of the Republic, as well as from the examples still preserved in public and private parks, that it needs no detailed description. A large buffalo bull described by Audubon (1897, p. 111), killed by one of the party at Fort Union (now Buford), in 1843, measured from tip of nose to root of tail, 131 inches; tail vertebrae, 15½ inches; hair on end of tail, 11 inches. When cut into pieces it weighed 1,777 pounds—it was not fat, and would have weighed 2,000 pounds if it had been in better condition. In his detailed description of the buffalo, Audubon (1851–1854, vol. 2, p. 44, 1851) says that very large bulls generally weigh about 2,000 pounds and cows about 1,200 pounds. These approximate weights are in accord with some recent records.

Early abundance.—Until the beginning of the past century, buffalo ranged over all of North Dakota in vast herds. Although no approximate estimate of their numbers is possible, the abundance of the animals is attested by vivid statements of early explorers. Alexander Henry (the younger) (1897, pp. 84, 162, 167, 208–209) recorded them in immense numbers along the Red River Valley in September, 1800, and on January 1, 1801, near the junction of the Park and Red Rivers, as in great abundance, the Plains entirely covered, the animals moving in a body from north to south; and on January 14 of the same year, he says:

> At daybreak I was awakened by the bellowing of buffaloes. . . . On my right the Plains were black, and appeared as if in motion, . . . and on my left, to the utmost extent of the reach below us, the river was covered with buffalo moving northward. . . . I dressed and climbed my oak for a better view. I had seen almost incredible numbers of buffalo in the fall, but nothing in comparison to what I now beheld. The ground was covered at every point of the compass, as far as the eye could reach, and every animal was in motion.

In January, 1803, on a trip from Park River, N. Dak., to Riding Mountain, Manitoba, he says "we never marched a day without passing herds of buffaloes;" and men who "have lately been up as far as Goose River, tell me the buffalo continue in abundance

from this place to that river and as far as the eye could reach southward."

On October 19, 1804, Lewis and Clark (1893, pp. 172, 174, 175, 276, 278, 282, 286) counted 52 herds from a single point on the Missouri River, 11 miles above Fort Rice; the next day they saw great numbers on the flats just below where Bismarck now stands, and the following day a little farther up the river found the Plains covered with herds. As they journeyed toward the Mandan villages, where they spent the winter, herds of buffalo were frequently seen, although during the winter the Indians had to make many hunting trips to bring back a meat supply. Again in the following April, as the expedition proceeded up the river, numerous buffalo herds were encountered, and great numbers of carcasses of drowned animals were seen floating in the current or stranded along the shores. On the broad flats at the mouths of the Little Missouri, the Muddy, and the Yellowstone, buffalo were reported in "vast herds" and immense quantities. In 1811 between the Arikaree and Mandan villages Brackenridge (1816, pp. 133–134) says, "I discovered in every direction immense herds of buffaloe . . . in this [small] valley there appeared to be several thousand . . . armies of buffaloe all in motion as far as the eye could distinguish in every direction."

In 1833, Maximilian (Wied, 1839–1841, Bd. 2, p. 84, 1841) found buffalo abundant throughout the North Dakota section of his trip up the Missouri River, except near the larger Indian settlements, where persistent hunting kept them at times at considerable distances. During the migrations, however, as the great herds swept back and forth from summer to winter range, they came close to the villages. While wintering at Fort Clark, Maximilian says the herds did not appear in the immediate vicinity except when the weather was very severe, because they were too much disturbed by the numerous Indians in the neighborhood. The hunters of the fort were often obliged to ride 20 miles before finding them. In the cold snowstorms, so prevalent during the winter, the animals took refuge in the forests on the banks, where great numbers were killed and where it was almost impossible to drive them out of the woods. Their bones and skulls, scattered all over the ground, prove the immense destruction of these harmless animals.

At Fort Union on the upper Missouri, Audubon (1851–1854, vol. 2, p. 47, 1851) in 1843, gave a good idea of the immense numbers of bison on the wild prairies at that time in an account of a trip by Mr. Kipp, one of the principals of the American Fur Company, from Travers Bay on Lake Winnipeg to the Mandan Nation on the Missouri River. In August, "in a cart heavily laden, he [Kipp] passed through herds of buffalo for six days in succession. At another time he saw the great prairie near Fort Clark on the Missouri River, almost blackened by these animals, which covered the plain to the hills that bounded the view in all directions." On his return trip down the Missouri in August, Audubon (1897, pp. 154–155) also saw great numbers of buffalo and said the roaring of the bulls was like the long continuous roll of a hundred drums, and could be heard for miles; while the animals were seen all over the prairies and river bars and many were swimming in the river.

In 1845 Father De Smet, (1905, p. 657) on crossing the Missouri River west of Fort Union, said: "the whole space between the Missouri and the Yellowstone was covered [with buffalo] as far as the eye could reach . . . During a whole week we heard their bellowings like the noise of distant thunder, or like the murmurs of the ocean waves beating against the shore."

In "A story of 53," of the fur-trading days at Walhalla, Charles Cavileer states that 10,000 to 12,000 buffalo robes, worth $1.25 to $2.50 each, were brought in to that post each year.

In the spring of 1862, on the Missouri River, A. H. Wilcox (1907, p. 46) writes:

> At two different times our steamboat was obliged to stop, and tie up alongside the shore to avoid the immense herds of buffalo that were floating down the river. The first drove we encountered was near where Bismarck in North Dakota is now located. The river was nearly half a mile wide and was filled nearly its entire width with live buffaloes, and they were at least half an hour in passing. We encountered the other drove a little above the mouth of the Yellowstone and it must have contained at least 20,000 animals.

L. C. Ives, of Veblen, S. Dak., told the writer that his company of cavalry, the Second Minnesota Volunteers, on their return trip from an Indian expedition up the Yellowstone in 1863, encountered untold thousands of buffalo on the prairies east of the Missouri River.

In July, 1866, R. M. Probsfield (Wilcox, 1907, p. 50) reported a herd on the North Dakota side of the Red River about 18 miles north of Fargo. He says: "There may have been 10,000 or 100,000 of them . . . as we could not see their limit either north or west." The next herd, only 25 in all, was seen in 1867, and another small herd in 1868 in the same vicinity on the east side of the river.

Often the early travelers reported days without seeing buffalo, or only scattered bunches or occasional individuals, from which to draw their meat supply. The great numbers seen at certain times and places were usually the migrating bands that swept back and forth from north to south or east to west, according to season or the abundance or scarcity of food and water. But, while migratory in habits, the buffalo did not entirely leave the State at any time of year, nor apparently any considerable part of it, as the fall and spring herds swept in a general way north and south, those from farther north and farther south coming in to replace those that drifted beyond its borders and to fatten on the rich summer grasses or to paw through the winter snow for the still abundant supply of well-cured prairie grass underneath. The country was well stocked but not overstocked. The buffalo had reached a fair equilibrium between natural increase and annual loss, loss from wolves, bears, and native hunters, and from quicksand, water, rotten ice, blizzards, and prairie fires.[2]

Natural checks on abundance.—At his winter quarters on the Park River, where it joins the Red River, Alexander Henry (1897, pp. 174, 175, 177, 253, 254) writes in his journal, on March 31, 1801: "Rain broke up the ice . . . It continued to drift, . . . bearing

[2] For full and interesting accounts of the buffalo, see Allen, J. A. (1876), The American bisons, living and extinct; Hornaday, W. T. (1889), The extermination of the American bison; Seton, Ernest Thompson (1909), vol. 1, pp. 247–303, Life-histories of northern animals.

great numbers of dead buffalo from above, which must have been drowned in attempting to cross while the ice was weak." On April 1, he says: "The river is clear of ice, but drowned buffalo continue to drift by entire herds . . . It is really astonishing what vast numbers have perished; they formed one continuous line in the current for two days and nights. One of my men found a herd that had fallen through the ice in Park River and all been drowned; they were sticking in the ice, which had not yet moved in that part." On April 18 he records "drowned buffalo still drifting down the river, but not in such vast numbers as before"; and on May 1, "The stench from the vast numbers of drowned buffalo along the river was intolerable . . . Two hunters arrived in a skin canoe from Grandes Fourches with 30 beaver and 7 bear skins. They tell me the number of buffalo lying along the beach and on the banks above, passes all imagination; they form one continuous line, and emit a horrid stench. I am informed that every spring it is about the same." Similar accounts of buffalo in the Missouri River are found in journals of the early explorers.

In the Hair Hills, at the source of Salt River, on November 25, 1803, Henry saw the effects of fire on the buffalo and writes:

> Plains burned in every direction and blind buffalo seen every moment wandering about. The poor beasts have all the hair singed off; even the skin in many places is shriveled up and terribly burned, and their eyes are swollen and closed fast. . . . In one spot we found a whole herd lying dead. The fire having passed only yesterday these animals were still good and fresh, and many of them exceedingly fat. . . . At sunset we arrived at the Indian camp, having made an extraordinary day's ride, and seen an incredible number of dead and dying, blind, lame, singed, and roasted buffalo. The fire raged all night toward the S. W.

Extermination by man.—Although natural losses among the buffalo herds were at times great, they were local and irregular. With the advent of the white trappers and traders with powder and ball, and later of the skin hunters with better rifles, the long-established equilibrium was destroyed, and as settlements crept in the buffalo were crowded back or killed for local supply of meat and robes, and the great herds were followed and exterminated for their skins by gangs of men employed for the purpose. Old hunters have told of shooting 75 to 100 buffalo a day, from which their skinners would remove the hides and pin them to the ground to be dried and later hauled by teams to the nearest river or railway point for transportation. In the seventies the principal cargo of boats coming down the river from Fort Benton to Bismarck consisted of buffalo hides, more than 60,000 having been shipped down by one firm. Big wages were paid and big profits realized.

The first record of the buffalo receding before the settlement of the area now included within the State of North Dakota was in 1821, by Alexander Ross (1856, pp. 57, 100, 255, 257, 267), who reported them as becoming scarce in the vicinity of Pembina, and in 1826 as apparently not found without going 150 or 200 miles beyond Pembina. In 1840, he says the Pembino hunters went 250 miles in the direction of the Sheyenne River for buffalo, and in 1840 he prophesied that the end of the buffalo was fast approaching. Thenceforth the history of the buffalo becomes the history of their slaughter and rapid disappearance. On July 4, 1840, Ross records

a buffalo hunt organized and carried to the vicinity of the Sheyenne River, west of Fargo. The herds were located and on the evening of the first day's hunt 1,375 tongues were brought into camp and more than 2,000 buffalo were estimated killed by the 400 mounted hunters.

In September, 1861, Charles E. Patton and party, traveling west from the Red River Valley, saw the first buffalo and killed seven, about one day east of Devils Lake. A few days later 15 more were seen and 2 killed, a half day west of Sullys Hill. One day farther west herds of 15 and 20 were seen and the main great herd was near.

At Devils Lake, in 1916, Frank Palmer said that in 1866, on a trip in Minnesota and North Dakota, the first buffalo in any abundance were encountered on the James River near the southern border of the State. In 1868 when he came to Devils Lake they were getting scarce near the fort and the Indians were in the habit of making trips to procure their meat supply. In 1869 and 1870 they were getting scarce all around the lake and hunting for hides had begun on a commercial basis. (Hornaday, 1889, pp. 507–508.) Near Valley City the last buffalo was killed in 1874.[3]

A surveying party in charge of George G. Beardsley in 1874 encountered a herd of buffaloes numbering about 300 near the Hawk's Nest Buttes, not far from where Carrington now stands. The next year these were all killed (Wilcox, 1907, pp. 51, 53).

In 1876 the Northern Pacific Railway reached Bismarck and diverted most of the cargoes of buffalo hides from the Missouri at that point, but only incomplete records were kept of the shipments. In 1881 more than 75,000 hides were shipped out from there, but these were mainly of animals killed in Montana (Hornaday, 1889, pp. 507–508).

Mr. Holes, who settled at Fargo in 1871, told the writer that the nearest buffalo then were found on the prairies south of Devils Lake. J. A. Allen (1875, pp. 39–40) says the last buffalo killed near Fort Rice was in 1869, when three were killed from a herd of 10 old bulls which had strayed far eastward from the main herds. In 1915, Remington Kellogg was told that the last buffalo seen in the Goose River country was killed in March, 1878.

Some of the old settlers reported in 1916 that the last buffalo was killed near Cannon Ball in the seventies. In June, 1882, the last great buffalo hunt of North Dakota took place on the headwaters of the Cannonball River, where 600 Indian hunters, well mounted and well armed, killed in a two-days' hunt 5,000 animals, as vividly described by Major McLaughlin (1910, pp. 97–116), who took part in the hunt.

The Fargo Record reports an old bull killed near Sykeston, in Wells County, in 1881, and E. E. Booth, of Minot, tells of one seen near Sawyer, in the same county in 1883, which was chased by horsemen but not caught. He says the animals were still common in the Dickinson country in 1882. Near Stump Lake the writer was told that the last buffalo ever seen in that region was a lone wanderer seen and chased, but not killed, in the winter of 1881–82.

In 1913, at Fort Clark, Stanley G. Jewett learned from old hunters that the last buffalo in that region was killed by Joe Taylor during

[3] Report by John Halland to Morris J. Kernall in 1913.

the fall of 1884. At Medora he was informed that the last killed was in the neighboring hills in 1884; and at Sentinel Butte, Lewis F. Crawford told him that, so far as he knew, the last one killed in the State was in the country south of Dickinson in 1884.

There may be later records for the State, but even those of 1884 were of scattered individuals missed in the big hunts that had swept the main herds out of existence.

Present-day remains.—To-day a buffalo robe or coat is rarely seen and the few remaining are greatly prized. A few mounted heads are still preserved in museums and public places.

In 1887 when the writer first visited North Dakota, heaps of bones, mainly of buffalo, were commonly found at the stations along the Northern Pacific and Great Northern Railways. Great piles of bones were often seen near the sidetrack, waiting until enough more were brought in to load one or more freight cars for shipment to fertilizer plants. Almost perfect buffalo skulls and horns were found in these bone piles but unfortunately the importance of saving series of skulls for future study was not then appreciated.

Buffalo bones have now almost disappeared from the surface of the prairies, but they are still abundant under ground and under water. The marshy and springy places around the edges of lakes or along the river valleys fairly bristle with them. The shores and beaches of Devils Lake, Stump Lake, and the Sweetwater Lakes are strewn with such characteristic bones as the skulls, vertebrae with the long dorsal processes which supported the hump, and pieces of the rough black horns always distinguishable at a glance from those of cattle. Even the islands in the middle of Devils Lake are thickly strewn with buffalo bones, the unrecorded history of which is well understood by reading the accounts of Alexander Henry, Lewis and Clark, and others, of the thousands of buffalo carcasses found in spring floating down the rivers when the ice was melting and breaking up.

Every lake and river in North Dakota seems to have trapped the buffalo during their abundance, while marshes, bogs, and spring holes drew heavily upon their numbers. The spring and fall migrations were in large part responsible for these fatal results, as rivers and lakes must necessarily be crossed or the migrating herds be checked or change their courses. For ages to come, well-preserved skeletons will be found embedded in the mud and silt, and still more perfect specimens in the oozy bogs of cold and mineral-impregnated water so common in the State.

The old buffalo trails have not all disappeared. In many places they are still deep and well preserved in the tough prairie sod or on steep sidehills and Badlands buttes, where not disturbed by the plow or by the less hardy domestic stock.

Buffalo wallows, little prairie basins that caught the rain and were used for mud baths by molting bulls with itching hides, are still found in great numbers not only on level areas but on hilltops and along the crests of ridges. Rubbing stones, great granite bowlders high enough to reach the itching sides of the buffalo, still stand on the prairie or on morainal ridges where they have been rubbed and polished until their sides are smooth and glossy, and

the earth around them has been trampled and blown away, leaving them like inverted cups standing in deep saucers of earth.

The survivors.—Of living buffalo, there are many in private and public parks, and a small national herd is maintained in the Sullys Hill Park, on the south side of Devils Lake. These are hardy and bid fair to keep the species permanently within the borders of the State as a reminder of the romantic days when tribes of wild Indians and herds of wild bison roamed at will over the great prairies and sought the shade and shelter of the groves on the margins of streams and lakes.

Ovis canadensis auduboni Merriam

Audubon Mountain Sheep

Bighorn of the Badlands; *Ansa-chta* of the Mandans (Will); *Hekiⁿskagi;* (*Hekiⁿshkagi*) of the Dakotas (Gilmore); *Azichtia* of the Hidatsas (Matthews); *Arikusa* of the Arikaras (Gilmore).

Ovis canadensis auduboni Merriam, Proc. Biol. Soc. Wash., vol. 14, p. 31, 1901.

Type locality.—"Upper Missouri," probably the Badlands between the Cheyenne and White Rivers, S. Dak. Type specimen supposed to have been collected by F. V. Hayden in 1855. [See original description.]

General characters.—Fully as large or larger than *Ovis canadensis*, molars and jaws much heavier. Audubon (1851–1854, vol. 2, p. 165, 1851) gives the color of July specimens as light grayish brown, rump and underparts, grayish white; and the weight of a male as 344 pounds, and of a female as 240 pounds.

Distribution, habitat, and habits.—Lewis and Clark in 1805, Maximilian in 1833, and Audubon in 1843, in their trips up the Missouri River, found mountain sheep on the Badlands bluffs between the points where the Little Knife and White Earth Rivers join the Missouri from the north, below the mouth of Muddy River, and near the junction of the Yellowstone with the Missouri. Maximilian reported them as abundant in the "Black Hills," where the Indians went to hunt them, and on his map includes under this name the Killdeer Mountains and Badlands along the Little Missouri River. At Fort Clark he (Wied 1839–1841, Bd. 2, p. 85, 1841) said they were not found within 50 miles, which may have been either north or west, but was probably both. Apparently the original range of the bighorn in North Dakota included all of the very rough Badlands country along and west of the Missouri River. Howard Eaton in the seventies, and Theodore Roosevelt in the eighties, killed mountain sheep in the Badlands along the Little Missouri, but they were then no longer abundant; and at the present time there is probably not a live wild mountain sheep in the State, nor one of this subspecies in existence.

The history of the bighorn in North Dakota is in a small way like that of the buffalo—a record of extermination. In 1804, Lewis and Clark (1893, pp. 150, 214, 284) reported bighorns in the Badlands west of the Missouri River. At the Mandan villages they saw sheep horns among the Indians, and near the mouth of the Yellowstone one of their men met several of the bighorn animals, but they were too shy to be obtained.

In 1833, Maximilian, Prince of Wied (1839–1841, Bd. 1, p. 423, 1839; Bd. 2, pp. 85, 309, 315, 1841), on his way up the Missouri to Fort Clark and Fort Union and thence west to Fort McKenzie and back to Fort Clark, where he spent the winter of 1833–34 among the Mandan Indians, first saw mountain sheep above the mouth of the Little Knife River. Later he found them below the mouth of the Muddy River and near the mouth of the Yellowstone, while among the Mandans and Minnetarees he found beautiful shirts made of bighorn leather. The Minnetarees, he said, went to the Black Hills and other mountainous tracts to hunt, and killed a hundred or more sheep in a season. Among the Mandans and some of the other tribes he found the horns in use as bowls or ladles.

Audubon (1897, pp. 24, 28, 40) saw his first bighorns in 1843 on the summit of a hill above the mouth of the Little Knife River, quite probably the same butte on which Maximilian had seen them 10 years before, and he was told by the captain of the steamer that they had been seen there on his previous trip up the river. He saw others 6 miles below the mouth of the Muddy River, and near the mouth of the Yellowstone he saw a mixed band of 22, including rams, ewes, and one lamb (June 12). Many others were seen by members of his party, but it was with great difficulty that his hunters obtained enough sheep for his drawings and for a few specimens to be brought back. The sheep were very shy and kept on the highest and roughest parts of the Badlands buttes. He says, "I am told that the Rocky Mountain rams lost most of their young during the hard frosts of the early spring; for, like those of the common sheep, the lambs are born as early as the 1st of March, and hence their comparative scarcity." This explanation suggests some more recent theories to account for the scarcity of game, but with wolves and coyotes as abundant as they were at that time, the wonder is that any lambs could escape to grow up, even on the very rough slopes that afforded the only protection to the adults.

In 1860, J. G. Cooper (1869, p. 296) reported mountain sheep along the rocky bluffs bordering the Missouri River "above the Great Bend," but this record is indefinite, as most of his notes refer to the part of his trip from Fort Buford west to Fort Stanton, Mont.

A. McG. Beede, who has had long acquaintance with the Indians and is familiar with their language, hunting lore, and traditions, says that there never were any mountain sheep near the Missouri at Cannon Ball, but that formerly the Indians went farther west to hunt them.

Howard Eaton stated that in October, 1879, he killed two mountain sheep on Bullion Butte, a high plateau about 20 miles south of Medora. He also captured a live ewe on or near the butte and sent it to the Philadelphia Zoological Gardens, and he had killed many more in the Badlands of the Little Missouri.

In the early eighties Theodore Roosevelt (1900b, pp. 73–105) hunted mountain sheep in the Badlands along the Little Missouri, and, although much hard hunting was required for the few mountain sheep seen and the one fine ram killed, he has given us the best account of the habits and haunts of this species to be found in literature.

In 1913, Stanley G. Jewett, while in the Killdeer Mountains, was told by Mike Caskelly, of Oakdale, N. Dak., that three mountain sheep were found in the Killdeer Mountains in 1888. For several days they were seen feeding on the ridge above his ranch, where the present town of Oakdale now stands. Two of these were killed by Caskelly's brother. In 1915, Remington Kellogg saw a mounted mountain sheep head at the home of Charles W. Hoffman, principal of the Indian School at Shell Village. It was one of the three killed by an Indian (Birdsbill) in 1898 from a bunch of five in the Badlands of the Little Missouri just outside the reservation. Later a photograph was obtained of this head. On Magpie Creek, a branch of the Little Missouri, west of the Killdeer Mountains, Jewett saw an old weathered horn that had been picked up a few years previously, and ranchmen told him that mountain sheep had formerly ranged over the rough hills along Magpie Creek. The last one known there was an old ram killed about 1905, the head of which was in the possession of a ranchman near Quinion. So far as known this is the last record for the State, although there are somewhat later reports of the species from the Badlands of South Dakota.

In the destructive and constructive periods of the West, as it passed from savage to civilized life, the bighorn of this open and accessible area contributed its all. Besides its most savory of wild meats, its magnificent head and horns offered a highly prized trophy not often obtained in the low country or where hunting on horseback was possible. Whether for sport or profit there was always a high price on the head of the bighorn, and this spells the doom of any species.

Family ANTILOCAPRIDAE: Pronghorned Antelope

Antilocapra americana americana (Ord)

Pronghorned Antelope; American Antelope; Pronghorn

(Pl. 7)

Koka of the Mandans (Will); *Tatókana* of the Dakotas (Beede); *Uchi* of the Hidatsas (Matthews); *Chka* of the Arikaras (Gilmore).

Antilope americana Ord. Guthrie's Geog., 2d Amer. ed., vol. 2, pp. 292, 308, 1815. (Reprint by S. N. Rhoads, 1894).
Antilocapra americana Ord, Journ. Phys. [Paris], vol. 87, p. 149, 1818.

Type locality.—Plains and highlands of the Missouri River.

General characters.—Size of a small deer, very slender, graceful, and swift. The striking characters are the flat-pronged and hooked horns, which are shed and renewed each year, the mere stump of a tail, the great white rump patch that is spread in a wide rosette or closed down at will, and the strongly contrasted buff and black and white markings. It is neither a true antelope nor a goat, but belongs to a family of one-pronged deciduous-horned animals including one species and several geographic races peculiar to North America.

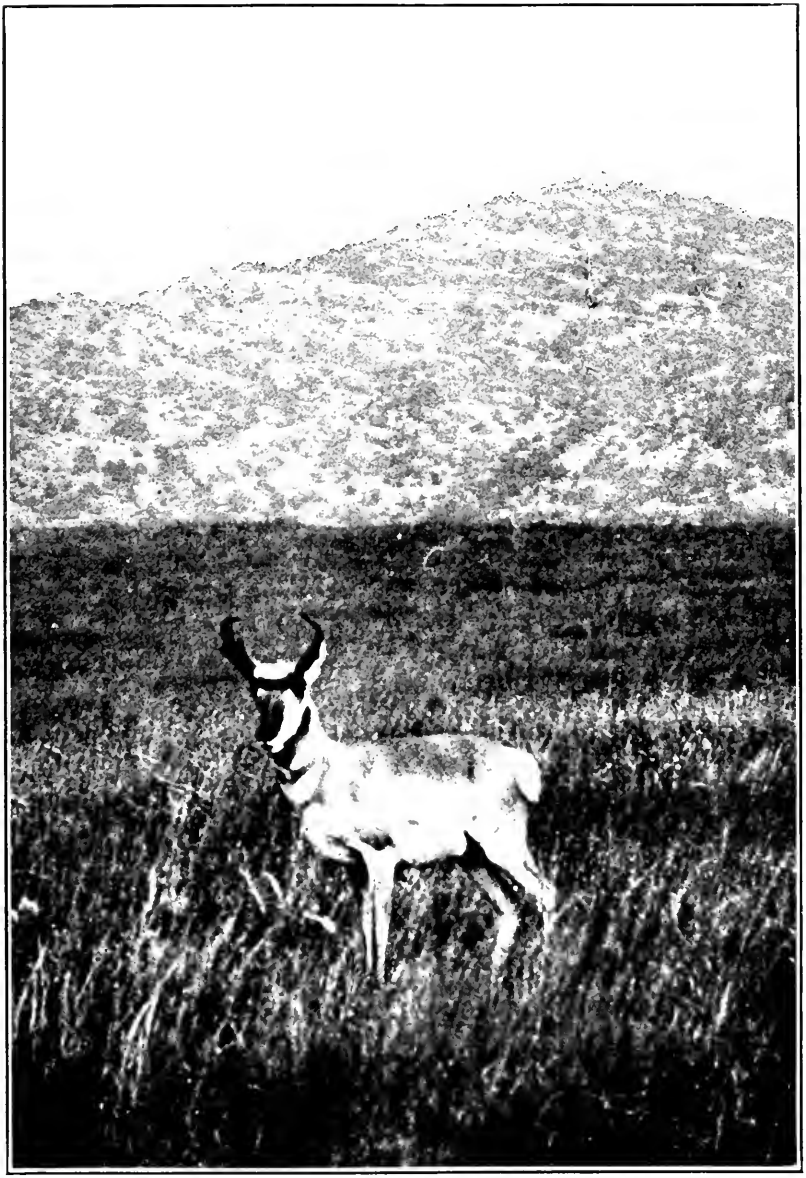
Distribution.—Antelope originally ranged over nearly all of the open country of North Dakota. It is doubtful that they ever penetrated the timbered area of the Turtle Mountains to any extent,

and they seem to have been always absent or scarce in the immediate valley of the Red River. On his numerous trips up and down the Red River Valley from 1800 to 1806, Alexander Henry (1897, p. 191) never mentioned them except for one brought him by an Indian at Pembina, November 15, 1801. At Fargo, James Holes, one of the early settlers, said in 1912 that as long ago as 1871 there had been no antelope nearer than the western part of Cass County, where they were abundant until at least 1879. In 1887 at Pembina, the writer heard that they were still found in the Pembina Hills, 34 miles west of the Red River, and all along the valley they were reported west of the low, flat bottom of old Lake Agassiz. Perhaps their range was established before the lake disappeared, but more probably the tall grass and rich waxy soil kept them away from the valley bottom.

Early abundance.—In 1804, Lewis and Clark (1893, pp. 170, 174, 190, 211) reported great numbers of "goats" (antelope) along the Missouri River. On October 16, 9 miles below the mouth of Cannonball River, they recorded great numbers on the banks and in the river, where they were driven by the Indians and killed with sticks and guns. Again, great numbers were seen on the wide flats just below Bismarck and about their camp above Mandan, where 100 were caught at one time in a pen by the Indians. The explorers were told that the antelope were then on their fall migration west to the "Black Mountains" to spend the winter, but would return to the plains east of the Missouri in spring; and as the party continued up the river the following April, after wintering at the Mandan villages, they met the returning antelope in great numbers.

In August, 1806, Alexander Henry (1897, p. 410) reported numerous herds of "cabbrie" (antelope) on his way from Mouse River to Fort Union. In 1833, Maximilian (Wied, 1839–1841, Bd. 2, p. 84, 1841; 1843, p. 246) says the "cabri" or antelope (*Antilocapra* Ord), lived the whole year in the immediate vicinity of Fort Clark. In the summer great numbers congregated, going in the winter toward the mountains, where they found protection from the snow, and returning in April, when large bands of them were seen about the Missouri. Their migrations were by no means checked by the Missouri River, as bands were frequently seen swimming across, and the great prairies east and north of the river were a favorite summer range, as the Badlands of the Little Missouri, the Powder, and the Cheyenne Rivers (South Dakota) were a favorite winter resort for the antelope of that region.

In 1873 from Fort Abraham Lincoln west to the Little Missouri J. A. Allen (1875, p. 40) found antelope the most abundant game animal, almost constantly in sight and attracting much attention for their grace and beauty. On his return trip a few months later a fatal epizootic had raged among the pronghorns over nearly the whole area between the Yellowstone and Missouri Rivers, destroying apparently three-fourths to nine-tenths of the animals. For the whole length of the Heart River, considerably over 100 miles, along the line of march, he says, their carcasses were thickly scattered and included both sexes and all ages, fawns often lying within a few yards of their dams. There were 10 dead seen to every live antelope, but the disease had apparently not extended beyond the Yellowstone or Missouri Rivers.



B2778M

BUCK ANTELOPE (ANTILOCAPRA AMERICANA AMERICANA)

From photograph by H. W. Henshaw, Wichita Game Preserve, Okla.

Decrease in abundance.—In later years the disappearance of the antelope over the State has been not so much in advance of settlement as in the case of the buffalo, but has been coincident with the early filling up of each section of their range by settlers. Frank Palmer, of Devils Lake, told the writer that antelope were numerous in that part of the State up to 1872 and common to 1876, while a few remained into the eighties. Mr. Holes, of Fargo, reports "lots" of antelope seen in the western part of Cass County in 1879. In 1877 a herd estimated at 3,000 was seen by J. S. Weiser between Valley City and Jamestown. From 1878 to 1880 they were common about Valley City, according to John Hailand, and as many as 200 were seen in a bunch. In 1882 a "whole herd" of antelope was seen on Judge Green's farm, southwest of Valley City, by D. W. Clark, and in 1892, ex-Governor Frank White saw eight antelope near Valley City. In 1887 the animals were reported as still common in the Mouse River country, a few were still found in the Pembina Hills and country east of the Turtle Mountains, and a bunch of 14 had wintered near Devils Lake. In 1891 and 1892 Elmer T. Judd killed several near Canby, but they were the last he knew of in that section of the State. At Stump Lake the writer was told in 1912 that antelope were abundant over the prairies during the eighties and that the last few individuals had disappeared in 1909 or 1910. A few were reported on the prairies west of the Turtle Mountains in 1909, but the latest record available at Crosby, in the northwestern corner of the State, was of three seen in 1906, although they had been numerous there until about 1903.

In 1915, Remington Kellogg was told of one recently seen near Lostwood Lake in the northern part of Mountrail County, but it is doubtful if there are at present any remaining east or north of the Missouri River.

West of the river, the more arid prairies have been used as stock range and only in recent years have filled up with grain farms and close settlement, to which fact, and to the fact that the areas of rough Badlands country are unsuited to farming, the antelope owe their present though scant existence in the State. In the early eighties Roosevelt (1900c, pp. 72, 77–80, 97–98, 119–120) found them still abundant in places. On one trip with the round-up between the Little Missouri and the Yellowstone, he wrote: "Antelope were very plentiful, running like race-horses across the level, or uttering their queer, barking grunt as they stood at gaze, the white hairs on their rumps all on end, their neck bands of broken brown and white vivid in the sunlight." Being detailed to get antelope meat for the round-up camp, he says: "There was no lack of the game I was after, for from every rise of ground I could see antelope scattered across the prairie, singly, in couples, or in bands." They were wild and in open country, but he managed to bring in three to the camp that night. One December in the eighties, making a trip of about 20 miles from his ranch to where a band of antelope were wintering, he found a herd of several hundred and killed an old buck and a yearling to take back for meat. The others ran around him, but would not leave the flat for the broken country and deep snowdrifts beyond. He says: "Their evident and extreme reluctance to venture into the broken country roundabout made me

readily understand the tales I had heard of game butchers killing over a hundred individuals at a time out of a herd so situated." Again, he says: "Several times I killed and brought in prong bucks, rising before dawn, and riding off on a good horse for our all-day's hunt on the rolling prairie country 12 or 15 miles away" [from his ranch].

In 1893, A. K. Fisher reported antelope as still common within 25 miles of Medora, where J. L. Foley had killed 13 on one trip the previous fall. In 1909 the farmers reported a bunch of 20 that had been seen a little west of Fort Clark a couple of years before.

In 1913, Charles Converse said there were still a few antelope about Schafer and Alexander; and Stanley G. Jewett reported a few still on the rolling prairie around the Killdeer Mountains, where the settlers told him it was not uncommon to see them anywhere in the open country north and west from Oakdale to the Little Missouri. At the Q-Bar ranch, on Magpie Creek, he was told of five antelope often seen on the hills to the east of the ranch house, but no others were known in that vicinity. At Medora, he learned that there were still a few on the plains about 30 miles south of there, where a doe and a fawn had recently been seen by a ranchman, and where four others were reported by a local surveyor. At Sentinel Butte, Mr. Crawford told him of a band of 17, which he had seen a few miles south of town two years previously, and of one that was frequently seen on the hills north of town during the summer of 1912. In August, 1913, there were about 30 antelope ranging on the Dakota National Forest, some 25 miles south of Medora, and a few on the big flats south of Bullion Butte. In 1915, H. H. Sheldon reported about 30 still in and around the national forest, and a few seen on Deep Creek, south of it, but said that they were being frequently killed and were apparently on the decrease. In August and September of 1915 Remington Kellogg reported a buck seen several times in Dunn County, west of Elbowoods, and a few near Goodall in McKenzie County. In 1916 the writer was told that there were still a few antelope in the section about Cannon Ball, and that two had been seen only a few miles west of the town within a few days. The great numbers formerly occupying that region had entirely disappeared.

A recent report on antelope by E. W. Nelson (1925) gives their present numbers in the State as follows:

> Antelope have almost disappeared from North Dakota. The remaining herds now number only five and aggregate about 225 animals. Their future appears to be extremely doubtful unless a game preserve can be established wherein they may be safeguarded.
>
> The distribution of the herds [in 1924] is approximately as follows:
>
> 1. In September, 1924, 60 antelope were reported as ranging from northwestern Dunn County into the adjacent part of McKenzie County.
>
> 2. A band of 9 was reported in September, 1924, in southwestern McKenzie County.
>
> 3. About 75 are reported in adjacent parts of central Golden Valley and Billings Counties. This is the largest band reported in the State. William McCarthy, who owns 11,000 acres of rough, rolling land in the heart of the Badlands along the Missouri River, which affords a natural range for game, writes that when he came into possession of the range in 1910 there were about 15 antelope there. Much hunted, they sought and were given every protection in his pastures, where they found running springs and flowing wells with an abundance of grass, and as a result have become very tame.

4. Bands numbering 55 were reported in September, 1924, in the Badlands of the Little Missouri River in Slope County.
5. In September, 1924, a band of 26 was reported from southwestern Bowman County.

Protection for the remnant.—The few antelope still inhabiting the roughest and least-settled parts of the Badlands would doubtless, if taken in time, form the nucleus of a herd that might rescue the species from being wiped out of the State, if not out of existence. If rough land of little value except for forest production and grazing were properly fenced so that the antelope would not stray to unprotected areas, and if coyotes were trapped to a harmless minimum and sheep scab kept out, it would seem that antelope should increase as rapidly as any herd of sheep. There are often, if not usually, two young at a birth, and these rough Badlands buttes and gulches afford the shelter and protection needed from storms and the most severe winter weather. Native plants furnish ample food in short grass for summer and in choice buds and tips of bushes for winter. Away from their native haunts no animals are more difficult to raise and keep in good health; at home no domestic animals are so hard and able to care for themselves under all conditions of weather and climate. Some of the Badlands areas that have been the wonder and admiration of geologists and travelers since the days of the early exploring expeditions could well be used as a preserve to save the antelope. Mule deer, elk, and bison could be added to the preserve thus created, but it is probably too late to rescue the Audubon mountain sheep for the purpose, although they have only recently vanished from the terraces and crests of these brilliantly colored buttes.

Family CERVIDAE: Moose, Elk, Caribou, and Deer

Alces americanus americanus Jardine

Moose

(Pl. 8)

Original, of the early French voyageurs; *Moose* [or *Muswa*] of the Crees and Ojibways (Seton); *Wesucharut* of the Arikaras (Gilmore); *Ta* of the Dakotas (Gilmore); *Pachúptaptach* of the Mandans (Will).

Alces americanus Jardine, Nat. Libr. Mamm., vol. 3, p. 125, 1835.

Type locality.—Eastern North America.

General characters.—The largest of the deer family, with throat pendant, or bell, long legs, short tail, and the dark colors of the deep forest habitat; the bulls with broadly palmate, deciduous horns. Measurements of a large bull by Seton (1909, vol. 1, pp. 145–146), total length, 9 feet, 6½ inches; tail, 2½ inches; hind foot, 31¼ inches; height at shoulders, 6 feet. Weight of very large bulls, 1,300 and 1,400 pounds.

Distribution and habitat.—Their long legs and wide-spreading hoofs enable moose to wade and swim and pass rapidly through marshes, swamps, and lakes, as well as through dense forests, but these animals avoid the open country as completely as antelope do the timber. From the great forests on the north and east, the moose in the early days entered North Dakota in the Turtle Mountains

and along the timbered fringes of the Red River Valley. In 1800, Alexander Henry (1897, pp. 90, 115) stated in his journal that they frequented the mouth of Park River. He also said that the Pembina Hills made a famous country for moose and elk. In 1887, when the writer was at Bottineau, moose were still reported from the Turtle Mountains, and in 1912, records were obtained of some killed there in 1888, 1899, and 1906. The country is ideal for them and the extensive area combines dense forest, thickets, and a network of marshes and lakes, where the tule borders half hide the floating pads and golden globes of the cowlily, forming a perfect moose paradise. It is not improbable that an occasional pair may still stray into these mountains, and if given sufficient protection these might remain to restock their old range. The mounted head to be seen in the agricultural college at Fargo is from a moose killed in 1898 by G. N. Brown at Rock Lake, just east of the Turtle Mountains. At Walhalla the writer learned of one killed near there in 1889.

In 1915, Remington Kellogg learned of a moose killed 3 miles south of Grafton, in 1900, and another on the Red River, 3 miles east of Grafton, in 1908. H. V. Williams reported one killed near Glasston in 1905, and another at Drayton, on the Red River, in 1906.

W. B. Bell reported the capture of a cow moose in Sargent County in the fall of 1913. It was kept captive at the Ellendale Industrial School for a time, but later was sent to a public park in Minnesota. A bull and cow and two calves near Mayville, in Traill County, were also reported to Doctor Bell the same year, but the report was not fully verified.

At the Fort Totten Indian School in 1916, Mr. Zibeau, the agent, said that the old Indians say there used to be moose in the timber around Devils Lake, but the report was not confirmed by the oldest white settlers in that region. The woods on the Sullys Hill Park are well adapted to moose, and it is hoped that sometime they may be added to the attractions of this historic park.

Few of our large game animals respond more satisfactorily to protection than do moose, as is demonstrated by their abundance and increase in such well-protected areas as in Maine and New Brunswick and in the Yellowstone and Glacier National Parks. They have few natural enemies that they can not overcome; they are too conspicuous to be much temptation to poachers; and, like the other deer, they often raise two young in a season. Although one of the most difficult of our native animals to keep in captivity, owing to their peculiar habits of feeding largely on the twigs of shrubs and small trees and from lake bottoms, they are extremely hardy in their natural environment in any sufficiently cold climate.

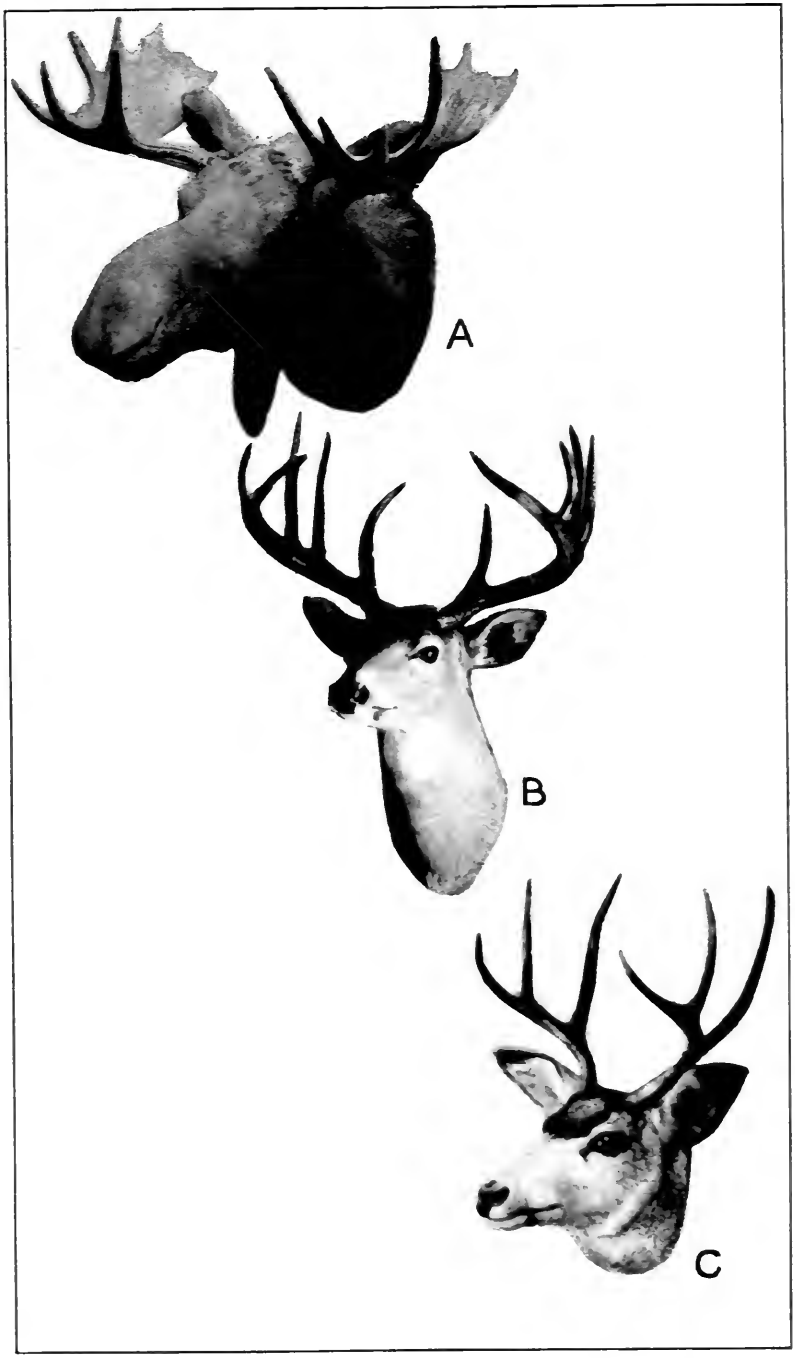
Rangifer caribou caribou (Gmelin)

Woodland Caribou

[*Cervus tarandus*] *caribou* Gmlein, Syst. Nat., 13th ed., vol. 1, p. 177, 1788.

Type locality.—Eastern Canada.

General characters.—In size between a large deer and small elk; horns large, with more or less flattened prongs and forks of beams, often with broad, flattened brow prongs in the male; females usually with small horns; feet, large; tail, short; color, dark smoky-gray, with more or less white on neck, feet, and underparts.



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HEADS OF BIG-GAME ANIMALS

(A) Moose (*Alces americana americana*), from Rock Lake, east of the Turtle Mountains; (B) northern white-tailed deer (*Odocoileus virginianus borealis*), from Riding Mountains, Manitoba; (C) mule deer (*Odocoileus hemionus hemionus*), from Pembina Hills

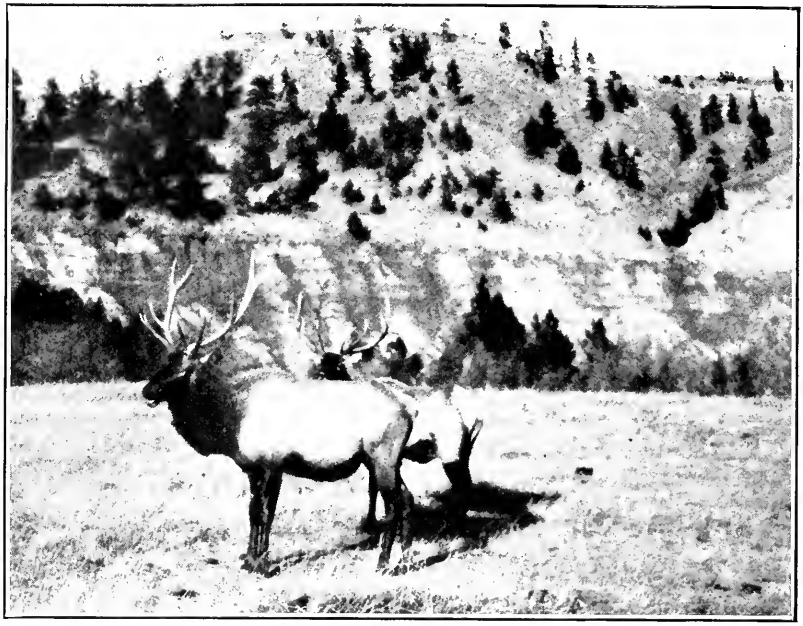

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FIG. 1.—TWO BULL ELK (CERVUS CANADENSIS CANADENSIS)

Photographed on game preserve, Niobrara, Nebr.

B15577

FIG. 2.—PLAINS WHITE-TAILED DEER (ODOCOILEUS VIRGINIANUS MACROURUS)

Family group of buck, doe, and two fawns from Missouri Valley below Williston

Distribution and habitat.—The eastern woodland caribou or closely related forms range through the Canadian Zone from the Gulf of St. Lawrence to the Rocky Mountains of western Canada, the lower edge of their recent range passing through northern Minnesota and central Manitoba. Their regular range is, therefore, at no great distance to the east and north of the corner of North Dakota, but apparently there are no records of their occurrence within the State since white men have known the region. It would not be strange, however, if at times during their former abundance, bands of this more or less wandering species should have strayed into the Red River Valley and the Turtle Mountain region. That this has been the case is shown by some fragments of old horns picked up in the Turtle Mountains and on exhibit at the museum of the fish hatchery near St. Johns. The writer has not seen these horns, but Mr. Eastgate writes that they are unmistakably those of caribou. If they came from the marshes or springy bogs of that region, they may have been there for many years, possibly centuries; but if from the surface of the ground, they could probably not have lasted more than 50 years at the most, and it is doubtful if they would have remained that length of time unless especially well protected.

Cervus canadensis canadensis Erxleben

American Elk; Wapiti

(Pl. 9, fig. 1)

Wapiti of the Shawnees (Handbook Amer. Indians); *Wah* of the Arikaras (Gilmore); *Ompa* of the Mandans (Maximilian), *O^{n}pa* (Will); *A^{n}pa^n* of the Omahas (Gilmore); *Upa^n* of the Dakotas (Gilmore); *Madoka* of the Hidatsas (Matthews).

[*Cervus elaphus*] *canadensis* Erxleben, Syst. Regni Anim., p. 305, 1777.

Type locality.—Eastern Canada.

General characters.—Next to the moose the largest of our deer, adult bulls being estimated to weigh from 700 to 1,000 pounds; adult cows, 500 to 600 pounds. Bulls with long, heavy, rounded, deciduous horns, each with normally six points in adults; cows hornless; tail short. General colors, dark brown with light-brown sides and a conspicuous white or buffy patch on the rump.

Distribution, habitat, and habits.—Originally elk ranged over all of what is now North Dakota, and were equally at home in the timber and over the open prairie. On his trip up the Red River in 1800, Alexander Henry (1897, pp. 83–85, 108) found them abundant and wrote in his journal of September 5: "Large herds were seen at every turn of the river and the bulls were bugling all through the woods. The rutting season was at its height." During the next six years he frequently mentioned them, and next to the buffalo they seem to have been the main source of meat supply for him and his parties of trappers in the Red River Valley and adjacent country.

In 1804–5, Lewis and Clark (1893, pp. 172, 174, 237, 250) recorded elk along the Missouri River all the way through North Dakota. On October 19, 1804, they reported three herds seen from a point 11

miles above the site of Fort Rice, and the next day great numbers on the wide river bottoms below where Bismarck now stands. At Fort Clark, where they wintered with the Mandans, elk meat was an important part of their winter provisions. On one hunting trip below the fort, February 21, 1805, they killed 14 elk, and on another trip on April 2, 21. Many herds were noted on the way up the river to Fort Union and beyond in the following April, and the Missouri River Valley seems to have been the great winter resort of the elk of the prairie region at that time.

In 1833, Maximilian (Wied, 1839–1841, Bd. 2, pp. 18, 47, 84, 1841) also found elk herds abundant along the river on his trip to Fort Union and westward and on his return trip to Fort Clark, where he wintered. On September 23 and October 31 he records the loud bugling (flöten) of the bulls from the timber along the river bottoms, and the spirited drawings by his artist, Karl Bodmer, show the elk herds in their prime. Maximilian said that the elk might be shot during the winter about 18 miles from Fort Clark, but that they did not approach nearer because of the Indians. Their skins were of great value in the manufacture of Indian moccasins.

Audubon (1897, p. 20, 157) (Audubon and Bachman, 1851, vol. 2, p. 88) found elk as abundant along the Missouri River in 1843 as had his predecessors. On June 9 he says: "We saw three elk swimming across it [the Little Missouri] and the number of this fine species of deer that are about us now is almost inconceivable." Many were killed during his stay in the country about Fort Union and on his return trip down the river they were seen and killed along the shores, while on August 26 the bulls were heard bugling, or "whistling," as he calls it. He says they were not confined to the wooded water courses, but roamed over the prairies in large herds.

L. C. Ives, of Veblen, S. Dak., told the writer of seeing thousands of elk along the Lower Yellowstone River in 1864 while on an expedition against the Indians. At Devils Lake, Frank Palmer reported that in the sixties, when he first came there, elk were common all over the State, and especially along the timbered areas of the Sheyenne River, and around Devils Lake, where they remained common up to 1879 and 1880. But as the country filled up with settlers, they rapidly disappeared.

In 1887, on the writer's first visit to North Dakota, he was told by an old hunter at Larimore of two elk killed near there in 1881 or 1882, and at Devils Lake there were said to be still a few. The last elk of which a record was obtainable in the Turtle Mountains was killed that year and a few were still found in the timbered areas along the Missouri and Yellowstone Rivers.

In the early eighties Colonel Roosevelt (1900c, p. 188; 1900b, pp. 155–156) says: "I have occasionally killed elk in the neighborhood of my ranch on the Little Missouri. They were very plentiful along this river until 1881, but the last of the big bands were slaughtered or scattered about that time." Later he says: "They have now vanished completely, except that one or two may still lurk in some of the most remote and broken places where there are deep, wooded ravines. Formerly the elk were plentiful all over the plains, coming down into them in great bands during the fall months and traversing their entire extent. . . . In the old days running

elk on horseback was a highly esteemed form of plains sport." He (Roosevelt, 1900c, p. 184) says: "Sometimes, but rarely, fighting wapiti get their antlers interlocked and perish miserably; my own ranch, the Elkhorn, was named from finding on the spot where the ranch house now stands two splendid pairs of elk antlers thus interlocked."

In 1915, Remington Kellogg was told of six elk killed in 1883 near Elkton, in Cavalier County. At Towner he was told by Mr. Lymburner that in 1884 elk horns were very plentiful in that section and that as late as the nineties the Sioux Indians had elk meat for sale that had been procured somewhere farther west. Near Plaza, in Mountrail County, he was told that a Mr. Hart had killed an elk in the summer of 1913, but no one could tell where it had come from. At Goodall, in McKenzie County, and near Elbowoods, in McLean County, in 1915, Kellogg found a few old antlers, as he did also on the river flats west of Sather, in Burleigh County.

On the flats east of Fort Clark in 1909, the writer found fairly well preserved pieces of old antlers, and in 1916 a few very old fragments near the mouth of Cannonball River, although the last elk there were said to have been killed 36 years before. At Stump Lake, in 1912, the writer also found a few fragments of old antlers, but could get no record of elk living there since 1881. The same year at the Sweetwater Lakes and in the Turtle Mountains he found a few old pieces, and in 1909, photographed a fairly well preserved pair of antlers at Mr. O'Neil's farm near Metigoshe Lake in the western part of the Turtle Mountains.

To what extent the elk were migratory in this open country will never be fully known, but their great abundance along the river valleys in fall, winter, and spring would indicate that these valleys were their wintering grounds. With a dense cover of timber and undergrowth and an endless supply of choice browse, they certainly afforded ideal conditions for elk winter range, just as the high wind-swept prairies gave equally ideal summer conditions. The shed horns of the elk are found mainly along the valleys or in the timbered areas around the lakes. According to Lewis and Clark (1893, p. 170), Big Beaver Creek in Emmons County was called by the Indians, "Warreconne," meaning where the elk shed their horns; Maximilian (Wied., 1839–1841, Bd. 1, p. 477, 1839) also speaks of the great numbers of shed horns along the river valley, and in his account of the region figures a pyramid of horns that had been piled up by passing bands of Indians as a landmark. As the horns are shed mainly during March and April, they are usually left on the winter grounds, but a few are carried back to the summer ranges and widely scattered.

Next to the buffalo, the elk at the height of their abundance were the easiest to hunt and hence the most rapidly killed of the large game, but when much hunted they become very wild, and it is probable that besides the vast numbers killed in the State, many were driven out of its borders.

With the possible exception of mountain sheep, elk meat is the most delicious of all our large game and a half year or year's supply of jerked elk meat has carried many an early pioneer's family safely over the period of "hard times" coincident with the settle-

ment of wild land. In the open country the disappearance of elk before settlement was inevitable and in their going the advancement of civilization has been well served. Only the needless waste caused by skin and tooth hunters need be regretted. Among the Indians elk skins provided most of the moccasins, but were little used for other clothing. Later, together with the buffalo skins, they found a ready market and, like many of the noblest of our game animals, the elk were sacrificed by the white skin-hunters.

Elk teeth were prized by the Indian women, to whom their use as ornaments was restricted. The wealth and rank of the women were often indicated by the number of elk teeth worn in necklaces and attached to various parts of their clothing. Even in recent times some of these treasured teeth have been worn by the older women and were so coveted that a price of a dollar each was put upon them. More recently, however, white men have adopted elk teeth as emblems or ornaments and, outbidding the squaws of savage tribes in their price for a useless bauble, have caused the wanton destruction of thousands of these superb animals. The braves and chiefs of these savage tribes, adopting the claws of the grizzly bear, scorned elk teeth as feminine adornments.

Economic considerations.—In domestication elk have proved more hardy and prolific than other stock and almost as easily handled under well-fenced range. If in the future the production of elk meat proves as profitable an industry as it promises, there will be found ideal conditions for elk pastures in many parts of western North Dakota, where rough and steep slopes lie close to brushy bottomlands, and winter browse and summer grass can be inclosed in single or adjoining areas. The severe winter weather which means suffering and loss to domestic stock without shelter is a joy to these native born and bred deer if a suitable and adequate food supply be available. Along many of the stream valleys with Badlands borders, which now lie idle or are of little use for stock, elk would find an abundance of their favorite food and choice living conditions. The time seems ripe for adding this industry to the many resources of the State.

Odocoileus virginianus macrourus [4] (Rafinesque)

Plains White-tailed Deer

(Pl. 9, fig. 2)

Tachtsha of the Dakotas (Gilmore); *Tsita-taki* of the Hidatsas (Matthews); *Mahmanaku* of the Mandans (Maximilian); *Ta-paht* of the Arikaras (Gilmore).

Corvus [sic] *macrourus* Rafinesque, Amer. Mo. Mag., vol. 1, p. 436, 1817.

Type locality.—Plains of the Kansas River.

General characters.—Similar to the eastern Virginia deer but slightly larger and paler in coloration. Horns with a single beam and upright prongs;

[4] In the Red River Valley, the Pembina Hills, and the Turtle Mountains, it is quite probable that the large northern deer of northern Minnesota, generally referred to *Odocoileus virginianus borealis* Miller, will be found to enter North Dakota, but until the group is more fully worked up the writer is referring all the white-tailed deer of the State to the Plains form, *macrourus*.

ears, small; tail, long, bushy, pure white below and gray on upper surface; no light rump patch. Metatarsal glands, small and low down on the hind legs. General color in summer, light-yellowish or reddish-brown; in winter, light gray with dark markings on face and ears; throat and underparts, always white. Fawns, spotted with white.

Distribution and habitat.—Unlike the mule deer in habits, the white-tails are secretive and depend largely upon cover for protection. While originally well distributed over North Dakota, they have always been locally restricted to the timber and brush areas along the stream valleys, about the lakes, or in the rough and hilly parts where the gulches are well filled with timber and a tangle of undergrowth.

Little mention was made of the deer of this region by the early explorers, as most of their attention was taken up by the other more abundant and conspicuous forms of game. Alexander Henry rarely mentions them in the Red River country, and their principal use seems to have been to provide skins for clothing. Along the Missouri River bottoms, however, they were so numerous in the timber and lake regions that their numbers were often commented upon by Lewis and Clark (1893, pp. 174, 233, 237) on their expedition up the river in 1804–5. On October 20, 1804, on the great flats just below the present site of Bismarck, great numbers of deer were reported. At Fort Mandan and old Fort Clark, these deer furnished an important part of the winter's food supply of the expedition as it wintered among the Indians. On one trip a hunting party brought in 40 deer, 16 elk, and 3 buffalo. On another trip a few miles down the river, February 21, 1805, Lewis returned with 3,000 pounds of meat, having killed 36 deer, 14 elk, and a wolf. Many deer were mentioned at other localities along the river on the way to Fort Union (Buford).

In 1833 while wintering among the Mandan Indians, Maximilian (Wied, 1839–1841, Bd. 2, p. 84, 1841) reported the white-tail as found in the nearest woods not a mile from the fort, while all other game was kept at a much greater distance by the Indians, who were constantly hunting for meat.

The disappearance of these deer from the greater part of North Dakota was coincident with the settlement of the country. While they were quickly destroyed, however, or driven from the small areas of cover, the more extensive areas are still preserving them in some degree of abundance locally. At Fort Sisseton, just below the southeastern corner of the State, Doctor McChesney (1878, p. 203), reported them as very common 10 years before, but said that none had been seen in that vicinity for several years. At Valley City Morris J. Kernall was told by several of the early settlers that white-tailed deer as well as mule deer were common there from 1878 up to 1885 or 1886, and one was reported by Frank White as killed in 1893. At Ellendale, in the possession of Fred S. Graham, Sheldon found a mounted head of a deer killed in the hills 12 miles northwest of Forbes in 1886.

In 1887, on the writer's first trip to the North Dakota region, he found no trace of white-tails in the Red River Valley, which was then well occupied by settlers, but they were still abundant along the Missouri River bottoms and were reported in the Pembina Hills and

Turtle Mountains. At Devils Lake, Frank Palmer reported that white-tailed deer were more numerous about there than the mule deer from 1868 to the early eighties. At Stump Lake they were said to have been common in the early days, and in 1912 Mr. Hovey said that four or five had wintered in a little grove on his place near Tolna, a few years before. In Benson County, Remington Kellogg learned of two that were killed at Bald Creek in 1912, but none had been known in that region for so long that these were supposed to have been driven from Minnesota by forest fires. In 1912, the writer was told that there were still a few deer in the Turtle Mountains, probably an overflow, however, from the well-stocked game preserve just across the line in Manitoba. The same year Eastgate reported two that had been killed on the North Dakota side not far from the borders of this preserve. He said that the ground under the ash trees in this preserve, from which the deer had been eating the seeds, looked like a goat pasture.

At Fargo, in the grounds of the agricultural college, in June, 1912, there was kept an interesting group of eight beautiful does, all raised from one pair of deer brought from the northwestern part of the State. They were captured when fawns on the Missouri River flats, about 20 miles south of Williston. The buck from this herd had died the previous year and was preserved in the college museum, but another was obtained later and the breeding of this little herd has continued. The mounted buck was in the long winter gray coat, but the does were in the full yellowish-red summer coats. When the herd was seen again, on August 27, 1914, there were three pairs of twin fawns in beautiful spotted coats. All were in the summer red coats and the horns of the fine young buck then with the herd were in the velvet. Altogether it would be hard to find a more beautiful group of animals.

In 1913, careful inquiry was made for deer in the region about Crosby, in the northwestern corner of the State, but only two were heard of, seen during a heavy snowstorm at a farmhouse north of town 3 years before. At a livery stable, however, there was the mounted head of a buck which had been killed 6 or 8 miles north of there 10 years previously. At Williston, there were still a goodly number of white-tails in the densely timbered and brushy bottoms of the Missouri River, where, owing to several years of protection from hunting, they were apparently on the increase. Formerly hunters had been coming in in great numbers during the open season and by hiring men with dogs and horses to drive the deer out of the bottoms had killed them off to the verge of extinction; with such systematic hunting the last deer could easily have been destroyed in this their best and almost their last stronghold in the State.

In the same year, Stanley G. Jewett found a few deer in the thickets along the river bottoms near Fort Clark, where fresh tracks were often seen. He found none in the immediate vicinity of Mandan, but some were still seen in the bottoms a few miles above. At Medora, they were reported as rare, but along the Little Missouri River below that point they were fairly common in the brushy draws and in the side gulches. South of Medora, along the northern edge of the North Dakota National Forest they were fairly common in the thickets and draws of the Badlands

breaks. In the horse pasture of Forest Ranger Follice, there were a half dozen that kept in the dense thickets along the banks of the river and in the gulches. When the hunting season opens, Mr. Follice said, they quickly leave his pasture and scatter out over the country, but usually after it ends all return to their former haunts. If a little more of this brushy area had been included in the national forest, an ideal game preserve for the white-tail, as well as for the mule deer and antelope, could have been established.

In 1915, Sheldon found white-tailed deer comparatively common on the brushy flats near the mouth of the Cannonball River and also on the flats of the Missouri bottoms. Tracks were abundant and a number of deer were seen from August 12 to September 9. The following year the writer found them there in considerable numbers, judging by their fresh tracks and trails among the thickets of the river bottoms. The law protecting them was then apparently well observed and they were comparatively tame and unsuspicious.

In 1915, at Towner, Remington Kellogg was told of a large doe that was killed seven years before by Clyde Coss from a bunch of three does and a buck in the forest along the Mouse River. At Grinnell, in the southeastern corner of Williams County, he was told that one buck was still left in the forest along the Missouri River. In a boat trip down the Missouri from Williston to Bismarck, during September, 1915, he found the deer more or less common all along the river bottoms. At Goodall, he reported a few in a patch of woods on a point of the river, where they were slowly increasing since the law protecting them had gone into effect. Above Shell Village a few tracks were seen, and above Elbowoods there were thought to be a dozen deer in the vicinity. At Big Bend, he was told that 125 deer had been seen and counted in the spring when the ice was breaking up. At Stanton a buck and doe and fawn were often seen from the settlement in the evening. From Stanton to Washburn and down the river to Bismarck, deer tracks were seen near almost every patch of timber along the river.

In September, 1919, O. J. Murie told of a deer recently killed near the Red River, 15 or 20 miles north of Fargo, and at Grafton H. V. Williams told of two that had been seen during the month about 5 miles north of town. At Walhalla it was reported that a few white-tails were still in the Pembina Hills near there, but that enough were killed each year by irresponsible residents to prevent any increase, even during the five-year period of protection accorded them by State laws. These hills, like the Turtle Mountains with their extensive area of timbered, brushy, rough, and sparsely settled country, afford a natural paradise for deer and could well support several thousand without detriment to anyone.

Along the Missouri River, at Buford, Sanish, Mandan, and Cannon Ball in 1919, the deer were holding their own or were slightly on the increase and it was thought would rapidly multiply and restock the timbered bottoms if they could be adequately protected.

Protection.—Reasonable protection would keep white-tailed deer fairly abundant along the Missouri and Little Missouri Rivers, as they are less averse to disturbance by people and domestic stock than any other deer. Theodore Roosevelt (1900a, p. 172), in writing of his ranch life along the Little Missouri in the early eighties, says

that when the cattle were first driven onto the northern plains the white-tailed deer were the least plentiful and the least sought after of all large game and that they had held their own as none of the others had begun to do. In certain localities they were more common than any other kind of game and in many places were more so than all other kinds put together. Ranchmen along the Powder River, for instance, had to content themselves with white-tailed venison, unless they made long trips back into the hills, and the same was becoming true along the Little Missouri. Skin and meat hunters found this deer the most difficult to hunt and the least remunerative to the hunter, and therefore only turned their attention to it when nothing else was left to hunt. In Roosevelt's long and interesting account of the habits and methods of hunting these deer he gives a good picture of their former abundance and rapid disappearance after other more easily obtained game had vanished, and he pays a well-merited tribute to the cunning and sagacity of the animals in protecting themselves, even where the country became well settled.

General habits.—When not harassed the white-tails are active both day and night, feeding mainly during the evening and morning hours. When much disturbed, however, their activities are for the most part nocturnal, while during the daylight hours they keep closely hidden in the dense cover of brush and timber. Once convinced of man's friendly intentions, as in some of the national parks, they become frankly confiding and will feed in the open for hours at a time, lying on the sunny slopes in cold weather and in the shade during the warm seasons, often in plain view of passers-by.

Food.—The food of these deer rarely includes much grass, but is mainly leaves, buds, and seeds of a great variety of shrubs and trees. Where acorns are available in fall the deer hunt over the oak-covered ridges in search of these rich-meated nuts, and often paw away the snow to obtain them from the surface of the ground. A great variety of other seeds and nutlets are eaten, including the pods and beans of many leguminous plants. In early spring, the first blades of green grass form an attractive food for the deer, but in the hunting season the writer has never found a trace of grass in a deer's stomach. The little herd in the fenced inclosure on the campus of the North Dakota Agricultural College left the beautiful dense grass of this half-acre inclosure untouched, but not a weed of any kind could be found within it. Outside the dandelions and other weeds were numerous, and a handful of dandelion leaves pulled up and thrown to the deer would create a frantic rush, each deer endeavoring to get as much of the dainty morsel as possible. As they prefer weeds to grass, a limited number of deer in every cattle pasture would improve the grazing by keeping down weeds and other plants that are of no value for ordinary stock.

Domestication.—Naturally quiet in disposition, these deer take readily to domestication. In favorable situations they can be raised with little trouble and much profit, either in the same inclosures with cattle and horses or in pastures by themselves, where the proper food is available. The usual number of fawns at a birth is two, and the increase is even more rapid than with sheep.[5] In the

[5] For information on raising deer and elk, see U. S. Dept. Agr. Farmers' Bul. 330 (Lantz, 1908).

fall when in prime condition their venison is unexcelled, and in many States the game laws have been modified to allow its being placed on the market under proper regulation.

Odocoileus hemionus hemionus (Rafinesque)

Mule Deer [6]

(Pl. 8)

Tsitashipisa of the Hidatsas (Matthews); *Sinte-sapana* of the Dakotas (Gilmore); *Shunie-psih* of the Mandans (Will); *Ta-katit* of the Arikaras (Gilmore).

Cervus hemionus Rafinesque, Amer. Mo. Mag., vol. 1, p. 436, 1817.
Cariacus virgultus Hallock,[7] Forest and Stream, vol. 52, p. 404, 1899.

Type locality.—Mouth of Big Sioux River, S. Dak.

General characters.—In size considerably larger than the white-tail, with forked antlers in adult bucks, very large ears, small white tail with black tip, and conspicuous white rump patch. The long metatarsal gland high up on the outside of each hind leg is one of the strongest group characters, when compared with the small glands low down on the white-tail's legs.

Distribution and habitat.—Although never in such conspicuous numbers as the elk and the antelope, the mule deer apparently occupied all of North Dakota before the country was settled by whites. They were largely animals of the open country, however, and ranged freely over the prairies, keeping as much as possible on the roughest and highest ground. The Badlands were their favorite haunts; here they were most abundant and here long-range rifles accomplished their most deadly destruction. Of the original thousands there is to-day scarcely a remnant left in the State.

The early explorers paid little attention to deer and rarely mentioned them, as buffalo, elk, and antelope were generally more conspicuous and more easily drawn upon for the meat supply. Alexander Henry (1897, p. 274) states in his journal in March, 1806, that three "fallow" deer were seen and one killed by the Indians near Pembina, but says they were the first he had seen in that quarter.

In 1802, LeRaye (1812, p. 180) saw these deer at the mouth of the Big Sioux River and wrote his description, which later furnished the foundation for Rafinesque's publication of the name *hemionus*. He also reported them as one of the principal game animals of the Big Heart River country, in what is now North Dakota. Lewis and Clark rarely mention them on their way up the Missouri in 1804–5, and Maximilian (Wied, 1839–1841, Bd. 2, p. 84, 1841) in 1833 gives only a few records along the river and distinctly says that they were not to be found within 20 or 30 miles of Fort Clark. Audubon in his journal of 1843 records only a few mule deer among the numerous white-tails seen and was unable to pro-

[6] The name "mule deer" was given to this species by LeRaye in 1802, 15 years before Rafinesque clumsily converted it into the Latin combination *hemionus*, and this earlier name should be used instead of "black-tail," which Lewis and Clark in 1805 occasionally applied to it, but later fixed to the "Columbia black-tail."

[7] There are no specimens from the type region of *hemionus* for comparison, but on general principles of geographic variation it is assumed that *virgultus* from northwestern Minnesota is not sufficiently different for separation. Until the group can be more thoroughly studied, it seems best to refer all the mule deer of North Dakota to *hemionus*.

cure a good buck for a specimen and for drawing, so figures in his Quadrupeds of North America only a doe, taken near Fort Union.

Lieutenant Hayden (1875, p. 94) in 1856, collected specimens of mule deer at White Earth River and Fox Ridge, which are still in the United States National Museum, and reported them as more abundant than the white-tails on the Upper Missouri. In 1873, J. A. Allen (1875, p. 41) reported them as "more or less frequent along all the wooded streams" from Fort Rice westward.

From his Little Missouri ranch experiences of the early eighties, Theodore Roosevelt (1900a, pp. 220–221), in his delightful chapter on the "black-tailed" deer, wrote:

> After the disappearance of the buffalo and the thinning out of the elk, the black-tail was, and in most places it still is, the game most sought after by the hunters; I have myself shot as many of them as of all other kinds of plains game put together. But for this very reason it is fast disappearing; and bids fair to be the next animal, after the buffalo and elk, to vanish from the places that formerly knew it.

At Valley City, in 1913, Morris J. Kernall gathered the following notes from early settlers: J. S. Weiser reported mule deer so common in 1878 that one could not travel 5 miles without seeing them. John Hailand reported them common in 1878 and the last one shot in 1885 or 1886; he says:

> There was so much venison in camp during the first years that visitors' ponies were usually loaded down with it before they returned. There was no sale for venison nor for skins, they were so plentiful. Skins were used for mattresses; they would get damp and deteriorate during summer and a new supply was provided each fall for the winter's sleeping.

In 1887, at Fort Sisseton, just below the southeastern corner of the State, the writer was told that the mule deer had been killed off three or four years before. At Pembina, in the extreme northeast, three mule deer had been killed that year a few miles to the east in the corner of Minnesota, and there were said to be still a few in the Pembina Hills, 34 miles west of Pembina, and still farther west in the Turtle Mountains, and along the Mouse River. A few also were reported in the hills back of Fort Buford.

At Devils Lake in 1916, Frank Palmer, who came there in 1868, told the writer that there were a good many mule deer until the country settled up in the early eighties. At Cannon Ball the old residents and Indians reported them as once common, but said they had disappeared a long time ago.

In 1896 Ernest Thompson Seton (1909, vol. 1, p. 118), in company with Howard Eaton, on a 15-mile ride across the Badlands of the Little Missouri saw only three "black-tail" where ten years before his companion had counted 160 over the same ground. In 1897 or 1898 Elmer T. Judd killed a mule deer in the hills south of Cando, and he still has the mounted head. In 1913 Mr. Allen reported that none had been killed in the vicinity of Mandan for 15 years, but that some heads had been sent him for mounting from Medina 8 or 10 years before.

In 1912, Eastgate reported mule deer as rare in the Turtle Mountains, but he obtained the skull of a young buck for the Biological Survey collection. He said that just across the line in Manitoba they were more common and a number were killed each year. In 1913, Stanley G. Jewett reported them as still fairly common in the Bad-

lands along the Little Missouri, below Medora, especially along Blacktail, Beaver, and Magpie Creeks. He saw mounted heads at the ranches and talked with men who had killed the deer during the preceding winter when they were driven down from the hills by deep snow. In the Killdeer Mountains, however, he found that all had been killed off near the settlements, one man at Oakdale having killed seven in 1911 but none since that time. At Sentinel Butte he saw the mounted heads of several killed near there in 1901, 1910, and 1911, and was told by Lewis F. Crawford that they were then found only in the rougher parts of the Badlands and were becoming very scarce where they were formerly abundant. Later in the same season the writer learned that there were a few mule deer on the Dakota National Forest, south of Medora, and H. H. Sheldon in 1915 reported a few still found there. The same year Remington Kellogg learned of two near the mouth of the Little Missouri, and in 1919 a few were reported west of Sanish. L. F. LePage exhibited a mounted head of about a 4-year-old buck, taken by an Indian in the Pembina Hills about 7 miles west of Walhalla in 1916. It was the largest of a bunch of four mule deer but had not reached its full growth.

At the present time there may be a few mule deer in the most remote corners of the Badlands and an occasional wanderer from the Canadian side of the Turtle Mountains and Pembina Hills but, if not already extinct, this finest of all native species of the smaller deer will soon have vanished from the State. Its disappearance, while greatly to be regretted, is as inevitable as that of the elk and the buffalo. A few in public parks or on private game farms are all we can hope to save in open country, but in the steep and rugged mountain areas farther west, where the game and recreational value of extensive tracts is greater than its agricultural value, a strong effort is being made to preserve mule deer as a permanent part of the wild life of the country.

Order RODENTIA: Gnawing Animals

Family SCIURIDAE: Squirrels, Chipmunks, Prairie Dogs, Ground Squirrels, and Marmots

Glaucomys sabrinus canescens Howell

Pale Flying Squirrel

Glaucomys sabrinus canescens Howell, Proc. Biol. Soc. Washington, vol. 28, p. 111, 1915.

Type locality.—Portage la Prairie, Manitoba.

General characters.—About twice the size of the little southern species.[8] Wide membranes connecting the front and hind legs along each side when spread form a monoplane which enables the animal to soar or glide from tree to tree. Tail, wide and flat; fur, very soft and silky, of a delicate cinnamon-brown color over upper parts, creamy white below. Average measurements of adults: Total length, 297 millimeters; tail, 138; hind foot, 37 or 38.

Distribution and habitat.—The pale flying squirrel, a big northern member of the family, comes into eastern North Dakota along

[8] *Glaucomys volans volans* (Linnaeus). There is still a possibility of finding this little flying squirrel in extreme southeastern North Dakota, as it ranges northward into central Minnesota and could readily extend into the Red River Valley at Wahpeton.

the timber of the Red River Valley and up some of the streams to the west. Specimens have been examined from Pembina, Grafton, Portland, Grand Forks, and Fargo. These squirrels are common throughout the forest areas of the Pembina Hills and probably occur in the Turtle Mountains, although no definite records have been obtained. At Portland, in 1895, J. A. Loring caught one in a meat-baited trap set under a log in an oak grove. At Grafton, in 1915, Remington Kellogg reported several taken during the preceding winter when the timber was being cleared from some bottomland, but he was unable to obtain any specimens. He found one in the collection of H. V. Williams, which was examined later by Howell (1918) for identification while preparing his revision of the flying squirrels. At Manvel, in the eastern part of Grand Forks County, he reported a family of flying squirrels including a nest and six young, found by a farmer, William Brown, the preceding year; the nest was made of bark fibers and placed in the fork of an elm tree, but when Kellogg examined it it was empty. W. B. Bell told the writer of a family of flying squirrels found by a boy in the woods at Fargo, in 1912.

General habits.—Owing to their strictly nocturnal habits flying squirrels are rarely seen although they are much more common than is supposed. In a wide range over the northern timbered country woodchoppers and lumbermen frequently see them leaving the hollow of some falling tree and soaring on widespread membranes to a neighboring trunk, or sometimes, in their confusion, to the ground, from which they quickly seek the nearest tree. Usually their nests are within the hollow cavities of tree trunks, sometimes in hollow limbs, knotholes, or the old nest cavities of woodpeckers. Occasionally nests of moss and bark fibers are built among the branches, much like those of the red squirrel. Where the little animals are common it is not difficult to frighten them out of their nests by pounding on the hollow trees with an ax. A few smart raps on the base of their trees will usually induce them to peer out of their nests, and continuous pounding will often alarm them into making long flights to neighboring trees. Often one will run to the top of its tree to get a good start and, sailing downward until momentum is gained, go coasting off 50 or 75 feet and, curving gracefully upward to check its speed, strike lightly on the trunk of another tree much lower down than where it started. By running up each tree and soaring downward to the next, the squirrels pass rapidly through the woods until some safe retreat is found.

They are soft, silent, owl-like animals and in the daytime seem sleepy and sluggish. At night their presence is mainly shown by their getting into traps set for fur animals and by their tracks on the snow between trees whose span is too great to be bridged by their soaring flight. Little is known, however, of their real habits except that they make interesting and often mischievous pets, are easily tamed, and become playful and affectionate, but insist on sleeping through the day and carrying on most of their activities at night. They are frequently preyed upon by cats and owls, which occasionally leave their tails uneaten to mark the place of a nocturnal meal.

Food.—A great part of the food of flying squirrels consists of nuts and seeds of trees, shrubs, and vines. At Moorhead, in 1908, Murie

watched several of them by moonlight feeding on the seeds of ash trees. He says: "They sailed about from tree to tree, stopping occasionally to eat some seeds. Several times I saw one turn a little in its flight and they turned up a little just before landing on a tree trunk." The woods where they occur are usually well supplied with acorns, basswood, boxelder, ash, elm, hackberry, ironwood, birch, and alder seeds and a great variety of berries, grapes, and other seeds, fruits, and buds that remain all winter and are easily obtained, so that generally these animals do not lay up stores of food. They are more omnivorous than most squirrels and will readily take bread, oatmeal, fruit, or meat used for trap bait, and closely related varieties are often caught in marten or weasel traps baited with meat, fur, or feathers.

Economic status.—Though rarely of sufficient abundance to be of economic importance, flying squirrels are, so far as known, practically harmless. Crops and cultivated fruits are rarely if ever disturbed by them and the tree seeds they consume are doubtless well paid for in the scattering and wider planting of those not eaten. As pets for children few animals are more gentle and attractive.

Sciurus carolinensis hypophaeus Merriam

Minnesota Gray Squirrel; Black Squirrel

Sciurus carolinensis hypophaeus Merriam, Science, vol. 7, p. 351, 1886.

Type locality.—Elk River, Minn.

General characters.—Larger and darker colored than the Carolina gray squirrel, with little or no white on the underparts. Color, generally dark gray, often becoming dusky or black. Tail, large and bushy. Average measurements of adult specimens: Total length, 496 millimeters; tail, 220; hind foot, 67. Weight of adult female, 14 ounces (Murie).

Distribution and habitat.—The large Minnesota gray tree squirrels barely come into the southeastern part of North Dakota along some of the timbered stream valleys, although they are abundant throughout the oak region of Minnesota. At Wahpeton, in 1915, an old resident said that he had killed one there 18 years before, but had never seen one since. Later, some squirrels had been brought from Minnesota and placed in a grove on the Dakota side of the river, but they were not protected and all were killed. At Fargo and Moorhead, O. J. Murie remembers them as long ago as 1906, and thinks they have always been there. Since 1910, they have been increasing and in 1919 were common on both sides of the river, and especially in the extensive and beautiful parks just south and north of Fargo, where an abundance of old hollow trees, oak, basswood, elm, and ash, furnish safe homes and choice food. At Valley City, in 1912, Eastgate reported them as introduced in the city parks and slowly increasing. In Minnesota their northern limit seems to be in the vicinity of Crookston, and it would be strange if they did not occasionally extend into the Red River Valley in the neighborhood of Grand Forks. Records, however, are wanting north of Fargo.

General habits.—Besides being good game animals, these large, handsome squirrels are one of the popular attractions of city parks and protected grounds, where they readily become familiar and, with a little care, very tame. Constant hunting keeps them extremely

shy and secretive in their wild state; but, for rodents, they show a high order of intelligence and quickly learn the protected areas, eagerly responding to friendly advances in the way of food, water, and nest boxes. In their native habitat their food consists very largely of acorns from the numerous species of oaks with which they are associated, but it also includes nuts and seeds of many other plants. For a successful introduction into parks or private grounds they must be supplied with acorns, nuts, or grain.

Their winter homes are usually in the hollow trunks of trees, where in well-protected and warm nests of bark and plant fibers they pass the coldest winter weather in comfort. In summer they build large nests of leaves in the branches of the trees, covering them over to form comfortable, rain-proof houses, with nest cavities in the center, which they enter through half-concealed side doors. In some cases the houses are made large and warm for occupation throughout the winter, but usually a hollow trunk or warm box is preferred for a winter residence.

The interest and delight of children in watching the squirrels, which in parks and private grounds become so tame that they will come to the hand and beg for nuts, gives them a value far greater than that of game and fully repays the effort to provide them with comfortable quarters and to plant such trees as will insure their permanent food supply.

Sciurus hudsonicus hudsonicus Erxleben

Red Squirrel; Chickaree

Ahjiduhmo of the Ojibways (Wilson)

[*Sciurus vulgaris*] *hudsonicus* Erxleben, Syst. Regni Anim., p. 416, 1777.

Type locality.—Hudson Strait.

General characters.—About half the size of the gray squirrel, with full bushy tail and a general reddish or rusty color over the upper parts; a black line along each side in summer borders the white underparts, which in fall is lost in the reddish-gray winter coat. Average measurements: Total length, 340 millimeters; tail, 140; hind foot, 50. Weight, 8½ to 9 ounces (Murie).

Distribution and habitat.—The sprightly little red tree squirrels are generally abundant in the timbered areas along the Red River Valley from Wahpeton to Pembina and along all of the streams which carry lines of timber into the prairie country west of the valley; also in the Pembina Hills and Turtle Mountains as far west as the Mouse River and upper timbered strips of the Sheyenne River near Stump Lake. In 1887 they were common near Fargo, Grand Forks, and Pembina, and in the Turtle Mountains. In 1912, there were said to be a small number in the timber around Lake Elsie, near Hankinson, in the extreme southeastern corner of the State, though they had been mostly killed off there. At Portland, in 1892, J. Alden Loring took a specimen, and reported them as common in the groves along the Goose River. In 1893, A. K. Fisher saw one in the timber along the Sheyenne River near Lisbon. In 1912 Eastgate reported a few along the Sheyenne River 3 miles south of Tolna. At Valley City he reported them as very common all along the river in the timber and occasionally in the larger groves around farm buildings on the prairie close to the river valley,

and at Lisbon, farther down the river, he said they were common in patches of woods sufficiently large to afford them suitable homes; often two or more pairs were found in a single grove, and from his tent in one of these groves he was able to see three occupied nests at one time. At Fargo they were still common in the timber along the Red and Sheyenne Rivers. Kellogg, in 1915, found them in good numbers at Grand Forks, Grafton, and Pembina; near Towner, in the timber along Mouse River, he reported them fairly common and saw many of their nests in the branches of the trees.

General habits.—In June, 1912, while camping near the fish hatchery in the eastern part of the Turtle Mountains, the writer found red squirrels common throughout the timber, as they apparently are throughout the Turtle Mountains and Pembina Hills. At that season, when the females taken for specimens were still nursing young, they were quiet and keeping out of sight as much as possible. Only once was a subdued barking heard. They live mainly in hollow trees, but a few nests of grass and bark fibers were found in the branches of the trees, and in places the squirrels apparently were occupying burrows and hollow spaces in old stumps and logs. As soon as the young are safely out of the nest and able to care for themselves the squirrels become noisy and for the rest of the year their sprightly chatter and scolding is heard throughout the forest.

Their food consists of acorns, nuts, seeds, mushrooms, and occasionally birds' eggs. Their omnivorous tastes are strikingly different from those of the gray squirrel, and for this reason they have incurred the enmity of those who appreciate the value and beauty of birds as well as of squirrels, and also those who have unprotected corncribs or grain bins to which squirrels may gain access. It is often necessary to reduce the numbers of these cheerful little marauders for the protection of birds and crops, but where they are not doing serious damage they are among the brightest and most attractive forms of wild life either in the forest or in parks and private grounds. In winter, although they spend much of the time within their warm nest hollows, they are active even during the coldest weather, visiting their food caches, to which they gain access by endless tunnels in the deep snow. One of the cheeriest sounds of the forest on a bright winter's day is the long *chr-r-r-r-r-r* from the feeding branch of one of these squirrels as he cracks a hazelnut or eats an acorn above the glistening field of snow.

Eutamias minimus borealis (Allen)

Little Northern Chipmunk

(Pl. 10)

Tamias asiaticus borealis Allen, Monogr., North Amer. Rodentia, p. 793, 1877.

Type locality.—Fort Liard, Mackenzie, Canada.

General characters.—Readily distinguished from the larger gray chipmunks, with which often associated, by the series of fine longitudinal light and dark stripes extending over the back from head to tail, by their slender build, long slender tails and pointed ears, and by the generic character of five molars in each upper tooth row. A specimen from the Turtle Mountains measures in total length, 223 millimeters; tail, 106; hind foot, 33. Weight of adult female, 52.6 grams.

Distribution and habitat.—The little northern chipmunks are abundant throughout the forested and brushy areas of the Turtle

Mountains and Pembina Hills, and they have been reported in the forest along the Mouse River near Towner (fig. 1). H. V. Williams, in 1912, reported them abundant in the Pembina Hills throughout the timbered parts, where they lived in underbrush and around brush piles, old stumps, and fallen trees. They were very tame, but when alarmed always sought protection in their ground burrows rather than in the trees.

General habits.—In all parts of the Turtle Mountains the writer found them more or less common and often very tame and unsuspicious, although nervous and quick to take alarm. Their fine, rapid chipper or the slow *chuck—chuck—chuck* notes are usually the first indication of their presence. It is often difficult to locate them by their voices, which are more or less ventriloquial, but by

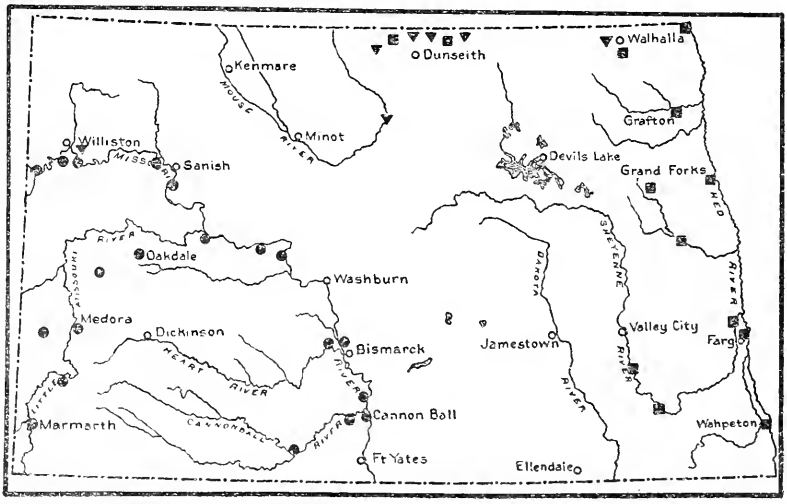
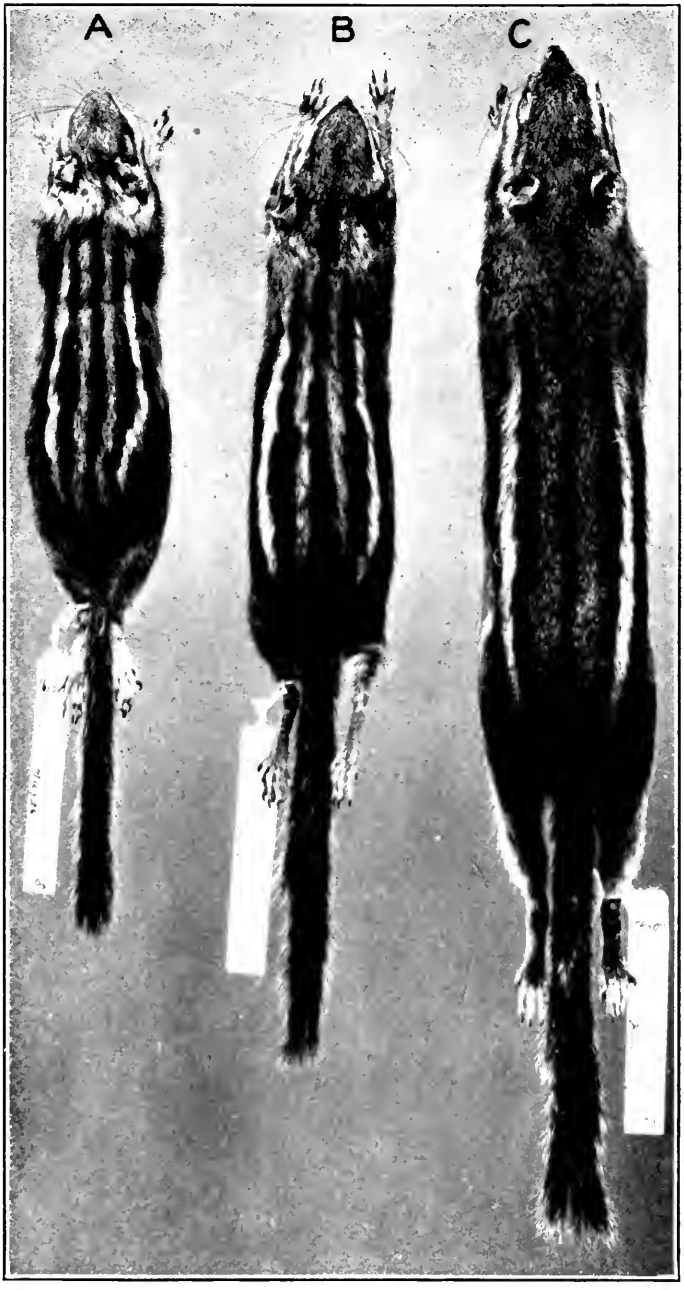


FIG. 1.—Records of three species of chipmunks in North Dakota: Squares, Gray chipmunk; triangles, little northern chipmunk; circles, pale chipmunk

moving cautiously one can usually find a chipmunk perched on the branch of a bush, on a brush heap, or on a stump or log close to its underground home. In a dense thicket careful search is often necessary to locate the voice, but if it does not vanish with a sharp chipper, one may find the little striped gray-coat perched half way up a willow or aspen bush, chirping and waving its tail. To the casual observer its actions may indicate mere curiosity, but its curiosity is far from idle. It involves parental care, mutual protection, watching for enemies, and warning of danger. Although restless sprites, disappearing like a flash and quickly reappearing, at times they will sit quietly for some minutes, calling in a monotonous *churp—churp—churp*, much like the cry of a robin in distress. If an enemy approaches the note often changes to a more rapid *quit-quit-quit*, finer and faster, but suggesting the note of the ruffed grouse when about to take wing. When suddenly frightened they run with a rapid twitter, which at times becomes frantic in their haste to get to cover.



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SKINS OF CHIPMUNKS

(A) Pale chipmunk (*Eutamias minimus pallidus*); (B) little northern chipmunk (*Eutamias minimus borealis*); (C) gray chipmunk (*Tamias striatus griseus*). Slightly more than half natural size

In the Turtle Mountains in August, 1887, northern chipmunks were found feeding extensively on the seeds of chokecherries, the shelled kernels of which were stuffed in their cheek pouches, evidently to be stored for winter food. Acorns and various seeds also were found in their pockets. Their feeding grounds show traces of many seeds and berries that have been eaten. They are said to do some mischief in gardens and along the edges of grainfields, but nowhere were they found a serious pest.

In the Pembina Hills in 1919 up to October, they were busily storing seeds and grain. They were often seen with cheek pouches distended, running for their storehouses in underground cavities, where evidently enough food was being laid up to carry them through the winter, for they showed no signs of becoming fat or preparing for hibernation.

Eutamias minimus pallidus (Allen)

Pale Chipmunk

(Pl. 10)

Sachho of the Arikaras (Gilmore); *Hetkadan* of the Dakotas (Gilmore); *Hinudek* of the Mandans (Gilmore); *Kokokshi* of the Hidatsas (Gilmore).

Tamias quadrivitatus var. *pallidus* Allen, Proc. Boston Soc. Nat. Hist., vol. 16, p. 289, 1874.

Type locality.—Camp Thorne, near Glendive, Mont.

General characters.—Differs from *borealis* mainly in lighter coloration, which goes with the more open and arid habitat; the brown tones are more yellowish, the gray lighter, and the white markings more extensive. Adult specimens average in total length, 206 millimeters; tail, 91; hind foot, 31. A male of the year taken October 15 at Sanish measured 200, 90, and 30 millimeters, respectively, and weighed 38 grams.

Distribution and habitat.—The sagebrush Badlands country along the Missouri River and westward is the home of the little pale chipmunk. (Fig. 1.) Specimens have been taken at Wade and Parkin on the Cannonball River, Palace Buttes, 6 miles north of Cannon Ball, near Sanish, Williston, Buford, Oakdale, Quinion, Medora, Sentinel Buttes, the former Dakota National Forest, and Marmarth. A little below Williston and near Grinnell and Elbowoods a few are found on the north side of the Missouri River, but generally they are restricted to the country south and west of the river. In 1833, Maximilian (Wied, 1839–1841, Bd. 2, p. 49, 1841) wrote of them: "A few miles below the mouth of the Muddy River, these pretty little four-striped squirrels are in great numbers, running along the ground and up the trees with the fruit of rosebushes in their mouths." In 1843, Audubon (1897, p. 27) reported them in the very same place, running over the ground. In 1913, in company with W. B. Bell, the writer crossed the river at this point and was greatly interested to find the chipmunks still there in the brush and timber on both sides of the river. In 1910 H. E. Anthony collected a series at Fort Buford and found them common also on the south side of the river. Near the Sioux Crossing, 6 miles southeast of Buford, he found them abundant along brushy banks and coulées and about ranches where there were woodpiles or old buildings near the banks of ravines on the south side of the river. Some were also found in

the heavy brush, but apparently they are partial to the more open country. In 1915 Remington Kellogg, on his way down the river from Williston to Bismarck, reported them very common near Grinnell, in Williams County, both in the Badlands and in the brush along Beaver Creek, where several were taken. At Goodall, in McKenzie County, they were very common along creeks, rivers, and in the Badlands. Others were seen along the river on the way down to Elbowoods, where they were most abundant on the west side. Near Expansion, in Mercer County, a few were found in the willows, and at Stanton a pair was seen in a buffaloberry bush eating the ripe fruit. They are said to occur at Mandan, and Russell Reid says that he has seen them on the east side of the river at Bismarck. In 1913 Jewett found them in the Badlands and gulches about Medora, near Quinion, and also in the Killdeer Mountains. At Sentinel Butte he collected two specimens among the rocks of the large buttes south of town, and they were found common both along the gulches about the Little Missouri south of Sentinel Butte and on the Dakota National Forest. At Marmarth, in the southwestern corner of the State, they were found common in 1909, over the brushy sides of the Badlands buttes.

General habits.—The little Badlands chipmunks are skilful climbers, but as they generally live in thickets and sagebrush their climbing is mainly through the branches of these dwarf trees and is largely done in search of food or to get high enough above the ground to watch for their enemies. Their real homes are in the ground or in cracks and crevices of cliffs or Badlands banks, to which they dart when alarmed. They are often seen running over the sides of banks and bare walls, from one brush patch to another, or from their dens to the patches of brush and weeds which furnish food and shelter. When alarmed they run with such speed even over the roughest ground that pursuit is useless, and the collector in search of specimens must use much patience and skill to secure them. At other times they are so sure of their safe retreats that they come out boldly to satisfy their curiosity and are easily collected at close range.

Their voice is similar to that of many other species of small chipmunks, but very fine and light. It varies from the slow *chip-chip-chip* as one sits confidently near a safe retreat, to the much more rapid chipper of alarm as it flies for cover. At times this chipper is heard from the top of a bowlder, the point of a clay bank, or from a branch of bullberry or other bush.

These chipmunks eat a great variety of seeds and berries and a little green vegetation. They seem particularly fond of the bullberries, which in fall load the bushes with masses of scarlet fruit. The seeds of these berries are removed and either eaten on the spot or carried away for winter stores. Serviceberries are also a favorite food. The chipmunks eat the outer pulp of the rose haws as well as the hard seeds within and are fond of the flesh and seeds of the little wild currants and purple gooseberries. Their cheek pouches often contain the seeds of various grasses, sedges, and numerous other plants, which are carried away to be eaten at leisure or stored up for winter use. In the Killdeer Mountains Jewett says that acorns and hazelnuts furnish them with a choice supply of food.

Economic status.—In places the Badlands chipmunks become very numerous around the edges of gardens and fields, where they do some mischief to growing crops. Anthony says that at one ranch near Buford they became so troublesome that the owner was forced to shoot them, killing 26 in one afternoon. They are easily trapped or poisoned, however, when it is necessary to thin them out, and by a little care their mischief can be controlled.

Tamias striatus griseus Mearns
Gray Chipmunk

(Pl. 10)

Tamias striatus griseus Mearns, Bul. Amer. Mus. Nat. Hist., vol. 3 (1890–91), p. 231, 1891.

Type locality.—Fort Snelling, Minn.

General characters.—Large and heavily built, with broad stripes on the back; readily distinguished from the two species of small chipmunks by larger size, heavier build, more phlegmatic dispositions, more reddish-brown in the colors of the upper parts, and by the generic character of only four molars in each upper tooth row. Average measurements: Total length, 260 millimeters; tail, 95; hind foot, 37. An adult female weighed 3¾ ounces.

Distribution and habitat.—The grayish race of the large rusty-brown chipmunk is common in the timber all along the Red River Valley from Wahpeton to Pembina, and westward along the timbered valleys as far as Lisbon, Kathryn, Portland, Larimore, Grafton, and throughout the Pembina Hills and Turtle Mountains (fig. 1). Apparently they do not reach the timbered area of the Devils Lake region. They are restricted entirely to timbered and brushy areas, where they live in hollow logs, stumps, trees, and underground burrows.

General habits.—The gray chipmunks climb trees readily, but are more often seen running over the ground, logs, stumps, or fences. Their summer nests are usually placed in hollow logs or trees, but their winter homes and food stores are mainly in burrows underground. These burrows are also used throughout the summer as safe retreats and for storing winter food supplies.

The chipmunks are occupied through the spring and early summer with their family cares, and as soon as the half-grown young are out of the nests in June, the search for food, and a little later the storing of a winter's supply of nuts, seeds, and grain fill the daylight hours. Soon after frosty nights begin late in September, they enter their winter burrows, where they remain buried under the snow until the following March or April. The four to six young are born about the first of May. During the breeding season they are very quiet and shy, keeping as much as possible out of sight, but later a slow *chuck—chuck—chuck* is often heard from the woods and thickets, or a shrill chipper of alarm, as the startled animals rush for the nearest cover or up the trunk of some friendly tree.

Their food includes a great variety of nuts, seeds, grains, berries, and some green vegetation, as well as occasional insects, frogs, and lizards. Acorns and hazelnuts are the favorite winter stores and often are deposited in cavities near the nest chambers, a quart or more in a place. Just when these food stores are used is not well known; they may furnish an occasional meal throughout the winter,

or tide over the drowsy period of entering upon and emerging from hibernation, or carry the chipmunks through the spring, when the ground is still frozen and wet and food scarce, or even through the breeding period. It is improbable that the stores are used up before spring, as hibernation seems to be complete and considerable fat is laid up inside the skins of the animals to carry them through the winter.

Economic status.—In places where they are abundant gray chipmunks sometimes do serious mischief along the edges of fields, digging up the planted corn in spring and harvesting more than their share of the ripe grain later on. Many of the missing hills of corn along the edge of a brush-bordered field are due to the fact that these little squirrels have carried away the seed just when it was sprouting or earlier. Where their mischief becomes serious, it is easily checked by scattering poisoned grain along the fences and under the logs where they run.

Citellus tridecemlineatus tridecemlineatus (Mitchill)

Striped Ground Squirrel; Thirteen-lined Ground Squirrel; Leopard Squirrel

Tashnáheca of the Dakotas; *Tshíshkarani* of the Arikaras; *Naksátshi* of the Hidatsas; *Mashedónikcha* of the Mandans (all, Gilmore).

Sciurus tridecem-lineatus Mitchill, Med. Repos., vol. 21 (n. s., vol 6), p. 248, 1821.

Type locality.—Central Minnesota.

General characters.—Short ears, slender body and tail, seven dark-brown and six narrow buff lines on the back, and buffy underparts. The brown stripes are dotted and these distinguish it from chipmunks and all the other striped squirrels. A rather large specimen from Fargo measures in total length, 300 millimeters; tail, 115; hind foot, 39.

Distribution and habitat.—The striped, or thirteen-lined ground squirrel, with its paler western form, covers the whole of North Dakota, and most of the specimens east of the Missouri River are referable to the typical dark form (fig. 2). Belonging to a widely distributed group, covering most of the prairie and Great Plains region of the United States and southern Canada, they are fortunately never so numerous as some of the other species of ground squirrel. They inhabit both the prairie and brushy areas, but usually are not found in heavy timber or on low, wet ground. Open grassy ridges and dry prairies are their favorite habitat, and here their numerous burrows and striped coats afford the best of protection.

General habits.—They are true ground squirrels, spending all but their working hours below the surface in their well-made dens and burrows.[9] They are strictly diurnal and are partial to warm weather. Early on bright summer mornings they may be seen running over the prairie in search of food or mates or in playful exercise, but in cold or chilly weather they keep mainly within their burrows, where a supply of food is generally stored. In the tall grass, weeds, or brushy patches they keep out of sight for the most

[9] For diagrams and descriptions of burrows and general habits see Johnson, G. E. (1917, p. 261).

part and would rarely be noticed but for their call notes, long bubbling trills, given as signals of alarm or to convey other information among themselves.

Breeding habits.—Breeding activities begin soon after the adults emerge from hibernation in March or early in April, but the actual dates of birth of young are not easily obtained. Females collected in May usually contain embryos showing various degrees of development, but the young do not appear above ground until June or July. They are then nearly half grown and able to run about and take care of themselves under the watchful care of their mothers. When first born the young are very small, naked, and helpless. Doctor Hoy (Kennicott, 1857, pp. 76–77), who observed them in confinement, says that they have no hair on the body before they are 20

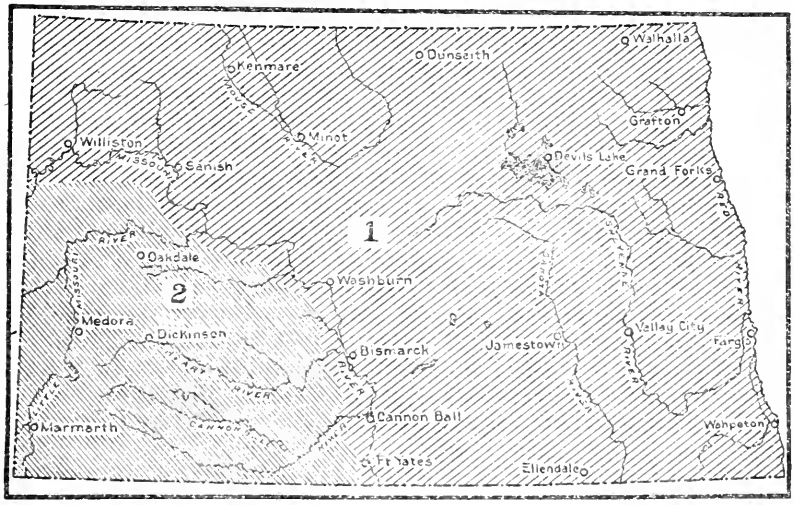


FIG. 2.—Distribution of the thirteen-lined ground squirrel (1), and its pale western form (2), in North Dakota

days old, and that the eyes do not open till the thirtieth day. The number of young in a litter varies widely, but seems to be usually from 7 to 10. A female taken by Sheldon at Fairmount, on May 9, contained 11 embryos, and there are other records of still larger numbers up to 13 (Lee) and 14 (Seton). The full number of mammae in adult females is 12. Apparently but one litter of young is raised in a season, and even for that the time is short for them to mature and lay up sufficient fat and food to carry them through the six months of hibernation.

Food habits.—Although a great part of their food consists of seeds, grain, and nuts, they are omnivorous in habits and take besides berries and some green vegetation, numerous insects, and the flesh of mice, birds, or any small animals which they can capture or find dead. Acorns and hazelnuts are eagerly gathered and stored for winter food, but over most of their range only the smaller seeds and nutlets are obtained, unless grainfields are within reach. Seeds and grain are stored for future use, but much soft food that will

not keep is eaten as it is taken. The examination of the contents of large numbers of stomachs shows a considerable portion of grasshoppers, crickets, caterpillars, beetles, ants, cocoons, insect eggs, and even traces of flesh, hair or small mammals, and feathers of birds; also green foliage, the white pulp of bulbs and tubers and the fruit of solanum, cactus, and strawberries. The contents of the ground squirrel's capacious cheek pouches give a good index to the selection of seeds and grains. The pouches are often distended with wheat, oats, barley, rye, or any of the cultivated grains that are obtainable, but also are found to contain acorns, hazelnuts, seed of sunflower, cactus, bindweed, goosefoot, puccoon, wild peas and beans, and a great variety of grass seeds.

During late summer and fall, all work industriously, laying up their winter stores, quickly filling their cheek pouches and running to the burrows to empty them into the storage cavities near the winter nests. The seeds of native plants are gathered over a considerable area. Sometimes a quart or more is found in a storage chamber, and at the edge of a field where an abundance of grain can be rapidly gathered the winter's stores assume much larger proportions.

Economic status.—In spring the planted seed is dug up and eaten or stored from the time it is sown until long after it has sprouted. Then the green stalks are eaten during the early summer, and as soon as the grain is headed out great numbers of the heads are cut off for the young kernels, from the very beginning of their formation. Thus, before harvest time the edges of the grainfields have become ragged and thin for a considerable distance into the field. Although depredations of these ground squirrels do not compare with those of the more abundant flickertails, their wide distribution over North Dakota and many other States renders them one of the most serious of rodent pests.

But for their natural enemies, which are legion, it would be impossible to raise crops within their territory. They are constantly preyed upon by many species of hawks, and some owls, and by foxes, weasels, skunks, and badgers, so that in spite of their rapid increase their numbers are usually kept somewhat within bounds. However, it is necessary over much of their range to supplement the work of their natural enemies by the systematic use of poison.

Citellus tridecemlineatus pallidus (Allen)

Pale Striped Ground Squirrel; Pale Thirteen-lined Ground Squirrel

Miniwakao of the Cheyennes

[*Spermophilus tridecemlineatus*] var. *pallidus* Allen, Monogr. North Amer. Rodentia, p. 873, 1877.

Type locality.—Plains of Yellowstone River, Mont.

General characters.—A pale western form of the thirteen-lined ground squirrel, slightly smaller, and with paler tones of buff and lighter brown stripes. Average specimens from the type region measure in total length, approximately 255 millimeters; tail, 82; hind foot, 34.

Distribution and habitat.—The striped ground squirrels become gradually paler across the middle part of the State, but not until the semiarid Badlands country is reached west of the Missouri

do the pale forms become clearly recognizable. In the part of the State west and south of the Missouri, they are the only ground squirrels, and here with the prairie dogs they occupy the short-grass plains country in considerable numbers. While sometimes seen in the open, where there is not sufficient grass to conceal them, they are more often found in the better cover of grass and weeds and low bushes. In this region they were originally one of the interesting and harmless forms of native life, but since grain farms have spread over it they have become one of the serious problems with which the farmer has to contend.

General habits.—In habits these squirrels do not differ from their darker relatives to the eastward, except as a change of environment gives them other kinds of food and local conditions which they seem always ready to meet. In many places some protection is sought for their burrows, such as grassy spots or weedy ground. Sometimes a piece of paper or cloth is drawn over the entrance to the burrow, apparently for concealment or protection.

At Parkin, on June 28, 1916, a burrow was found where fresh earth had been lately thrown out and the entrance was securely packed with sand from the inside. As the entrance to this burrow was opened a half-grown young of the species poked its head out of another entrance near by. In the tunnel, about 8 inches below the surface of the ground, was found a large, soft nest in a roomy chamber, with two doors opening out on opposite sides. The nest was made of dry grass, bark fibers, and bits of paper from the railroad track. It was soft and well matted together like a bird's nest, but not covered over. The young had escaped in the branching burrows. Evidently this was their home nest, from which they had not yet begun to make excursions to the world above. The closing of their doors from within was evidently in this case to protect the young from outside enemies.

Economic status.—In many places it has been found necessary to poison these squirrels for the protection of grainfields and garden crops; the methods given for the Richardson ground squirrel, or flickertail, will be found to apply equally well to this species.

Citellus franklinii (Sabine)

Gray Ground Squirrel; Franklin Ground Squirrel

Arctomys franklinii Sabine, Trans. Linn. Soc. London, vol. 13, p. 587, 1822.

Type locality.—Carlton House, Saskatchewan, Canada.

General characters.—Largest of the ground squirrels of this region; sometimes mistaken for the gray tree squirrel, which it approaches in size and slightly resembles, but from which it differs in slender form, very short ears, and much smaller and less bushy tail. Color, dark gray with a brownish wash and a mottled effect in fine, wavy cross lines or scallops over the back. Adults measure in total length 388 millimeters; tail, 136; hind foot, 55.

Distribution and habitat.—Extending over a wide range in the central United States and Canada, from Oklahoma and Illinois to the Athabaska River, the large gray ground squirrels cover approximately the eastern half of North Dakota (fig. 3). Their greatest abundance within the State lies within the Red River Valley and westward to the Dakota River Valley, Devils Lake, and the Mouse River. There is an indefinite record for Burleigh County, near Bismarck,

and another for Turtle Lake in McLean County, but the most westward authentic record is from Kenmare, in the valley of the Riviere des Lacs, where W. B. Bell collected a specimen in 1913. They are particularly animals of open timber and brush land and do not occupy wide stretches of prairie unless there is ample cover for concealment.

General habits.—Although occasionally seen up among the branches of low trees, the Franklin squirrels are strictly ground squirrels, living in burrows generally concealed in brush or weed patches, from which well-worn trails or runways radiate to other burrows or feeding grounds. They are shy and secretive, keeping much under cover of protecting vegetation, as they are too large and dark colored to be inconspicuous in the open. When frightened they rush for their burrows, usually uttering a trill of alarm and warning to other members of the family. Their voice is much like

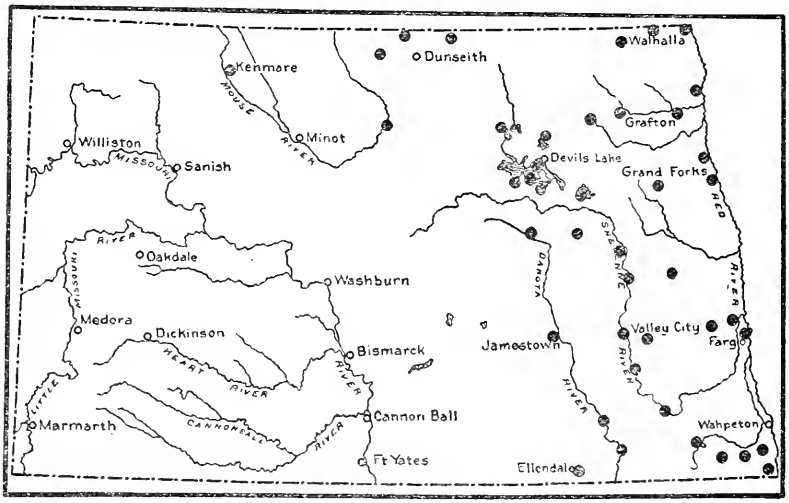


FIG. 3.—Records of the Franklin ground squirrel in North Dakota

that of the thirteen-lined ground squirrel but is as much heavier as they are larger. It is often heard in a long bubbling trill from a weed patch and is almost birdlike in musical quality.

In the timber and brush patches along the Red River Valley, about Stump Lake, Devils Lake, the Sweetwater Lakes, and in the Turtle Mountains, the squirrels are especially numerous and in such situations they are generally the most abundant of the three species of ground squirrel occupying the general region. Throughout the Turtle Mountains they were found along the edges of meadows, fields, and clearings along roadsides, and in all the open places where woods and small brush served for cover. They gathered around camps or dwellings where there were no dogs or guns and even came into the writer's cabin and helped themselves from the grub box. They persisted in getting into traps set for others long after enough of them had been secured for specimens and most of the trails and runways attributed to other animals proved to belong to them.

Their burrows were generally in groups of three or four, or more, not far apart and evidently connected below ground. They were in all sorts of situations, but a sloping bank, brush heap, old log, or stone pile usually provided the protection sought for their dens. A considerable quantity of earth is usually thrown out in front of one of the burrows but others open out with less conspicuous markings. Many old dens and burrows are located through the brush and woods and one seems always to be convenient when danger approaches. Often the animals will stop at the entrances of their burrows and straighten up in the picket-pin attitude, to make sure whether an enemy is pursuing. If approached too closely, they quickly dive into their burrows with a flirt of the tail and a parting chatter, but if all is quiet they soon reappear cautiously to reconnoiter.

Franklin squirrels are easily tamed and make interesting, though rather mischievous, pets. H. V. Williams, at Grafton, had a tame one for which he made a den by burying a box underground. The squirrel carried about a half bushel of grain into this box, and in fall hibernated as usual. When examined in January it was unconscious, but before its awakening time in spring water ran into the box and it was drowned. While collecting specimens at Fish Lake in the Turtle Mountains, Williams fed one around his tent until it became so tame as to take food from his hand and come to the tent regularly at meal times. It finally became so bold that it would enter the tent and search through the baggage for food. After breaking and carrying off a lot of birds' eggs that had been collected for specimens it had to be killed to prevent further trouble.

Hibernation.—With the first freezing weather in fall, usually in September, Franklin squirrels go to their nests deep underground and usually do not reappear until the following April. Before entering upon their hibernation they become very fat and depend upon this concentrated form of nutriment to carry them through the winter rather than upon the ample stores of food laid up in convenient chambers near their nests. Just when these stores are eaten is not well known, but probably before the squirrels have become entirely inactive in fall and again before the outside food supply is available in spring.

Breeding habits.—Their half dozen young are usually born in May or June and by the last of July are half-grown squirrels, out of the burrows, and hunting for their food.

Food habits.—Living largely upon nuts, seeds, and grain, these squirrels show an appetite for a wide range of food. The examination of a large number of stomachs and cheek pouches shows their food to consist not only of a great variety of grains and seeds, but also of berries, green vegetation, roots and bulbs, beetles, caterpillars, grasshoppers, crickets, ants, and eggs and pupae of insects. They also eat young birds, birds' eggs, and young mice, and are said to kill young chickens. When caught in traps or found dead they are even eaten by their own kind. They feed upon grain from the time the seed is planted until the last bundle is removed from the fields. Unlike the smaller ground squirrels, they do not cut the standing grain, but pull down the heads and in this way destroy the grain even more rapidly. In their capacious cheek pouches seeds of

grain are rapidly carried to their winter storehouses. Where a large number of the squirrels gather along the edge of a field they will often harvest considerable of the grain after having fed upon it during every stage of its growth through the summer.

Economic status.—To a great extent the Franklin squirrels occupy the limited areas where the other two ground squirrels of the State, the thirteen-lined and the Richardson, are absent or less numerous. In extensive areas, therefore, they are the dominant species and levy their toll of destruction on the grainfields and gardens that otherwise would be comparatively safe. In some places, however, the three species occupy the same ground and in combined numbers cause enormous losses of crops. Although larger and according to their numbers possibly more destructive to grain than the Richardson squirrels, the Franklin ground squirrels are apparently less numerous in most of their habitat. They are easily poisoned and their abundance may be controlled at comparatively little expense, using the same methods as recommended for the Richardson, or flickertail.

Citellus richardsonii (Sabine)

Richardson Ground Squirrel; Flickertail

Honkóta of the Arikaras; *Pinsa* of the Dakotas; *Shapka-sop* of the Mandans; *Tsipá sopa* of the Hidatsas (all, Gilmore).

Arctomys richardsonii Sabine, Trans. Linn. Soc. London, vol. 13, p. 589, 1822.

Type locality.— Carlton House, Saskatchewan, Canada.

General characters.—A plump little ground squirrel much resembling the prairie dog, but about half the size. Color, rich buffy yellow, darkened over the back with obscure mottling and wavy scallops. Ears, minute; tail, short. Measurements of average adult: Total length, 237 millimeters; tail, 73; hind foot, 45. Ebner gives the usual weight in fall as 16 to 17½ ounces and in spring as 11 to 13 ounces.

Distribution and habitat.—From a wide range over southern Saskatchewan, Alberta, and Montana, Richardson ground squirrels, or flickertails, cover practically all of North Dakota east and north of the Missouri River (fig. 4). They are absent from most of the immediate valley of the Red River and the wooded bottoms and timbered areas generally, being most abundant over the high open prairie of the central part of the State. For some unknown reason they seem to stop at the Missouri River where the prairie dogs begin, although the ranges of the two species overlap slightly in Montana, where no enmity between them is noticeable. The more humid and fertile part of the country was occupied by them long before the great wheatfields spread over their range to supply a new and choice food. Of the three species of ground squirrel in the State, these are by far the most numerous and most destructive.

General habits.—Originally the flickertails had a continuous distribution over the prairies in great numbers. On some favorite slopes they were so numerous as to suggest a colonial tendency, but apparently this only showed a preference for certain kinds of ground yielding an abundant food supply.

In 1887, when much of the prairie was still unbroken, they were living in their primitive manner on such food as the prairie afforded and doing practically no harm except as grainfields and crops en-

croached upon their original range. Their greatest numbers often appeared to be in the areas of the shortest grass and lowest vegetation, possibly because the grasshoppers and other insect life on which they fed to some extent were most easily obtained there. In places the prairie seemed alive with them and they could be seen scampering about together or standing up like picket-pins, while their shrill whistle was heard on all sides. With each call-note their short little tails are flipped up and down, a farewell twinkle being given as they disappear down the burrow, hence the popular name of "flicker-tail." In 1887 they were often seen also in the main streets of Devils Lake and Bottineau, which were then in their early stages of construction, and in 1916, it was most surprising to find them still occupying vacant lots on the edge of the city of Devils Lake. It was a striking illustration of their tenacity in holding to their

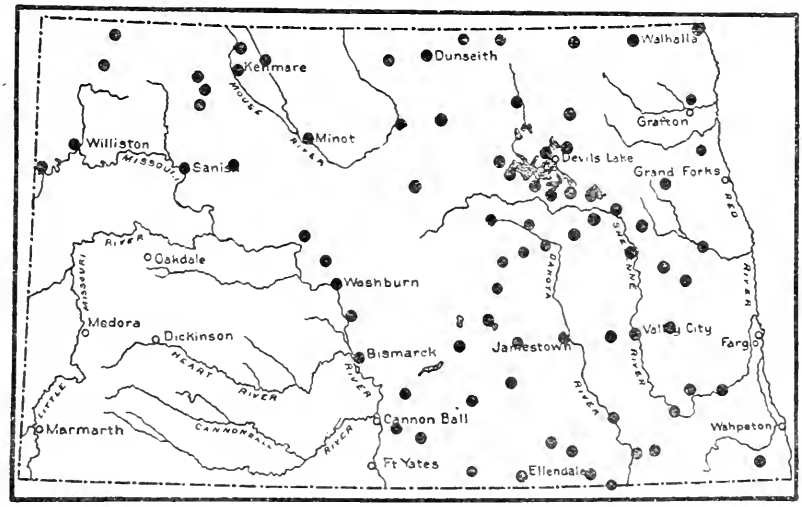


FIG. 4.—Records of the Richardson ground squirrel in North Dakota

original habitat through years of vigorous but sporadic efforts to destroy them.

As soon as the grainfields spread over their range they quickly gathered along the edges to feast on this wonderful new and abundant food. They did not long confine themselves to the edges of the field, however, but went into the middle of large cultivated areas and made their burrows in the plowed ground or in the growing grain.

No reliable estimate of their numbers can be obtained, but a general idea of their abundance may be gained from the statements of Elmer T. Judd, of Cando, in a letter of August 1, 1890, in which he says:

> An old gentleman here killed 1,500 'gophers,' by actual count, before the first of June. From the first of June to the middle of July, he and a cotton broker from St. Louis, who spends the summer here on his farm, calculated that they killed over 2,500 more. One forenoon they killed 135, as shown by the tails they had captured.

These 4,000 animals were killed on and around the outer edges of one section of land.

Breeding habits.—The number of young to a litter is given by Ebner as 6 to 11, with an average of 7 or 8, born in the underground nests mainly in May. By the first of June the young are out of the burrows and find part of their own food while still under the anxious care of their mothers. Small young are occasionally seen much later than the first of June, and apparently the breeding season extends over a considerable period. It has been supposed that flickertails raise two or more litters in a season, but this seems improbable on account of the brief period between their emerging from hibernation in the latter part of March or early April, and entering hibernation in the latter part of August or early in September. This is scant time for even the earliest young to get anywhere near their full growth and lay in sufficient fat to carry them through the winter. By the first of September there are always many individuals that are still small and these are the last to hibernate, presumably because they have not laid up sufficient fat. Even in spring many of those that are seen before the young are born are not nearly full grown and apparently these late young of the previous year are late in breeding. The principal mating season is early in the spring soon after hibernation but sometimes it is as late as the latter part of June. On September 1, 1914, at Bismarck, a few were seen but these were the young of the year, the adults having already gone into their winter dens. At the same time, Silver, who had been studying them at Garrison, for the previous week reported only young of the year caught. At Van Hook on October 16, 1919, the writer saw one out on a warm, sunshiny day after a cold wave, but none had been seen before for some time.

Food habits.—During the summer much green vegetation is eaten by the flickertails—largely the leaves and stems of grain, grass, and a great variety of succulent plants—and apparently it would be possible for these rodents, like the prairie dogs, to subsist entirely upon such vegetation were no grain and seeds available. Late in summer and in fall, when the seeds of the prairie plants and grasses begin to ripen, they constitute the principal food of the squirrels. An important part of the summer food consists also of such insects as grasshoppers, crickets, and caterpillars, though these vary greatly with season and locality. At Crosby, in July, 1913, they were found feeding extensively on the little juicy striped-backed army-worm caterpillars, which swarmed over the roads and fields. Some of the squirrels examined had their stomachs half full and others entirely filled with the caterpillars. Where grasshoppers are abundant they are often fed upon extensively, but wherever grain can be obtained it seems to be the favorite food. One flickertail, shot as it ran out from under a shock of grain, had 269 kernels of oats in its cheek pouches. One recorded by Seton had 162 grains of oats in its pouches and another 240 grains of wheat and nearly a thousand grains of wild buckwheat. Their cheek pouches are so capacious that when well filled they often make the head appear more than double its natural size. The stores gathered are rapidly carried home to be deposited in the burrows and large quantities of food are thus provided for future use. No

stores of grain have been found in the hibernating dens, however, and more study is needed to show when it is used.

Destruction of crops.—The annual loss in grain crops in North Dakota occasioned by these ground squirrels has been estimated at $6,000,000 to $9,000,000 in addition to the annual expenditure of at least $100,000 of public and private funds to combat their depredations. Their tendency is to multiply rapidly in a well-settled and cultivated part of the country because many of their natural enemies are destroyed or kept at a distance, and the food supply is most abundant. As soon as they emerge from hibernation early in spring they begin digging up the seed and eating the young grain that has been sown in the fall, and as soon as the spring sowing starts they dig up the new seed and eat or carry it away. When the grain sprouts they dig both sprout and kernel, and after the kernels are entirely exhausted they feast on the young growing grain until it is headed out, when they begin on the young heads, cutting down the stalks and eating the young seed through all its growing stages. As soon as the grain is ripe they carry it away as rapidly as possible to their storehouses, and this is continued until the last bundle is removed from the fields. Four thousand of these squirrels on or around the edges of a section of land would remove a considerable portion of the crop, and it is not surprising that they are considered the greatest pest of the region. They seem to have no preference between wheat, rye, barley, oats, or flax, but take whatever is nearest their dens.

Natural enemies.—The natural enemies of these ground squirrels are numerous, and but for them the abundance of the animals would be many times greater. Badgers are constantly digging them out and feasting upon them, from early spring until long after they have hibernated or until the ground becomes well frozen and the badgers themselves go into winter quarters. The long-tailed weasels enter their burrows and kill and feed upon them without the least trouble or hindrance and apparently destroy great numbers besides those merely killed for food. At the first appearance of one of these weasels, the squirrels give frantic alarm calls that set the whole prairie community in a panic. They rush to their burrows, but the weasel follows and helps itself to as many as it cares to kill for food or pleasure. This goes on as long as the burrows are open and probably even during the winter, when the weasels can gain access to the dens through the snow, as they are active all winter and sleeping squirrels fill their needs as well as any others. Skunks probably dig out a few, and foxes, coyotes, and bobcats help also to reduce their numbers.

Hawks and some owls prey upon them to a greater or less extent. The ferruginous rough-legged hawk apparently feeds upon them almost exclusively where they occur in its neighborhood and brings them in to feed its hungry broods. The Swainson, marsh, red-tailed, and red-shouldered hawks feed on them extensively, and even the bird-catching sharp-shinned and Cooper hawks may occasionally take one. The little sparrow hawks, which feed mainly upon grasshoppers, probably destroy some of the young ground squirrels, and it is likely that both the short-eared and long-eared owls capture many of them during early evenings or on cloudy days. Gopher

snakes feed upon them to considerable extent, but few data are available in regard to some of the most important species of snakes. The protection of such of their natural enemies as are not otherwise harmful in habits is one of the most important measures for the control of these ground squirrels.

Methods of destruction.—Most efficient methods of controlling these ground squirrels have been carefully worked out by members of the Biological Survey and the North Dakota Agricultural College and Experiment Station. In campaigns against these squirrels, the most economical preparation of poison that has been found to be effective is grain lightly coated with strychnine and starch in the proportions of 1 ounce of strychnine alkaloid to 1 tablespoonful of gloss starch made into a paste with 1 pint of boiling water and stirred into 20 quarts of oats. A teaspoonful of this coated grain placed near each occupied burrow disposes of a large percentage of the squirrels at the first application and the few that remain can be practically cleaned up at the second application. Well-organized and coordinated work over a large area is necessary for satisfactory results, as no matter how thoroughly the squirrels are cleaned out from one or a half dozen farms they will quickly reinfest the whole area from those remaining. This preparation of poisoned grain is equally successful with the other species of ground squirrels and chipmunks where it is necessary to reduce their numbers or clean them out of a section of country.

Ground squirrels as pets.—On a street car from Devils Lake to the Chautauqua Grounds one day the writer saw a boy who had one of these squirrels, which he had caught with a snare earlier in the day. It was about half grown and had become so gentle that he was playing with it and handling it freely, letting it climb up his coat sleeve and carrying it in his pocket or in his cap on his head. It made no attempt either to escape or to bite, but snuggled up to him in a way that suggested the possibility of using these squirrels as pets for children, a vital need that is not well met by any of our domestic animals. Cleaner, neater little pets could not be found. Although quiet in disposition, they have sufficient vivacity to be very attractive. If taken young and well tamed these native squirrels would certainly be far more attractive, interesting, and intelligent than white mice, rats, or guinea pigs, which seem to be the only small mammals available for this important phase of child development. The supply would be endless and easily obtained, and by using only one sex in one part of the country any danger from recolonization would be avoided.

Cynomys ludovicianus ludovicianus (Ord)

Black-tailed Prairie Dog

Pi^{n}spi^{n}sa of the Dakotas; *Achks* of the Arikaras; *Shopka* of the Mandans; *Si^{n}hpa* or *Tsipá* of the Hidatsas (all, Gilmore).

Arctomys ludoviciana Ord, Guthrie's Geogr., 2d Amer. ed., vol. 2, pp. 292, 302, 1815. (Reprint by S. N. Rhoads, 1894.)

Type locality.—Upper Missouri River, where discovered by Lewis and Clark.

General characters.—Prairie dogs might be described as big, husky ground squirrels or little, plump woodchucks, to both of which they are related and

between which they range in size. Although belonging to the squirrel family, they are compactly built for digging and for life on and under the surface of the ground. The ears are minute, the tail short, and the legs short and muscular. The color generally matches well the fresh yellow earth of their burrows, being a yellowish or pinkish cinnamon above and buffy below; the tip of the tail is blackish, and coarse black hairs are scattered over the upper parts; the fur is soft and silky in winter, coarse and harsh in summer. Average measurements: Total length, 388 millimeters; tail, 86; hind foot, 62.[10] Weight, 2 to 3 pounds.

Distribution and habitat.—From a wide range over the Great Plains from western Texas to northern Montana, these prairie dogs extend over that part of North Dakota west of the Missouri River (fig. 5). In this latitude they are all west of the Missouri River, but farther south they occur on both sides. Fortunately they are colonial in habits and have a scattered distribution, so that the

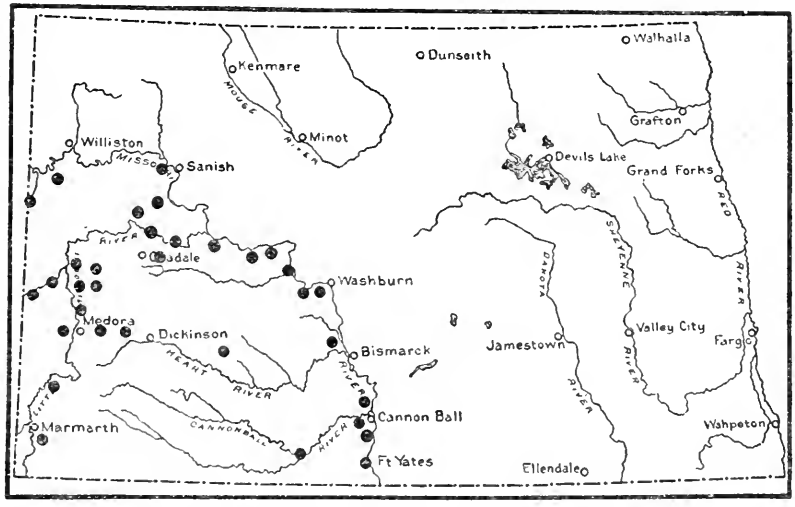


FIG. 5.—Distribution of prairie-dog towns in North Dakota

country is not fully occupied by them, but the colonies, or "dog towns," have been numerous over the part of the State which they occupy. In 1910, Anthony reported a few prairie dogs on the south side of the river not far from Buford, and many 20 miles south of there. In 1909, prairie-dog towns were reliably reported near Mannhaven, just west of the Missouri River, and on the Little Missouri near Marmarth in the southwest corner of the State. In 1913 there was a considerable dog town east of Sentinel Butte. In 1913, Jewett reported a large colony on the flats about a mile west of Fort Clark, where the prairie dogs were doing considerable damage to crops, another colony on a piece of level prairie about 3 miles east of Oakdale, and many others along the Little Missouri River from Quinion to Medora, with exceptionally large colonies at the mouth of Ash Creek and near the head of Magpie Creek. Most of the dog towns he found around Sentinel Butte had been destroyed, but a small colony still existed about 10

[10] Measurements from North American Fauna No. 40 (Hollister, 1916, pp. 16–17).

miles east of there. A considerable dog town was located a couple of miles east of Medora and another along the Northern Pacific Railroad between Hebron and Glen Ullin. Kellogg, in 1915, found near Goodall an uninhabited dog town that had covered about 400 acres. A small colony on the west side of the river opposite Elbowoods was said to be decreasing in population. About a mile north of Mannhaven a colony was found covering about 100 acres. At Stanton there had formerly been a large colony but it had been destroyed by poison. In 1915, Sheldon reported a small prairie-dog town on Deep Creek near the former Dakota National Forest, and other colonies scattered over that general region. At a point about 4 miles northwest of Cannon Ball, he located a town containing about 2,000 prairie dogs and covering an area of approximately 160 acres. Another colony was located near old Fort Rice, covering about 40 acres and containing about 500 animals; still another about 9 miles south of Cannon Ball of approximately 80 acres and about 500 animals. He was told that the Indians had kept them down by shooting them for food. Near Wade, in 1913, Doctor Bell reported them as occurring in scattered colonies.

In 1915, U. S. Ebner, in charge of field operations in the rodent-control work of the Biological Survey in cooperation with the North Dakota Agricultural College and Experiment Station, investigated the prairie-dog situation over a part of the range west of the Missouri River. He reported small prairie-dog towns covering 25 to 250 acres scattered along the Little Missouri River in Billings County, larger colonies of 60 to 640 acres in the northern part of Dunn County, a number of towns of 20 to 160 acres along Big Beaver Creek in the northern part of Golden Valley County, other towns of 25 to 500 acres in the eastern part of McKenzie County, and some large towns running as high as 600 acres on the Berthold Indian Reservation. In most of these prairie-dog towns he estimated 20 to 40 burrows to the acre.

Although these records show only the colonies that have been located, they indicate a very general distribution of prairie dogs over this part of the State, and a careful survey would doubtless show a surprising number of inhabited prairie-dog towns in a region that is rapidly filling up with grainfields.

As a general thing the colonies are located on the open level prairie and often on the best of the grain land. In the Badlands they are usually on the flats and level spaces where the best grass grows, always away from the brushy and barren areas.

General habits.—Prairie dogs are highly social in disposition, almost invariably living in colonies. On rare occasions a new location is chosen where a family or a few prairie dogs have started a colony, but generally there is evidence of their long residence. The old burrows and mounds remain for many years and the sites of ancient prairie-dog towns are marked by little swells of grassy turf scattered over the prairie.

A well-populated prairie-dog town on a bright summer morning is as animated as any busy village could well be. At the first appearance of the sun the animals come out of their burrows and begin their breakfasts of grass and roots, most of them busily digging up grass and little plants for food, nibbling off the grass blades and

plant leaves like rabbits, or sitting up holding them in their hands like squirrels. There are always, however, a few on sentinel duty, usually sitting straight up on the highest mounds, or stretching up occasionally to full height from the grass where they are feeding. Some are always scampering from one point to another, and when the young are out there is much playing and scuffling among them.

A populous town of prairie dogs, all busy and many of them calling back and forth, with a few on sentinel duty, barking in steady little *yap–yap–yap–yaps* at some real or imaginary enemy, makes an interesting picture. If the enemy really approaches, the barking becomes frantic and is taken up by other members along the line, and there is a general scamper for the nearest burrows. If one walks toward them to within rifle range the panic increases and the nearest animals rapidly disappear down the burrows with a farewell twinkle of their tails. The barking passes along farther and farther through the town, usually beyond where the enemy can be seen, every prairie dog taking notice and most of them joining in the alarm. Occasionally one of the guards will stretch up to its utmost height and throwing its head back utter a long *Chu-r-r-r-r-r-r-r-r-r-r-r*, as if a dozen barks were crowded into one. This seems to be their only note besides the regular *yap–yap*, and a chuckling, scolding *Chu-r-r-r-r-r*, after entering their burrows, as if they were grumbling at having been disturbed.

The burrows are deep and go down at steep angles, sometimes almost straight down, for 2 or 3 feet and then slope off gradually. A pebble dropped into one can be heard rolling and bounding down, often for 5 or 6 feet, and a prairie dog with a string tied to its hind foot will sometimes take down 12 or 15 feet of string before reaching the end of the tunnel. The burrows are simple and almost never lead out to a second opening.

The nest, instead of being at the lowest point, is usually in a chamber well protected from any rain water that may run down the burrow. As a further protection the earth thrown out is carefully placed around the entrance to form a craterlike rim that serves the double purpose of a watch tower and a dike to prevent the entrance of water from heavy rains.

Originally the mound is built of the earth brought out of the burrow, but later fresh earth is scraped up from outside and brought back and added to the sides, and when the ground is moist after a rain the mound is carefully formed and patted and pushed with the end of the nose until externally it has the most approved slopes and internally the correct funnel form. A well-kept mound shows numerous dents and dimples where pushed and poked with the pudgy noses of the prairie dogs. Many old burrows with neglected and broken mounds are used, but the main nest burrows are always kept in good condition. Nest material of dried grass and soft plant fibers is carried into the burrows and the old material is occasionally brought out and scattered about the entrance. The cheek pouches of the prairie dogs are small and little used, and apparently no food is stored.

Breeding.—The 4 to 6 or 8 young are born early in May, but usually do not appear out of the burrows until the first or middle of June. They are then seen in family groups around the entrance to

their homes and always under their mother's watchful eye. At a signal from her they quickly rush to the burrow and disappear. As their experience increases they are left more to their own discretion, but even when half grown if danger appears the mother insists on their all getting down the burrow before she will enter. Small young are often seen later in the year, but in the northern part of their range it is doubtful if more than one litter is raised in a season, the late young probably being the first litter of females of last year's brood.

Hibernation.—In fall the adults become very fat and the young moderately so. They are always ready to hibernate in case of very cold or stormy weather or deep snow, but do not enter their dens to remain unless cold weather comes. In mild seasons they are sometimes active until midwinter and may be seen foraging on warm days when there is no snow. In severe winters, however, they disappear for a long period and evidently pass completely into the state of hibernation. They are out with the first warm days of spring and in March, when a few sagebrush tops were the only visible vegetation, the writer has seen them sitting on top of 2 feet of snow through which they had burrowed to the surface. As soon as the snow is off in spring they find plenty of food in the dry grasses and roots, and their store of fat helps to carry them through the mating season.

Food habits.—The food of the prairie dogs consists principally of grass, including seeds, leaves, stems, and roots, but it includes also a variety of other plants, generally everything that grows over the surface of the ground to a considerable distance around their burrows. The short blades of grasses are not only eaten off to the ground, but the roots also are dug up and the tender bottoms of many species are eagerly eaten. Other little plants are eaten to the ground and those with edible roots or bulbs are dug up and exterminated. Often tall plants, grasses, and weeds that have sprung up in the prairie-dog town are cut down, if not for food, to keep the ground clear and the view unobstructed. An old and well-populated prairie-dog town is often so completely cleared of vegetation that parts of it have to be abandoned, the animals moving on toward the best grass on the margins. In this way parts of the prairie are progressively denuded of vegetation.

The stomachs of prairie dogs are relatively large, as in all grazing animals, and at any time of the day except early morning they are found well filled with finely masticated vegetation, usually showing a good combination of green and white pulp from the foliage, stems, and roots of plants, often with streaks of color from various kinds of flowers and seeds. Many ripening seeds are included in their food, and fields of grain tempt them to extend their colonies into this unusual food supply. When the dog towns are plowed up and seeded to grain the occupants cling to the old burrows with great tenacity, opening them up and if left undisturbed living in the midst of wide grainfields.

Depredations.—An area occupied by a colony of prairie dogs may usually be considered stocked to its carrying capacity and of little or no value for grazing or agricultural purposes. It may also be considered that the area thus occupied is just so much withheld from

other use, and it is only a matter of determining the area of land given over to these animals to know the extent of the loss in grazing. If a well-populated prairie-dog town is plowed and seeded, prairie dogs will be the ones to harvest the grain unless they are first destroyed.

Destruction of prairie dogs.—Fortunately prairie dogs are easily poisoned by the use of oats or other grains coated with strychnine, as described for the Richardson ground squirrel, and a farm suffering severe losses may be reclaimed at comparatively small expense. Full directions for preparing and using the poisons will be furnished by the Biological Survey on request.

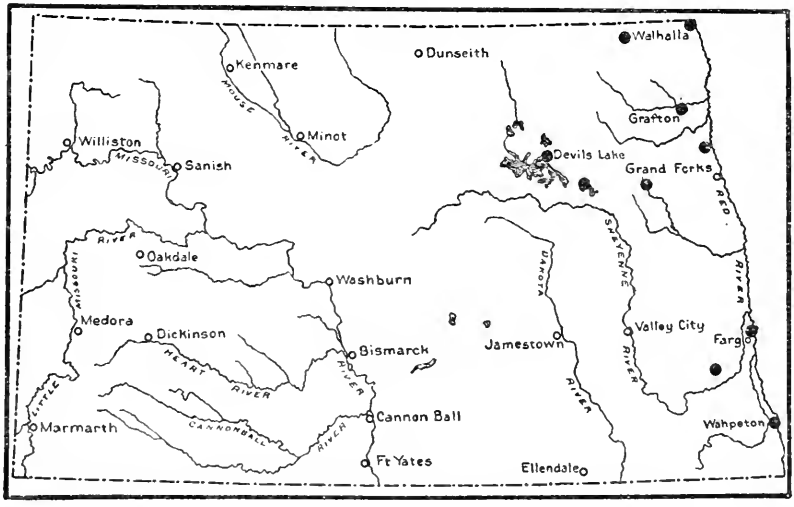


FIG. 6.—Localities where woodchucks are known in North Dakota

Marmota monax rufescens Howell

Rufescent Woodchuck; Groundhog

Marmota monax rufescens Howell, Proc. Biol. Soc. Washington, vol. 27, p. 13, 1914.

Type locality.— Elk River, Minn.

General Characters.—Heavy-bodied animals, with short ears, short legs, and short, bushy tails. Similar in general appearance to the southern and eastern woodchucks, but more reddish brown above and below. Upper parts dark brownish gray, sides and underparts strongly washed with reddish or rusty brown; feet blackish; tail black or dark brown, long-haired and bushy. Average measurements: Total length, 548 millimeters; tail, 143; hind foot, 83.[11] Weight, about 8 to 12 pounds, but individuals have been recorded as heavy as 13½ and 18 pounds. (Anon., 1900; Fellows, 1881.)

Distribution and habitat.—From the Transition Zone of the eastern United States woodchucks extend across Minnesota and into southeastern North Dakota as far as Devils Lake (fig. 6). In revising the group Howell examined specimens from Fargo, Grafton, and Leonard, in North Dakota; and at the biological laboratory in 1913 there were skins collected near Stump Lake and Devils

[11] Measurements from North American Fauna No. 37 (Howell, 1915, p. 26).

Lake. At Wahpeton woodchucks are reported common along the banks of the timbered river bottoms. At Fargo and Grafton they are occasionally found. In 1915, Kellogg collected a half-grown young near Larimore and obtained a specimen at Grafton. While at Manvel, Grand Forks County, he saw their burrows and one young that had been captured. In 1919, Williams reported them becoming more numerous each year at Grafton. Eastgate says they are occasionally found in the forest near the biological laboratory at Devils Lake, but that they are by no means common. Apparently they fill the forested belts along the rivers, extending westward from the Red River Valley and thus reaching the Devils Lake and Stump Lake forested tracts. Although mainly restricted to forested and brushy locations, where no timber is available they will live in the open. Steep banks and sidehills are favorite situations, but in many cases the burrows are found on level ground or under stumps, trees, or stones. Woodchucks are not fastidious as to habitat, the one requisite for their existence seeming to be an ample supply of green food during the summer season.

General habits.—These largest and least squirrel-like of the squirrel family have generally the burrowing habits of the ground squirrels and prairie dogs. They are mainly burrowing and grazing animals, occupying the region of rich plant growth rather than the short-grass prairie, and depending to a great extent on cover and concealment for protection. They are not colonial in habits, except as mother and young remain together during the season, but if undisturbed they often multiply so rapidly as to be seriously destructive to crops and forage.

Their burrows are extensive, and instead of being one simple tunnel, usually open out in two or more directions from the central den. Near Larimore, Kellogg dug out a den where an old female and her half-grown young were living. There were four entrances and three nests in different chambers. The nests were made of dry grass and leaves and one contained some fresh-cut plants, including nettles. The branches of the den were respectively 6, 7, and 9 feet long, but apparently there were other branches not discovered, as the old woodchuck and her young had been seen to enter the burrow, but could not be found. When first seen, one of the young was up in a basswood tree and when alarmed ran down into the burrow. These woodchucks are good climbers and in places where there are no fences or rocks to serve as watch towers, they are often found up in trees where a good view can be had. They also take refuge in trees to escape from dogs and other enemies. A family of seven young is reported from Manvel, by Kellogg, and this seems to be about the average number for the species.

Food habits.—The food of woodchucks consists largely of green vegetation, with which their large stomachs are usually filled. They are particularly fond of clover, alfalfa, or any of the native leguminous plants, but will eat grass and growing grain and vegetables with great relish. In fall, flowers, seeds, and grain furnish a richer food from which more rapidly to accumulate their winter fat. Apparently they do not lay up stores of food, but depend on finding an ample supply until time to hibernate, and in spring live on their store of fat until green vegetation is available. They usually come

out in spring while the ground is still covered with melting snow. Doctor Bell took a specimen at Fargo on April 29, 1906.

Economic status.—The fondness of woodchucks for almost every kind of garden or field crop renders them serious pests wherever they are numerous. Here on the border of their range they may never become troublesome, but they should be watched and their numbers kept down wherever an undue increase is noticeable.

It is unfortunate that the habits of so many of our native animals conflict with the interests of man, as their presence would otherwise add much to the interest of life. A few woodchucks in the meadow and along the fences, where their loud, shrill whistle is occasionally heard and where they are seen sitting up in the grass or on the fence watching for danger, or with flopping tails scampering to their burrows, would add a touch of life and interest to any landscape. Their depredations, however, are too serious to be taken lightly, and it is often necessary to destroy them. Usually they may be shot or trapped, or killed with carbon disulphide placed in their burrows, but they are not easily poisoned, as there is usually an ample supply of their favorite food within reach.

Woodchucks as food.—Woodchucks have some value as food animals; their meat is like that of squirrels, but coarser. Many persons are fond of them, and in the markets they sometimes bring as much as a dollar each. There could be no cleaner or more exemplary animal in food habits and their underground dens are as clean and fresh as the abode of any burrowing animal. When necessary to destroy them their use as food should be encouraged.

Marmota monax canadensis (Erxleben)

Canada Woodchuck; Groundhog

[*Glis*] *canadensis* Erxleben, Syst. Regni Anim., p. 363, 1777.

Type locality.—Quebec, Quebec, Canada.

General characters.—In size somewhat smaller than *rufescens*. Color, strongly rufescent. Average measurements: Total length, 513 millimeters; tail, 108; hind foot, 76.

Distribution and habitat.—From a range extending across Canada from Nova Scotia on the east to Fort Simpson on the Mackenzie, the small northern form of the *monax* group of woodchucks barely enters the extreme northeastern corner of North Dakota. One specimen collected at Pembina in 1887 was identified by Howell as belonging to this form. It was taken on the North Dakota side of the river, but after it had been seen to swim across from the Minnesota side. In 1915, Kellogg reported a few woodchucks at Pembina, but did not obtain any specimens. The river at this point has considerable timber along both sides, and woodchucks are likely to pass back and forth freely, if not during the summer, they certainly would early in spring before the river breaks up. At Walhalla they are fairly common, but by October 1, 1919, they had all denned up for winter. One found in the bank and later mounted was evidently the little dark-colored *canadensis*.

General habits.—The only difference in habits between this form and the more southern *rufescens* may be attributed to climate and environment. With a longer winter, more snow, and a somewhat different set of plants from which to draw their food supply, these

rodents readily adapt themselves to local conditions. In the shorter season they are still able to lay up sufficient fat to carry them through the long, cold winters, and in spring they come out of hibernation even while the snow is still deep. As early as March 18, in northern Minnesota, they sometimes come out on 4 feet of snow, making tracks in the soft, melting surface or on the frozen crust and visiting back and forth from one burrow to another, opened out through snow tunnels. This is the mating season, and, according to Seton (1909, vol. 1, p. 426), the four or five young are born about the end of April. Over this great northern country they are generally harmless, except where locally they come in contact with fields and gardens.

Family MURIDAE: Old World Rats and Mice

Rattus norvegicus (Erxleben)

Brown Rat; House Rat; Wharf Rat

[*Mus*] *norvegicus* Erxleben, Syst. Regni Anim., p. 381, 1777.

Type locality.—Norway, where introduced in 1762.

General characters.—Size, variable; ears, small; nose, long and pointed; tail, long, nearly naked, and minutely scaly; color, dull brownish-gray above, light or whitish below, occasionally bluish black. Measurements of average adults: Total length, 415 millimeters; tail, 192; hind foot, 43; measurements of a large individual, 468, 212, and 44, respectively. Weight of large individuals, about 1 pound.[12]

Distribution and habitat.—The familiar house rats are not native to America, but came over on ships about 1775, and since then have spread over most of this country, except some of the arid interior. They follow railroads and settlements into every part of the country where they can find food and cover, preferring the buildings and habitations of man. It is safe to say that they first entered North Dakota with the early steamboat traffic up the Missouri River.

In 1833, Maximilian (Wied, 1839–1841, Bd. 2, pp. 72, 251, 256–257, 1841) found them a great pest among the grain stores of the Indians at Fort Clark. He says that in the loft of the stores of the fort were 600 to 800 bushels of maize that a great number of Norway rats assiduously labored to reduce. They were so numerous and troublesome that no kind of provision was safe from their voracity, but their favorite food was the maize, among which they created much havoc, and it was calculated that they devoured 5 bushels, or 250 pounds, daily. The rats were brought thither by American ships, but as yet had not reached the Minnetaree villages. The following winter, in the house which had been built for him among the Mandan Indians, Maximilian says: "We were molested during the night by numerous rats and put my little prairie fox in the loft above us, where some maize was kept and here he did excellent service."

In 1887, these large rats were abundant at Fort Buford, which was then the terminus of the Great Northern Railway. The old buildings about the fort were filled with them and they were very destructive. Even in the little adobe hotel they were racing about the room every night until caught in traps. At Grand Forks they were said to have only recently arrived and they were not known

[12] Weights of more than 2 pounds have been recorded.

at Pembina, Devils Lake, or Bottineau. In 1909 they were common at Bismarck and Mandan and were said to be at Devils Lake and Rugby Junction, but at Bottineau none had been found. In 1912 they were abundant and troublesome about Fargo, Hankinson, Valley City, Lisbon, Stump Lake, and Grafton. At this time a dead rat was seen at a ranch near Marstonmoor, Stutsman County; Williams reported them at Walhalla, in Pembina County; and within a few years they had begun to infest the country along the eastern edge of the Turtle Mountains. In 1915 Sheldon found them at Fairmount, where they were a great pest around barns and granaries. He says that the farmers who tried to raise poultry had considerable trouble with them, as they took the little chickens at every opportunity. During his visit at the Hoffman farm, two of the farm hands, while transferring a quantity of hay from one section of the barn to another, killed about 100 rats in a few hours. Most of these were about half-grown, only 1 adult being killed. At Lidgerwood, in Richland County, Sheldon found them less common than at Fairmount. On a trip west across the rest of the southern part of the State, however, he did not find any further trace of them.

In 1915 Kellogg found them at Wahpeton, at Grafton, and a few at Oakes, in Dickey County; at Towner, McKenzie County, he reported them as not very common. In 1913 Jewett reported that no trace of them could be found at Sentinel Butte and old settlers living there had never seen them. At Medora, also, none were found. It is probable that the rats will not find their way to the scattered farms over considerable portions of the western and more arid parts of the State for some years to come, but eventually they will undoubtedly cover practically the whole State.

General habits.—So closely have rats been associated with man and his works and for so long a time, that they have become largely parasitic in habits, seeking the cover and protection of buildings and preying upon the food supplies produced and gathered by man. Their sly, filthy habits, mean appearance, and vicious dispositions have not only won the enmity of mankind, but have done much to instill a dislike for other harmless and more attractive native animals with which their name has become associated. To their destruction of property is added the even more serious menace of conveying disease to man. They are by far the most destructive and dangerous of rodent pests and warfare against them should be relentless.

Breeding habits.—A large female rat was sent to the Biological Survey from Fargo by K. F. Bascom, who reported that it had contained 12 well-developed fetuses. This is not an unusual number of young at a birth, and the rats breed so rapidly that under favorable conditions of food supply and protection the rate of increase is enormous. Litters of young are said to be produced sometimes at intervals of 25 days and the breeding season lasts for a large part of the year (Lantz, 1909, p. 16).

Food habits.—Probably no rodents are more omnivorous than rats. They accept anything of an edible nature from fresh or stale meat to young chickens, eggs, fruit and vegetables, grain, nuts, seeds, and even green vegetation. They revel in garbage of all sorts and will often find an abundance of food in city dumps, manure piles, and in the refuse about stables. In a grain-producing region their fondness

for grain leads to enormous losses, as where an abundant supply is available they merely take the germ and ruin far more than they require for food.

Control measures.—The depredations of these animals are so serious that it is generally found to be good economy to make buildings rat-proof, or as nearly so as possible, by means of concrete, brick, stone, and wire mesh. Where grain and other food can be kept away from them their numbers can easily be controlled, but they are so skilful in burrowing under walls and gnawing through wood that special methods are necessary to exclude them. So adept are they in avoiding traps and poison that a combination of rat-proofing, poison, and traps is often necessary to prevent serious losses from them. The most successful methods of combating them are given in Biological Survey bulletins and circulars, which are available for free distribution.

Mus musculus musculus Linnaeus

House Mouse

[*Mus*] *musculus* Linnaeus, Syst. Nat., ed. 10, t. 1, p. 62, 1758.

Type locality.—Sweden.

General characters.—Size small, with slender, tapering tail, pointed nose, and rather small ears. Color, brownish-gray above, buffy-gray below, usually without any clear white. Measurements of average adults: Total length, 160 millimeters; tail, 81; hind foot, 19. Weight of adult female, 23.5 grams.

Distribution and habitat.—Troublesome little Old-World mice have become well established over almost every part of North Dakota, in fact through most inhabited parts of North America. So thoroughly have they become dependent on the habitations of man that little is known of their origin and distribution. They followed quickly on the heels of the first settlement of the country and generally appeared within a few years after the establishment of a ranch or farm, even at a considerable distance from other habitations. At almost every place over North Dakota where field work has been done by the Biological Survey, these mice have been reported as common or abundant and troublesome about buildings, and in many cases they have been caught in the fields in traps set for native species.

At Fargo, in 1912, these little mice were so numerous along the edges of fields and roads that it was difficult to catch other species until enough trapping had been done to reduce the numbers of the house mice. Near Williston, in 1913, they were abundant at the ranches and very destructive of grain in the bins and sacks. In the bunk house at one of the ranches the mice kept up a racket all night, and in the morning there were little piles of oat shells on the floor where grain had been brought in and eaten. Their musky odor was very evident in the room, leaving no doubt as to the identity of the species, and one was shot as it ran across the floor. At Kenmare, in the northwestern part of the State, they were abundant both in town and in the weedy bottomlands, where many were caught in traps. At Mandan, in 1913, Jewett found them abundant in town and also on rough slopes in the surrounding fields to a distance of 2 miles from town. At Glen Ullin he caught them on the sides of buttes a mile from town, and also in the tall grass along the creek

bottoms. At Sentinel Butte they were found at almost every ranch; also at Fort Clark, and around Oakdale in the Killdeer Mountains. Specimens were also taken at Buford, Bismarck, Cannon Ball, and many other localities over the State.

General habits.—House mice are generally imported in boxes and loads of goods where they have made their nests, and are carried long distances on trains or in wagons. They prefer the protection of buildings, but when they have become numerous overflow into the surrounding fields and country wherever food and cover are to be obtained. They breed and increase with great rapidity and but for their natural enemies would soon overrun the fields and render agriculture unprofitable. Cats are generally used to keep down their increase, but serve as a very limited check. The native owls, hawks, and weasels, however, do much to control their abundance.

In habits the mice are often filthy, running through the dirt of stables and cellars and then over the food in pantries or kitchens, in this way not only destroying food but distributing disease germs.

They are so slender that they can slip through cracks and narrow openings into places supposed to be proof against their entry, and they will also gnaw through a considerable thickness of wood to get at food or grain that is stored. Concrete, plaster, and fine wire mesh are the best protection against their inroads, but in spite of all efforts it is often necessary to resort to poison and trap in order to destroy them. Inverted boxes covering poisoned grain, with small openings through which larger animals can not pass, may be kept in buildings where mice occasionally enter and many may be destroyed in this way. Directions for preparing poisoned bait, as well as for trapping these pests, will be furnished by the Biological Survey, United States Department of Agriculture, on request.

Family CRICETIDAE: White-footed Mice, Harvest Mice, Grasshopper Mice, Wood Rats, and Voles

Peromyscus maniculatus osgoodi Mearns

Osgood White-footed Mouse

(Pl. 11, fig. 1)

Tepa-uti[13] of the Omahas (Gilmore)

Hesperomys leucopus nebrascensis Mearns, Bul. Amer. Mus. Nat. Hist., vol. 2 (1887–1890), pp. 285, 287, 1890 (not of Coues, 1877).

Peromyscus maniculatus osgoodi Mearns, Proc. Biol. Soc. Washington, vol. 24, p. 102, 1911.

Type locality.—Calf Creek, Custer County, Mont.

General characters.—One of the smaller-sized white-footed mice, of rather pale buffy ochraceous color over the upper parts and pure white below; tail sharply bicolor. Immature individuals are more bluish-gray above, only the adults being buffy ochraceous. Average measurements of adults: Total length, 158 millimeters; tail 64; hind foot, 20. Weight of adult male, 20.5 grams.

Distribution and habitat.—The little native white-footed mice are abundant over the western, drier part of North Dakota east to the Missouri River Valley, thence grading insensibly into the darker eastern form *bairdi*. The area of intergradation is mainly east of the river, including such localities as Kenmare, Minot, Napoleon, and Linton. In the Missouri Valley the mice seem to be typical

[13] Mice that live in the buffalo skulls, most likely this species.

of this western form. They are abundant in almost every locality and situation over the areas they inhabit. At Fort Buford, in 1887, they were found abundant, and again in 1913 about equally abundant over the prairies and Badlands buttes, in marshes, and in wooded bottoms. In 1910 Anthony reported them there as numerous in the brush, among the rocks, and on the hills and prairies. At Fort Clark, Jewett caught them in traps set over a wide range of country, but most commonly among rocky buttes and around wheatfields. Along the Little Missouri River from Medora to Quinion he caught them wherever his traps were set, in the willows along the river, in the sagebrush, and on the rocks and hills. At Oakdale, in the Killdeer Mountains, he also caught them in traps set on rocky slopes, in the brush, along the creeks, and in the swamps around springs. At Sentinel Butte they were found on the open prairie, among rocks on the buttes, and in wet grassy places at the edges of ponds. At Glen Ullin he found them very common, living in burrows and among rocks all over the country. At Mandan he caught them in the brush, along the river, in rocks on the open prairie, and along fences or borders of wheatfields. At Cannon Ball, Sheldon reported them as inhabiting the grainfields principally, but also the arroyos and sandy bluffs.

These reports indicate great abundance, a continuous distribution, and perfect adaptation to a great variety of environment.

General habits.—These beautiful little animals, with large eyes, long whiskers, and large, expressive ears, show much intelligence by adaptation to a great variety of conditions of life, but are nervous and timid and do not readily accept conditions of domestication. In the woods they climb trees and are fond of living in hollow logs or other cavities, but in the Badlands they find safe retreats among the rocks, cliffs, and clay banks, and on the prairies they live in natural cavities or abandoned burrows of other animals. They probably dig burrows for themselves when necessary, but usually are able to find plenty of those abandoned by pocket gophers and other burrowing rodents. They often live in the driest situations and seem not to be dependent on a permanent water supply, although they have no objection to wet or marshy ground. Strictly nocturnal in habits, as is indicated by their large, dark eyes, they are rarely seen except when disturbed in their diurnal retreats, and although abundant, they are not generally well known. The plow often turns them out of their underground nests and they are frequently disturbed when land is cleared; after haying and harvesting they are found in haycocks or grain shocks that have been standing for some time in the fields. Wherever they take up their abode they quickly make a soft nest of fine plant fibers and seem perfectly at home if shelter and food are obtainable. They are often so numerous as to be very troublesome to the naturalist in search of rare specimens, as they fill his traps night after night until they have been thinned out.

Near the mouth of the Cannonball River one evening while it was still light enough to see fairly well, a brown-backed old *Peromyscus* ran out from under a stone. It darted about nimbly from one stone to another, then stood still and watched for half a minute, its big ears and bright eyes giving it a very animated expression. This

is one of the few times when these little mice have been seen out foraging of their own accord before daylight was entirely gone. They will often run over a person, however, while he is sleeping on the ground, and there is generally plenty of evidence of their presence about camp in the morning.

In winter on soft snow their tracks may be found leading from tree to tree, or bush to bush, or from one weed to another where they have run in search of food, but most of their tracks lead to or from holes in the snow which connect with tunnels under the snow or cavities under ground.

At Mandan and Cannon Ball late in October, 1919, the writer followed many of their tracks to nest cavities in the ground, and dug down and caught the mice in the hands. All were in old stump holes, where cottonwoods had decayed and left rotten wood or hollow spaces deep in the mellow soil of the forested bottomland. At a depth of 6 inches to a foot below the surface, nests of soft leaves and plant fibers were found, lined with cottonwood cotton and rabbit fur, and in these nests from one to four of the mice were comfortably housed for the winter. When disturbed they came out to see what was the matter and they were tied in a handkerchief or gloves and carried home for further study. Even when the temperature was —15° F. and the snow 11 inches deep the mice were out making long lines of tracks at night, in following which much was learned of their food and other habits. They seemed to know where to go directly to every seed-laden tree, vine, bush or weed, and whether to climb up or dig down to get the seeds or fruit.

Breeding habits.—The females usually bring forth four to six young at a litter and they apparently breed several times during the summer. Their increase is rapid, and but for numerous enemies their abundance would be far greater than at present.

Food habits.—The white-footed mice are dainty feeders. The contents of many stomachs examined show a mass of clean white material so carefully selected and finely masticated that there was no trace of shells or hard parts to show from what kinds of seed it came. Most of their food is of various seeds and grain, although sometimes a bit of green vegetation, some bright-colored flowers or berries, or a few insects are eaten. At Mandan the mice were feeding largely on the bullberries, which they gathered nightly from the well-laden bushes, apparently eating both the sweet pulp and seed kernels. There were bits of scarlet skins scattered over the snow and the mouse pellets neatly deposited in a cavity not far from the nest were mostly colored dull scarlet by the berries, while some of the seeds were found in mouse caches. From one cache near the nest a handful of seeds was saved and brought back for identification. Among them were seeds of chokecherry, woodbine, wild grape, smilax, buffaloberry, hosackia, dogwood, bindweed, two species of knotweed, two of pigweed, ragweed, Russian thistle, black henbane, sedge, barnyard grass, and dropseed grass. The mice seem fond of any kind of camp food, as flour, meal, oatmeal, grain, meat, butter, bread, or crackers. Rolled oats generally make the most attractive bait with which they can be tempted into traps. They are active throughout the year and do not put on fat to carry them

through the winter, but instead store up a limited supply of seeds and grain for winter use or for bad weather when they can not come out and run over the surface of the snow in search of food.

Economic status.—The small toll these mice take from grainfields would not in itself cause very serious loss, but added to that of many other species the constant drain on farm products is sometimes serious. They cut some grass in the meadows and eat the seeds of many grasses, thus, to some extent, retarding the forage reproduction and in places taking away so much seed as to form a serious check on the reproduction of other vegetation. Probably more than any other animals they check reforestation, whether this depends upon naturally or artificially sown seeds. So small, so numerous, and so widely distributed are they that they are not easily controlled, except by their natural enemies, which are numerous. They are favorite prey of all small owls and even of many of the larger owls, and form an important article of diet for weasels, skunks, badgers, foxes, and such of the other small predatory species as occur within their range. Reasonable protection of the species that prey upon them, especially the owls, forms the simplest and most effective means of keeping down their abundance.

Peromyscus maniculatus bairdii (Hoy and Kennicott)

Baird White-footed Mouse

Mus bairdii Hoy and Kennicott, Rpt. Comr. Patents. [U. S.] 1856, p. 92, 1857.

Type locality.—Bloomington, McLean County, Ill.

General characters.—About the size of *osgoodi*, but colors much darker, often dusky along the back, and less buffy or ochraceous; underparts, white. Measurements of an average specimen: Total length, 150 millimeters; tail, 60; hind foot, 19. Weight of adult male, from Fargo, 18.5 grams.

Distribution and habitat.—From Ohio and Oklahoma the little dark-colored white-footed mice (*bairdii*) extend over the eastern half of North Dakota and into southern Manitoba. In their typical form they do not reach west of the Missouri River, but at about the one-hundredth meridian they grade insensibly into the paler, more buffy *osgoodi*. There are specimens from almost every locality where collecting has been done in eastern North Dakota, from Hankinson to Pembina and westward to Linton, Towner, and Kenmare. They are found on the tall-grass prairies in the area of humidity and ample cover, where their dark color is protective in the grassy and weedy shadows.

General habits.—These little mice, like their western form, *osgoodi*, are the most abundant and generally distributed mammals of their region. They live in a great variety of situations, from brushy weedy bottoms in the woods, half-dried tule marshes, and dead-weed rows along the roadsides to the middle of grainfields and out over the wide, open, grassy prairie, making nests and homes in hollow logs or trees, in underground cavities which are found, or if necessary, excavated, or under any cover that will offer a dry bed. From *osgoodi* of the drier, more open plains farther west, they differ in habits only in adaptation to more abundant plant growth and more nearly continuous grainfields.

Where food is plentiful they congregate in great numbers, but where it is scanty they become scarce. At Stump Lake, in a line

FIG. 1.—OSGOOD WHITE-FOOTED MOUSE (PEROMYSCUS MANICULATUS OSGOODI) IN CAPTIVITY

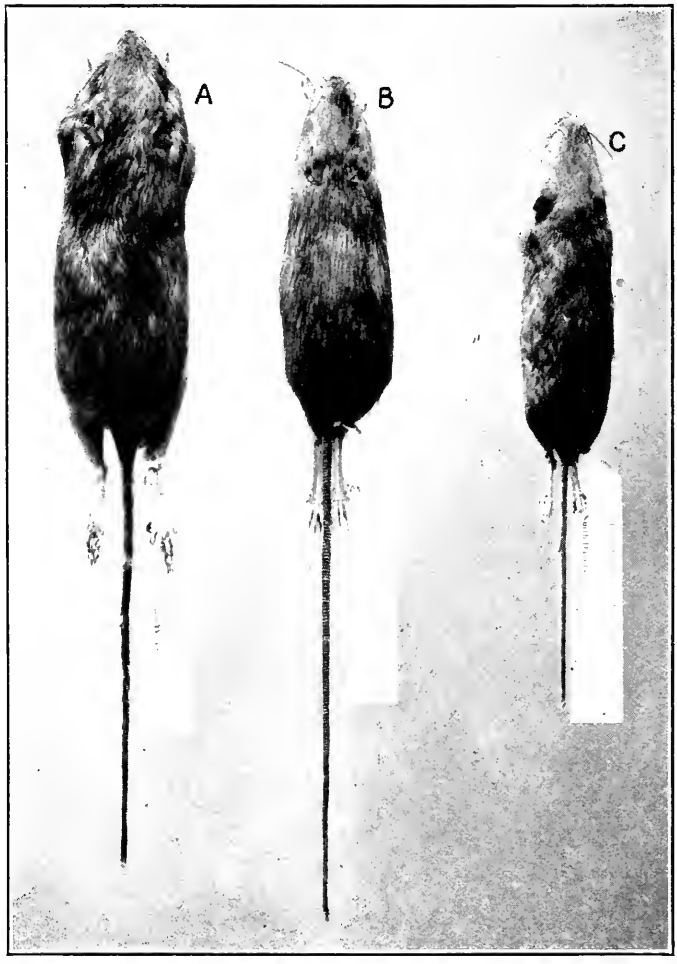
Slightly reduced

FIG. 2.—BEAN MOUSE (MICROTUS PENNSYLVANICUS WAHEMA)

Captive taken with store of ground beans near Cannon Ball. About two-thirds natural size

B252M

FIG. 3.—RICHARDSON KANGAROO RAT (PERODIPUS MONTANUS RICHARDSONI)



SKINS OF LONG-TAILED MICE

(A) Kansas pocket mouse (*Perognathus hispidus paradoxus*); (B) prairie jumping mouse (*Zapus hudsonius campestris*); (C) prairie harvest mouse (*Reithrodontomys megalotis dychei*). Half natural size

of traps set along the sandy beach, 16 of these mice were caught in one night where they were finding a choice food supply in the cocklebur which covered the sandy ground. At Crosby the writer found them feeding largely on little caterpillars. At Valley City many were caught in the rows of tumbleweeds or Russian thistles along the fences, where they were feeding on the seeds of these weeds under the cover of which they found ample protection. Eastgate reported 19 caught in his line of 41 traps the first morning after he camped near this place. They are often found in the haycocks and wheat shocks in the fields, and if these are left for a considerable time the mice are sure to make their nests in them and do more or less mischief.

In breeding and food habits these mice are essentially the same as the western *osgoodi*. Their injury to crops is somewhat greater because of the more general cultivation of land over their range. Their enemies are practically the same and if only given a fair opportunity will keep down the too rapid increase of these interesting but destructive little rodents. At Fargo in the well-cleared city parks not a mouse could be caught, while in the uncleared woods near by, where weeds and bushes protected them from the little owls, these mice filled the traps the first night.

Peromyscus leucopus noveboracensis (Fischer)

Northern White-footed Mouse; Deer Mouse

[*Mus sylvaticus*] *noveboracensis* Fischer, Synop. Mamm., p. 318 (p. 14, δ.), 1829.

Type locality.—New York.

General characters.—Largest of the white-footed mice of North Dakota, with relatively long tail and dark colors; upper parts of adults, dark buffy or tawny-gray, with more blackish or dusky about face and ankles than in *aridulus;* underparts and lower half of tail, pure white. Young and immature, bluish gray or plumbeous. Measurements of adult male from Fargo: Total length, 185 millimeters; tail, 78; hind foot, 22. Weight, 27.5 grams.

Distribution and habitat.—The northern form of the white-footed mouse is the common deer mouse or woods mouse of the northeastern United States and southeastern Canada from Nova Scotia to eastern North Dakota. It is largely a forest species, rarely found far from forest or brushland and seems not to extend over the open prairie country. Specimens taken at Fargo, Moorhead, and at Manvel, just north of Grand Forks, are fairly typical of this eastern form and certainly referable to it rather than to the paler *aridulus* of the Missouri Valley. They probably have a continuous range along the timber of the Red River Valley, but seem not to be abundant.

General habits.—Deer mice are largely forest dwellers, but have a wide range of adaptation and will go anywhere that safe cover and an attractive food supply lead them. From their original homes in hollow trees and logs or in the ground under old trees and stumps they readily follow the rail fences and brushy fence rows around the fields, taking up their quarters under grain shocks, haycocks, or haystacks, or entering new buildings erected in the clearings. They are great climbers and will run up the trunks and branches of tall trees or up vines and through bushes in search of

seeds or berries, or over walls and timbers of buildings, with ease and skill.

They are strictly nocturnal and very timid, nervous little sprites, with long, sensitive whiskers and large, thin, delicate ears that are constantly changing form and expression, apparently catching the faintest sounds; their large, prominent black eyes are owl-like in their adaptation to the darkness of night. Apparently they can see fairly well in the daytime, but are rarely natural or at ease in the light and lose much of their vivacity and beauty as usually seen when driven out of their diurnal beds or captured and held as unwilling prisoners. They are among the most beautiful and expressive of our small native rodents, to which the unfortunate name of "mouse" is generally applied, and but for their occasional mischief and nocturnal habits might be as interesting and popular as many of our song birds. In fact, they are not without voices, and certain individuals have a fine squeaking trill that might well be called a song. They have many little squeaks and low notes that doubtless mean much to them if little to us. A more common means of communication, however, consists of a rapid tapping with their finger tips on any hard surface or thin material, which produces a sound suggestive of the drumming of minute woodpeckers. These vibrations vary in length and tone and doubtless mean much to them in the way of communication.

Breeding habits.—Nests containing young are frequently found under grain shocks or haycocks, or are plowed out of hollows below the surface of the ground. They are usually as soft, well built, and well lined as those of any bird; and the delicate, naked young are found resting on silk or cotton wool from various plants or on feathers or fur or other equally soft materials provided by the parents. Usually 4 to 6 young are born at a time and apparently several litters are raised each year. The mammae of adult females are six in number, arranged in two posterior or inguinal pairs and a single pair of anterior or pectoral. Often when suddenly disturbed the mother runs from the nest with 5 or 6 young, each clinging securely to a nipple, as she drags them rapidly to some safe cover.

Food habits.—Although the greater part of their food consists of seeds, grain, and nutlets, deer mice also are fond of berries, fruit, and a great variety of such foods as the human species regards as its own and exclusive perquisite. This often leads to trouble, for the little moonlight people get into fields, gardens, granaries, and even cellars and pantries and help themselves, always to the best there is to be had. The fact that they consume large quantities of seeds of noxious weeds is generally overlooked and some easy method of lessening their abundance is sought. Unfortunately, this often takes the form of keeping cats, which may scare some of the mice away, while the cats live largely on song birds. If little owls could be kept instead, there would be no more trouble from the mice. In fact, there are usually enough little owls to keep down the abundance of the mice, where brush, weeds, and rubbish are removed so the mice will have no protecting cover.

Peromyscus leucopus aridulus Osgood
Badlands White-footed Mouse

Wiyashpena[14] [moon nibblers] of the Dakota Indians (Gilmore).

Peromyscus leucopus aridulus Osgood, North Amer. Fauna No. 28, p. 122. 1909.

Type locality.—Fort Custer, Yellowstone County, Mont.

General characters.—A pale buffy western form of the northern white-footed mouse quite distinct from *Peromyscus osgoodi* with which often associated. Differs in larger size, relatively larger ears and longer, less sharply bicolor tail, and in lacking the tiny white tuft of hair at upper anterior base of ear; otherwise the color and markings of the two species are practically identical. The young and immature are slaty gray. Measurements of type specimen: Total length, 177 millimeters; tail, 73; hind foot, 22. Weight of adult female, 27 grams.

Distribution and habitat.—The Badlands white-footed mice probably have a wide distribution over North Dakota, but are much less numerous than the smaller species and have not been so thoroughly collected. There are specimens from along the Missouri River Valley at Cannon Ball, Mandan, Sather, Fort Clark, Oakdale, Williston, and Buford, but to the eastward there are no more specimens of this group until we find *noveboracensis* in the Red River Valley. Typical specimens may be expected only from the Missouri Valley and westward. Apparently these are not prairie dwellers, as specimens have been taken only in timbered flats along the streams.

General habits.—At the mouth of the Cannonball River they are comparatively common and in August, 1915, Sheldon collected a series of 17 specimens in the forest of the river bottoms. In June of the following year the writer found them common there in the forest and caught them in traps set in thickets and at the bases of hollow cottonwood trees on the river bottoms. In one hollow tree, about 4 feet from the ground, one of the mice was found in a well-made nest lined with the silky down from the cottonwood seeds, and in another hollow cottonwood an old female was caught well up in the cavity of the trunk. At Mandan late in October, 1919, when the ground in the bottomland woods was covered with 11 inches of soft snow, some of these mice were tracked to their nest cavities in hollows where old stumps had decayed. In one of these honeycombed, rotten-wood cavities a nest was found about a foot below the surface of the ground and four of the five occupants were caught as they came out. There were an adult male, two adult females, and two immature of the year in the blue coats. They came out of a nest in one of the side cavities where a root had decayed, but they had free access to all parts of the porous wood from deep in the ground to the leaf-covered surface. Curiosity seemed to bring them up to see what was disturbing their home and they were caught and put in handkerchief and gloves and kept

[14] There is some confusion as to which species of mouse this name should apply. Doctor Beede gave it as one of the names of the bean mouse (*Microtus p. wahema*, p. 94), but it is not the name in common use by the Dakotas and does not suggest a diurnal, ground-dwelling species, but rather a wholly nocturnal and partly arboreal one. The mice that nibble the edge of the full moon until it is all eaten up must be good climbers, and Doctor Gilmore thinks the name probably applies to one of the white-footed mice. As it is doubtful whether the Dakotas distinguished the very similar forms of *Peromyscus*, this most arboreal of their species is chosen for the beautiful name.

for many months as interesting pets. The nest was a large, soft, warm ball of dry leaves and plant fibers lined with cottonwood cotton and was evidently the home of a family. In captivity they were very friendly and sociable, making a happy family in one nest with four of *Peromyscus maniculatus osgoodi*.

Like other members of the group, Badlands mice are strictly nocturnal in habits and are rarely seen except as caught in traps for specimens or driven out of their diurnal retreats. When seen by daylight, they are beautiful little animals with beady black eyes, large expressive ears, and long trembling mustaches, which give them a keen and animated expression. They are quick and agile in habits, running with long leaps, and climbing rapidly and skilfully over the trunks and branches of trees. In fall they do not become very fat, but lay up supplies of winter food and continue active throughout the coldest weather. Their delicate lines of tracks may often be seen from tree to tree, or from some old log to a stump or brush heap, or centering around a hole in the snow through which they have access to the surface of the ground, where their winter nests and stores are hidden. Over much of their range they are found only in limited numbers, but in certain localities are exceedingly numerous and at times become very mischievous around outbuildings and granaries. As they avoid the open country, they are less mischievous in grainfields than are their smaller and more generally distributed relatives. They are not usually considered a serious pest, but locally they add their little to the constant tax of such rodents upon farm crops.

Reithrodontomys megalotis dychei Allen

Prairie Harvest Mouse

(Pl. 12)

Reithrodontomys dychei Allen, Bul. Amer. Mus. Nat. Hist., vol. 7, p. 120, 1895.

Type locality.—Lawrence, Kans.

General characters.—A slender little mouse with large ears; buffy brown upper parts, and white underparts, distinguished from the house mouse, which it somewhat resembles in size and color, by slenderer and not noticeably tapering tail, and by pure white feet and underparts. From both the house mouse and white-footed mouse it is still better distinguished by a longitudinal groove down the front surface of each upper incisor. Average measurements of adults: Total length, 133 millimeters; tail, 52; hind foot, 16.

Distribution and habitat.—From the Upper Sonoran plains and prairie regions of the Central States the little prairie harvest mice come into North Dakota along the Missouri and Dakota River Valleys. There are specimens from Cannon Ball and Fort Clark in the Missouri Valley, Ellendale, Ludden, and Oakes in the Dakota Valley, and from farther east at Lidgerwood and Hankinson, and Fargo in the Red River Valley. At Cannon Ball, Sheldon found the mice quite common over the prairie and on sandy flats, but more abundant along the brushy borders of grainfields and even out in the fields. At Fort Clark, Jewett caught four in traps set near small burrows at the edge of a wheatfield and on the high prairie. At Ellendale, Sheldon found them fairly common in the grass along the fences, in brushy places, and occasionally in wheatfields, and at Lidgerwood he took

two specimens in tules at the edge of the lake. At Hankinson, W. B. Bell found them common in the tumbleweeds along the fences on sandy soil, and at Fargo Murie took four specimens on the grassy river bank at the edge of a field.

General habits.—These little harvest mice live mainly on the surface of the ground under cover of grass and low vegetation. Their tiny runways may be distinguished from those of meadow mice by being narrower. The harvest mice like the open ground, but must have sufficient cover to protect them from a host of enemies overhead. In places they apparently live in small burrows, but generally their trails seem to terminate at neat little nest balls on the surface or in low bushes and weeds. The nests are rarely found more than 8 or 10 inches from the ground, and more often they are lightly placed on the surface under some ample cover. At Hankinson, a harvest mouse was frightened from a pretty little grass nest in a lock of hay; the nest was a compact ball of fine grass lined with soft fibers, with a tiny opening at one side for a doorway.

Breeding habits.—Usually four to six young are brought forth and cared for in these birdlike nests, but at Oakes, on June 4, Eastgate took an old female that contained seven embryos. Apparently they breed more than once during the season, and in places where there is abundant food and good cover they sometimes become very numerous.

Food habits.—The principal part of the food of harvest mice consists of seeds, largely of grasses, which are found cut in small sections and drawn down until the seed-laden tops are within reach. The mice are fond of rolled oats and other grains used for trap bait and their presence in the fields indicates a fondness for the growing grains. They do not become fat in fall and evidently do not hibernate.

Economic status.—These little mice cover so small a part of North Dakota that they are of slight economic importance, but in areas where they are widely and abundantly distributed their inroads on the grain and forage production materially help to swell the total of rodent depredations. Although they are so small that any artificial means of combating their mischievous tendencies would be futile, effective check is constantly kept on their overabundance by such predatory birds and mammals as small owls, hawks, and probably crows, jays, magpies, and butcherbirds, as well as by weasels, skunks, and badgers.

Onychomys leucogaster leucogaster (Wied)

Maximilian Grasshopper Mouse

(Pl. 13, fig. 1)

Michtika of the Mandans (Maximilian)[15]; *Michtik-tak* of the Mandans (Gilmore).

Hypudaeus leucogaster Wied, Reise in das Innere Nord-America, Bd. 2, p. 99, 1841.

Type locality.—Fort Clark, Oliver County, N. Dak.

General characters.—Somewhat resembling the white-footed mice, but recognized at once by larger size, heavier build, short, thick, tapering tails, and

[15] This name is merely a general term for mice (George F. Will).

smaller ears. Legs also shorter and feet heavier, to harmonize with their entirely ground-dwelling habits. Upper parts dark drab-brown, darkest along the back; underparts and lower half and tip of tail white; immature specimens, dark slaty gray; occasional individuals nearly black. Average measurements of adults: Total length, 164 millimeters; tail, 42; hind foot, 22.

Distribution and habitat.—In his revision of the genus *Onychomys*, Hollister (1915, p. 434), refers all of the specimens from eastern North Dakota to the typical dark-colored subspecies *leucogaster* as described by Maximilian, Prince of Wied, from specimens taken by him at Fort Clark in 1833. The species as thus restricted covers little more than the eastern half of North Dakota, reaching slightly into western Minnesota and northeastern South Dakota and northward into southern Manitoba. There are specimens from Fort Clark, Linton, Grace, Devils Lake, Minot, Pembina, Sherbrooke, and Hankinson. None has been taken in the immediate valley of the Red River nor in the Turtle Mountains, but apparently the species covers the rest of the State either in this dark form or in the paler western form. It is strictly a prairie animal occurring neither in the forest nor the dense thickets, but scattered over the open country in bare and exposed situations as well as under the cover of grass, weeds, and low scattered shrubbery. Though widely distributed it is never very abundant locally.

General habits.—These anomalous little rodents, like the badger and other predatory animals, are apparently wanderers, to some extent, scattering out singly to cover their hunting grounds to the best advantage. Traps set at different kinds of burrows and holes in the ground over the prairie, under a variety of conditions, catch them apparently at random. Sometimes a whole family will be caught in a little thicket or weed patch or a few may be caught every night along a weedy fence row, where they evidently are hunting for their nocturnal prey, but there seems to be no specific place to look for them and rarely is there any trail, burrow, or sign found that can be unmistakenly attributed to them. Most of the specimens taken are caught by accident in traps set for other species.

At Fort Clark, Jewett caught them at small holes or the deserted burrows of ground squirrels and pocket gophers over the prairie, or along the edges of fields. At Hankinson specimens were taken among the sandy dunes, often on bare sand, but also in the rows of tumbleweeds along the fences. Some were caught in burrows of other animals and some in burrows that may have been made by the mice themselves; others in trails made by scraping with the foot in the sand for a distance of 8 or 10 feet; like many other species of mice, they will follow such a trail and are easily caught in traps set across it. Often they are caught in old badger holes, where apparently they are foraging for insects.

While mainly nocturnal they are less strictly so than the white-footed mice, and the writer has seen them running through the weeds in the daytime and on one occasion he shot one about 8 a. m. Generally they are unknown to residents of the country, who probably mistake them for the common white-footed mice. Many are doubtless thrown out of their burrows by the plow, but no one seems to have recorded anything regarding their habitations or home life. At night their fine, prolonged whistle, almost insectlike in pitch and quality, was often heard around the camps, but nearly the whole

summer of 1887 passed before it was discovered to what form the voice belonged.

Hibernation.—In fall these mice become moderately fat, but whether they hibernate in this climate is still a question. Farther south closely related species are caught at all seasons, but in a region well covered with snow for a large part of the winter they would have difficulty in procuring a food supply, as apparently they do not lay up stores or make any provision for winter.

Breeding habits.—An old female caught at Grace, July 2, 1912, contained four large embryos, which seems to be the usual number of young. The mammae of the females are arranged in three pairs, two pairs of inguinal and one pair of pectoral, and probably like other species of the genus the young are occasionally five or six in number.

Food habits.—Grasshopper mice are omnivorous in their tastes, readily accepting rolled oats, bread, cake, cheese, seeds, or grain as trap bait, but show a decided preference for animal food, as indicated by the examination of a great number of stomachs. At Fort Clark, the type locality, Jewett took a fine series of specimens, both old and young, in traps set around the edges of wheatfields and baited with fresh meat or bacon. He says some were taken in meal-baited traps, but that they prefer meat. Grasshoppers, crickets, beetles, and a great variety of other insects are found in their stomachs, also often the flesh and hair of other mice which have been caught or found dead. At Hankinson many of the other mice in the traps were eaten and the stomachs of grasshopper mice caught near by often proved that they had been the trap robbers.

Economic status.—The only complaint of these mice doing any mischief seems to come from their discoverer, Maximilian (Wied, 1839–1841, Bd. 2, p. 101, 1841), in 1833, at the Mandan villages, where he reported them as common over the prairie and in winter coming into the Indians' houses, where all sorts of stores were kept. He says the Mandans call them "mihtick," as they do all kinds of mice. There is no doubt that Maximilian knew the species, as his description is full and perfect, but it is suspected that the mice which did the mischief in the Indian stores were mainly the white-footed species, which also were abundant there. At Fort Berthold, in 1872–73, Doctor McChesney (1878, p. 206) reported them abundant and inhabiting the underground caches of the Indians. Before a definite statement can be made as to the destructiveness of these mice, more complete knowledge of their habits will be necessary. The great numbers of injurious insects eaten by them and their destruction of some other and more troublesome species of mice should class them among the highly beneficial mammals. A more detailed study of their habits is likely to prove of practical value.

Onychomys leucogaster missouriensis (Audubon and Bachman)

Audubon Grasshopper Mouse

Mus missouriensis Audubon and Bachman, Quad. North Amer., vol. 2, p. 327, 1851.

Type locality.—Fort Union (now Buford), N. Dak.

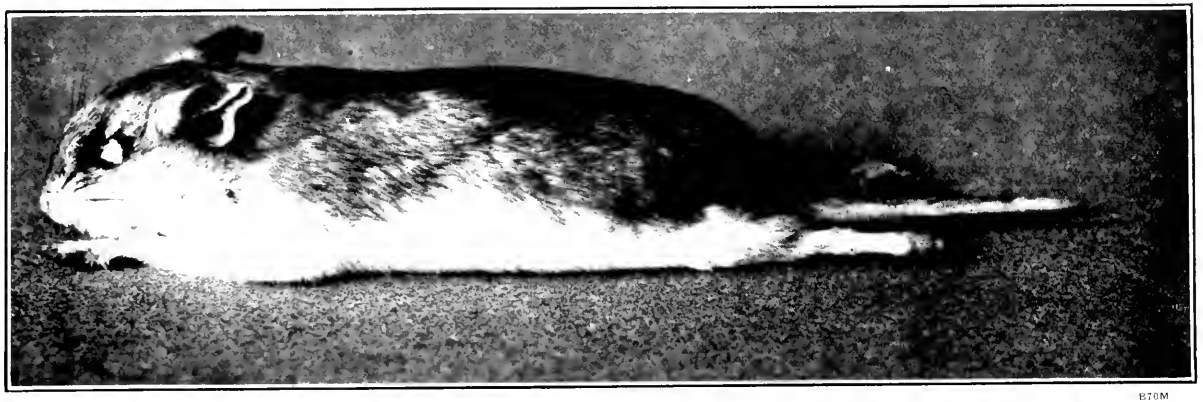
General characters.—Very similar to *leucogaster*, but slightly smaller and much paler, the upper parts being buffy brown, darker in winter pelage, and underparts white; immature specimens, slaty gray. Average measurements of adults: Total length, 150 millimeters; tail, 39; hind foot, 21.

Distribution and habitat.—The paler form of the grasshopper mouse comes into western North Dakota from a wide range over the semiarid plains of Montana, Wyoming, and Saskatchewan. There are specimens from Buford, Dickinson, Glen Ullin, and Cannon Ball. Although few specimens have been taken, the mice undoubtedly cover the whole western part of the State, grading insensibly into the darker-colored *leucogaster* near the type locality of that species, Fort Clark. They belong to the short-grass prairie or plains of the semiarid region and seem to be generally distributed over the open country.

General habits.—One of these mice brought to Audubon at Fort Union on July 14, 1843, was figured and described in his (Audubon, 1851–1854, vol. 2, p. 327, pl. 20–C, 1851) Quadrupeds of North America. Thus the species was made known and named, but nothing whatever learned of its habits. In 1887, with instructions to make a special study of the habits of this mouse, the writer visited Fort Buford. With such crude collecting traps as were available at that time a considerable number of specimens was obtained, most of them being caught alive in little tin box traps. They were common over the hills and prairies, living in burrows of other small animals, as pocket gophers, ground squirrels, other mice, and even in old badger holes. Some were caught at the burrows of the pale field mouse *Microtus pallidus*, which they were probably hunting for food. Some of the fresh burrows in which they were caught may have been of their own construction, but probably were the burrows of other mice, to which they were only paying visits in order to capturing prey. The bait first used for them was cheese and doughnuts, but since then a bit of fresh meat has been found much more attractive.

One of the mice caught in a box trap was not quite full grown and seemed so gentle and interesting that a cage was made for it and it was kept for some months. From the first it was not in the least alarmed and when handled never offered to bite nor struggled to escape, although in the cage at times it became frantic in its efforts to get back to its natural haunts. Unless very hungry it would sleep all day, but on waking up in the evening, after stretching and gaping and blinking for a while, would become thoroughly roused and eager to get out and hunt for its supper. It did not like a bright light and would show signs of discomfort by blinking its eyes, but, with its box faced away from the light, was very bright and animated. At a touch on the box it would come to the front and eagerly take whatever food was put in between the wires. Any insect put inside was quickly caught, and even flies would rarely escape it.

From the trap line the writer always brought back plenty of food for the mouse and greatly enjoyed watching it eat the different kinds of insects. In one forenoon it ate 16 crickets, 11 grasshoppers, 1 spider, 1 black bug, and 1 big fly. Its favorite food seemed to be crickets, and it would never touch anything else while there was a cricket in its box. Next to crickets it liked grasshoppers or flies, but did not seem to care much for beetles, although it would eat any kind offered including some ladybugs and a small black species that was common under sticks and stones, and it seemed to relish a potato bug found



B70M

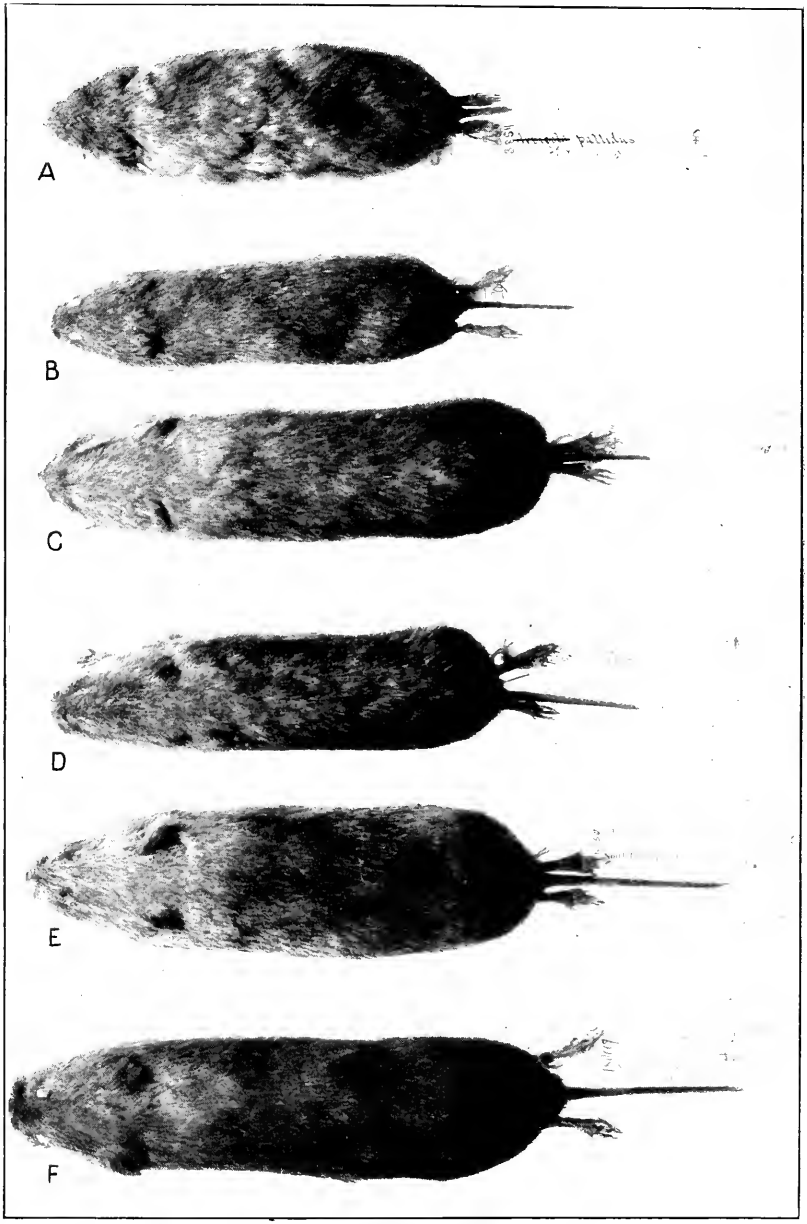
FIG. 1.—GRASSHOPPER MOUSE (ONYCHOMYS LEUCOGASTER LEUCOGASTER)

From photograph, about natural size, of specimen in National Museum

B1327M

FIG. 2.—PALE BUSHY-TAILED WOOD RAT (NEOTOMA CINEREA RUPICOLA)

Specimen in National Museum. About half natural size



B1329M

SKINS OF SHORT-TAILED MICE

(A) Pale mouse (*Microtus pallidus*); (B) little upland mouse (*Microtus minor*); (C) western upland mouse (*Microtus ochrogaster haydenii*); (D) Drummond meadow mouse (*Microtus pennsylvanicus drummondi*); (E) bean mouse (*Microtus pennsylvanicus wahema*); (F) eastern meadow mouse (*Microtus pennsylvanicus pennsylvanicus*). About half natural size

for it, as it ate all but the wings and legs. One day it ate 12 crickets and 1 spider in 7 minutes; and a little later, 11 grasshoppers, 4 crickets, 1 black bug, and 1 large fly, making 29 large insects and 1 spider eaten in about 4 hours, and it still seemed hungry. On another day the mouse ate 28 crickets, 15 flies, 8 grasshoppers, and 2 beetles, in all 53 insects in less than 12 hours. It seemed to relish a common gray moth and enjoyed a black hornet until it came to the tail, when the stinger evidently pricked its nose. Ants were the only insects it ever refused and a few of these in its box would make it violently frantic.

To see it eat a large grasshopper was amusing. The mouse would hold the grasshopper upright between its hands and begin on the head, when a few vigorous kicks of the grasshopper would tip it over backward; but it would never let go until the head was eaten off and and the body devoured. The wings and legs would drop off as it progressed, and if the mouse was still hungry they would be eaten later. If a number of grasshoppers were put into its box at one time, it would first bite off the heads of all, so that none would escape, and then finish them at its leisure. One day the mouse killed and ate a small frog, but did not seem to care much for it. Only when very hungry would it eat seeds and green leaves of plants.

It pounced like a cat upon a dead white-footed mouse dropped into its box, caught it beside the head near the ear, and began biting with all the ferocity of a carnivore. The bones could be heard to crack, and when taken out a small hole was found broken through the base of the skull. Its teeth had penetrated well into the brain. The dead mouse was returned to its captor, which began to tear and pull off strips of skin and flesh from the neck, shoulders, and head, and ate both of its eyes. Another mouse that was put into its cage was treated in the same way, and a song sparrow that had been accidentally killed the mouse bit through the head and then partially ate. It ate part of a mouse of its own kind, thus proving to be cannibalistic as well as carnivorous. It was fond of bits of fresh meat and especially of brains that were given it while specimens were being prepared.

The fierceness shown in attacking mice indicated a habit of capturing and killing these animals in their free state. In spite of its savage disposition and carnivorous tastes, it was the gentlest rodent to handle, as well as one of the most interesting and attractive pets; others of closely related species generally show similar dispositions.

Breeding habits.—On May 30, 1910, H. E. Anthony caught an old female at Buford, containing four embryos. Little is known, however, of the breeding or other home habits of these mice.

Hibernation.—One adult caught at Fort Buford in September was so fat as to suggest preparation for hibernation, but the fat was not distributed in a thick layer under the skin as is the case in most hibernating mammals. The question of their hibernation in the North is still to be determined.

Economic status.—Grasshopper mice make extremely interesting pets and their field of usefulness seems well worth careful investigation. They might in certain cases be used to advantage in keeping down insect pests in greenhouses and other buildings, and it is probable that their carnivorous propensities would render them valuable in combating other more destructive mice.

Neotoma cinerea rupicola Allen
Pale Bushy-tailed Wood Rat

(Pl. 13, fig. 2)

Neotoma rupicola Allen, Bul. Amer. Mus. Nat. Hist., vol. 6, p. 323, 1894.

Type locality.—Corral Draw, southeast base of Black Hills, S. Dak.

General characters.—About the size of the wharf rat, but of very different appearance. Ears and eyes, large; mustache, very long; tail, bushy, almost squirrel-like; fur, long and soft; expression, animated. Color of upper parts, pale pinkish buff; the feet and underparts, white. Young, light buffy gray; tails, mostly white, not buffy. Measurements of average adults: Total length, 349 millimeters; tail, 144; hind foot, 43.

Distribution and habitat.—Wood rats are scattered over the State from the Missouri River Valley westward, or throughout the Badlands region. Just where they grade into the slightly darker *cinerea* is not entirely worked out, but probably somewhat west of the line between North Dakota and Montana. They are nowhere abundant or even common, but seem to be generally distributed wherever there are Badlands cliffs and ledges to afford suitable homes and protection from their enemies. Their range can hardly be considered continuous, but they have managed to scatter from one cliff to another until they have occupied almost every suitable rocky slope. There are specimens from Mikkelson, Oakdale, Wade, and the Little Missouri River near the former Dakota National Forest, and their unmistakable signs have been found at Marmarth, Deep Creek, Medora, the White House Ranch (18 miles southeast of Williston), and near Goodall and Parkin. A few were reported at Cannon Ball, and Doctor Bell caught two at Wade. In 1833, Maximilian (Wied, 1839–1841, Bd. 1, p. 438, 1839; Bd. 2, p. 89, 1841) reported them in the forest at Fort Union, at Cedar Island, and at Fort Clark. In 1869 Cooper (1869, p. 296) reported them in the rock bluffs that border the Missouri River above Great Bend. In 1872, Doctor Allen (1875, p. 42) found them more or less frequent in the timbered portions of the streams west of Fort Rice. Their principal strongholds are cliffs and ledges, but they also occupy the cottonwood forests in the stream valleys, where hollow logs and trees often offer choice homes, and dense masses of bullberry brush and impenetrable cover afford the protection necessary for their existence. They are quick to find and occupy buildings of any sort, and for this reason their presence is soon made known wherever they occur.

General habits.—In habits as well as appearance wood rats are entirely unlike the Old World rats, and it is unfortunate that they should have to bear the odious name. Their long mustaches and big ears and eyes give them an even more animated expression than that of the squirrels. While mainly nocturnal, they are occasionally seen by day when disturbed from their cozy nests in cabins or cliffs. They are timid animals, with practically no means of defense against numerous enemies except the barricades of their dwellings. Their favorite home is a cleft in the rocks where narrow cracks admit them to deeper cavities or where the openings can be blocked with sticks, stones, and rubbish to keep out larger animals. This building habit has become so fixed that their first instinct is to gather building material wherever they are. Even where it is not

needed they often pile up heaps of rubbish, sometimes in front of their doorways, sometimes in large openings that they could never hope to fill. These accumulations remain for years in the caves and caverns, or hollow logs, trees, or cabins, where the wood rats have been; as also do the long black pellets of excrement. In buildings to which they have gained access all small articles of a convenient size are usually gathered into one corner to protect the nest, but sometimes they are piled into a box, cupboard, or stove, or heaped up in some doorway that the rats would like to be able to close. In occupied buildings they are noisy and mischievous, but may soon be discovered and disposed of.

Roosevelt (1900c, pp. 66–67), on returning to his ranch on the Little Missouri when it had been unoccupied for some months, found that "within doors the bushy-tailed pack-rats had possession, and at night they held a perfect witches' Sabbath in the garret and kitchen." Half the cotton had been dragged out of a mattress and made into a big, fluffy nest that entirely filled the oven. In 1909 one of their old rubbish houses was found in the rocks not far from Marmarth and two of the animals were said to have been caught in a house at the edge of town not long before. At Medora, Jewett was told that they occasionally came into the houses, but he could not find any while there, although he found signs of their characteristic work in the rocky ledges about 10 miles farther north, and took two immature specimens near Mikkelson. At Goodall, in the Killdeer Mountains, he was told that they rarely came into buildings, but he obtained two specimens in a ledge about a mile south of town. In the little Missouri Valley, about 25 miles south of Medora, the writer found their signs and old building material quite common in the Badlands gulches, in one of which Jewett obtained a specimen. South of the Missouri River, a little below Williston, old signs were found among the rocks in several places, but no specimens were taken.

Near Goodall, Kellogg reported one caught by a cat on the Goodall ranch, but apparently they were not common in that vicinity. Near Cannon Ball, Sheldon learned of several that had been caught, one in the cellar of an old sod building, and another near the mouth of the Cannonball River in the forested bottoms. At Wade, farther up the Cannonball River, W. B. Bell collected two specimens in a cave in the cedar-covered buttes, and reported them as frequently entering houses and stables of settlers, where they occasionally did considerable mischief.

Breeding habits.—Wood rats, like the other members of the group, probably have two or sometimes four young, which are raised in the soft birdlike nests of their safe retreats. Apparently only one litter of young is raised in a year, so that reproduction is not rapid and there is little danger that these rodents will become very numerous.

Food habits.—Examination of stomachs shows that the food of wood rats consists largely of green vegetation. One taken on the Little Missouri River had green foliage and buffaloberries in its stomach. About their occupied dens there are always traces of various plants brought in for food, and apparently these are brought in for the foliage more than for seeds. The rats, however, are eager for rolled oats, grain, fruit, or bacon used as trap bait and are easily

caught wherever they occur. They do not become fat in fall nor show any signs of hibernation during the coldest winter weather. Generally they lay up stores of green plants, berries, and seeds, which become dried and well cured for winter food, the dry vegetation forming the great bulk of the winter stores.

Economic status.—In North Dakota wood rats are not sufficiently abundant to be of any great economic importance, although related species in other parts of the country are very injurious to crops, forage, and native vegetation. Here they merely add a feature of interest to the picturesque cliffs of the Badlands, with which they are closely associated. They have a strong and not unpleasant musky odor which apparently comes from the glands of the skin; it in no way affects the flesh, which is sweet and delicate as that of young rabbits. Although too small to be of any value as game animals, wood rats are in every way suitable for food. There is a possibility of their serving as interesting pets for children, if properly tamed and kept within bounds.

Evotomys gapperi loringi Bailey

Red-backed Mouse

Evotomys gapperi loringi Bailey, Proc. Biol. Soc. Washington, vol. 11, p. 125, 1897.

Type locality.—Portland, N. Dak.

General characters.—In size somewhat smaller than the meadow mouse and of the same general form; ears small, nearly concealed in the long fur; tail, short; legs, short; eyes, small. Whole back, rich chestnut brown, lighter brown in winter; sides, gray; underparts, whitish. Average measurements: Total length, 123 millimeters; tail, 31; hind foot, 18. Weight, 18 to 22 grams.

Distribution and habitat.—Red-backed mice, which represent a small, pale form of a wide-ranging Boreal forest species, occupy the woods and thickets of the Transition-Zone plains region of North Dakota and central Minnesota. Specimens have been taken at Pembina, Grafton, Portland, Larimore, Devils Lake, Stump Lake, Valley City, Kathryn, throughout the Turtle Mountains and Pembina Hills, at Towner, Williston, Buford, Goodall, Elbowoods, Oakdale, Fort Clark, and Cannon Ball. In most of these localities the mice are abundant in the thickets and timber and it is probable that they occupy every suitable locality within the State.

General habits.—In the Turtle Mountains red-backed mice were abundant throughout the woods and brush, and many were caught in traps set under logs, near old stumps, at the bases of trees, in holes in banks, and on smooth ground where the leaves were scraped off to make an easy runway. At Portland, Loring reported them common, many being caught in traps set under logs and roots of trees. At Stump Lake the writer found them numerous in the woods, along the lake shore, and in the thickets out on the prairie. After dark one evening, the writer entered a dense thicket and, scraping away the leaves, set seven traps at random within a radius of 6 feet; the next morning five contained red-backed mice. At Cannon Ball he found the mice common in the forest on the river flats, and at Fort Clark and Oakdale, Jewett found them in similar situations. At the White House Ranch, 15 miles southeast of Williston, Doctor Bell and his party caught several among the dense growth of reeds

(*Phragmites*) at the edge of the woods, and at Fort Buford, Anthony found them common in the brushy river bottoms. Unlike meadow mice, they rarely make trails or roadways, but run at random over the leaves and open ground in the woods and bushes, or, preferably, under the cover of thickets and brush, so that little sign of them is noticed, even where they are abundant. They are by no means strictly nocturnal; occasionally the little animals are seen rustling about in the leaves and grass and nearly as many specimens are caught during the day as at night. To some extent they burrow in the ground, but any natural cavities in or under logs, stumps, or trees seem to answer their purpose for homes and nests.

Breeding habits.—Many of the females taken for specimens are found to contain embryos varying in number from 4 to 6, and occasionally 8. These are found at all times through the summer, which would indicate that several litters are raised in a season. As the mice do not hibernate, the breeding season probably covers all but the midwinter period.

Food habits.—The examination of stomach contents of red-backed mice shows usually a combination of seeds and green vegetation. Considerable grass and many small plants are found cut and partly eaten on their feeding grounds and some of these are drawn under the logs and brush where the animals live. They are always eager for rolled oats and will take almost any kind of grain or seed used for trap bait. At Walhalla, Williams caught one in his hands in the daytime, as it was eating a piece of bread crust in front of his tent. At Portland, Loring caught a large series of specimens by baiting his traps with meat, and found that occasionally they eat their own kind or other varieties of mice caught in traps where they run. For the greater part of the year, however, their principal food is green vegetation, which they find abundant even under the deep snow of winter, for they plow along the surface of the ground and come in contact with the tender shoots of frozen grass or roots under the leaf mold, or if these are not sufficient they gnaw the bark from bushes and small trees as high up as the snow offers concealment from their enemies above.

There is some evidence that the red-backed mice may be one of the bean-storing species of the Missouri River region. In attempting to discover what animal was really responsible for these caches of food which the Indians find, specimens of all of the small mice occurring at Cannon Ball were trapped, but the only evidence obtained in September, before the mice had begun making their winter stores, was the fondness shown by these mice for the mouse-beans (*Falcata comosa*). In one bean patch seven traps set on the bare ground, each baited with a half of one of these large, juicy underground beans, caught four of the mice in one night. The eagerness of the mice for the beans and their abundance in the localities where the beans grow suggests that the species may be in part responsible for the stores which have been an important food of the Indians and a boon to many early explorers.

Economic status.—As the red-backed mice occupy mainly woodland and thickets they are of no great economic importance in the grainfields or meadows, but wherever they come in contact with or-

chards and shrubbery, if present in great numbers, they are capable of doing considerable mischief, for trees and bushes girdled by them under the snow are usually killed or seriously injured. Their chief enemies are the small owls and hawks, weasels, skunks, and badgers, and these afford the principal protection we have from their depredations.

Microtus pennsylvanicus pennsylvanicus (Ord)

Eastern Meadow Mouse

(Pl. 14)

Mus pennsylvanica Ord, Guthrie's Geogr., 2d Amer. ed., vol. 2, p. 292, 1815. (Reprint by S. N. Rhoads, 1894).

Type locality.—Near Philadelphia, Pa.

General characters.—Size rather large for a meadow mouse; ears, tail, and legs, short; body, heavy and compact; fur, long and soft in winter, thin and harsh in summer. Colors, dark brown or blackish above, slightly paler and more grayish below. Average measurements of adults: Total length, 171 millimeters; tail, 46; hind foot, 21.2. An adult female from Grafton measured 162, 34, and 19, respectively, and weighed 43.6 grams.

Distribution and habitat.—From a wide range over the northeastern United States the abundant meadow mice, *pennsylvanicus*, barely reach into eastern North Dakota along the upper Red River Valley, and even here they are becoming slightly smaller than typical, in a very gradual gradation toward the little *drummondi*, which continues to the northwest. To this race are referred the Red River Valley specimens from Fairmount, Blackmer, Hankinson, Lidgerwood, Wahpeton, Fargo, Larimore, Grafton, and Drayton. Here, as in most of the range of the species, they inhabit mainly the marshes, but are occasionally also found on the uplands under any tall grass or dense vegetation.

General habits.—As their build and color suggests, meadow mice are ground dwellers and spend most of their lives under the shadowy cover of dense vegetation. They burrow in the ground, which is often perforated with their little round tunnels, while over the surface they make well-defined roads or runways from one burrow to another or from their nests and burrows to feeding grounds, but always under the protecting cover of grass or other plants. They are partial to moist ground and prefer rough meadows where moisture is abundant and where water often stands over part of the surface. They are good swimmers and seem as much at home in water as on land, swimming from side to side of little streams or ponds and diving and swimming under water when necessary. Their runways often lead through wet places, but dry banks or hillocks are always sought for their nest cavities. In summer they frequent the meadows and low moist ground, but in winter they leave their low underground burrows and push out under the snow of the uplands, extending their tunnels along the surface of the ground and building warm grass nests on the surface wherever they find an abundant food supply. In this way they often range over uplands, fields, and orchards in great numbers; and when the snow goes off in their winter nests exposed, they burrow into the ground again and spring, leaving their network of winter roads, their grass piles, and do not all get back into the meadows until the dry weather of summer compels their return to the moist lowlands.

Apparently they are about as much diurnal as nocturnal, although they appear to be most active in the early evening hours. Some are caught in traps during any part of the day or night, but they seem to fill up the collector's trap line more rapidly during the evening than at any other time. They do not become fat or hibernate and are active throughout the year without regard to weather.

At Hankinson, in July, 1912, they were found common in places where there was tall grass on the prairie, but more especially so in the meadows and among the tall tules on wet ground. After the hay was cut on the meadows they gathered under the haycocks in considerable numbers, and as these were loaded and hauled away the mice were forced out into the open stubble, where hawks or owls were constantly hunting them. As many of the extensive tule marshes in this region are never cut, they afford a safe harbor for the mice in which to multiply and from which to spread over the meadows and prairies. Similar conditions were found at Wahpeton, near Fargo and Grafton.

Breeding habits.—Meadow mice are very prolific and seem to have no well-defined breeding season. Females taken at any time of year from May to October are found to contain from 4 to 6 embryos and sometimes 8. Occasionally even in winter small young are found in nests or females are found with embryos. At times they increase very rapidly and remain abundant for a period, after which they become scarce, the variation presumably being correlated with protection from enemies and the abundance and quality of food. Their waves of abundance, which at times suggest migrating hordes, are undoubtedly due to favorable conditions for rapid reproduction.

Food habits.—During the summer the favorite food of meadow mice consists of tender vegetation, as the young shoots of grass, growing grain, clover, alfalfa, and a great variety of plants. Acceptable food is always abundant. Sometimes the tender bases of grasses are chosen, and again the seed-laden tops are drawn down within reach by cutting the stems into inch-long sections. Seeds and grain are always favorite foods, when they are available late in summer and in fall, but in winter the mice thrive equally well on the frozen grass and roots that they get under the snow, or on the bark from bushes or trees which they gnaw off with their sharp cutting teeth, under cover of deep snow.

They are particularly fond of the bark of many fruit trees, especially apple, but will eat the bark of almost any tree or shrub that is not too thick and hard for them to gnaw into. Aspens and willows are found peeled and killed by them, but most of the larger woodland trees are protected by their harsh outer bark. In trapping them rolled oats are a favorite bait, but they will take any kind of grain or seeds and are specially fond of fresh meat, fat pork, or bacon. Their carnivorous propensities are seen in trapping, as they almost invariably eat their own kind or other mice found dead in traps.

Economic status.—Over a wide range of rich farming country these are the most abundant mice in meadows, fields, timber, and orchards, and their total destruction of forage, hay, crops, trees, and shrubs annually causes an enormous loss in agricultural products. Among these losses nothing is more exasperating than the destruction of a few choice fruit trees in an orchard, or some choice shrubbery in

the yard, during the period of deep snow in winter. Orchards are infrequent in North Dakota, so that the few choice, hardy fruit trees that can be raised are of special importance, and if the bark is gnawed from the base, even on one side, the trees are often weakened so as to be unable to resist the severe climate to which they are exposed.

In wild-grass meadows the hay is not of sufficient value for the mice to cause much loss, but in meadows of clover and timothy and fields of alfalfa their mischief is much more serious. They enter grainfields as soon as the growing crop is sufficiently high to afford protection, and cut the grain shoots for food; then when the grain is headed out, they cut off the base of the stems, drawing down the heads in order to reach the green and ripening grain. After harvest they congregate in the grain shocks and if these are left long in the field considerable grain is eaten or shelled out and destroyed. As either these meadow mice or closely related species with similar habits cover all of North Dakota, the total loss from them is by no means insignificant. The importance of placing every possible check on their increase is obvious.

That they can be successfully poisoned when necessary has been demonstrated, but the expense suggests this method as a last resource. The most practical method of controlling the abundance of such small rodents is by protecting their natural enemies, among which the owls and certain species of hawks are foremost. The little owls, during the dusk of evening and all night long, are watching for them and miss no opportunity to pounce upon an unwary mouse that exposes itself. The marsh hawk, or mouse hawk, as often called, sailing low over the meadow and prairie, with eyes intently fixed on the ground, drops suddenly into the grass and secures a mouse more often than it does any other prey. Many other hawks feed upon them extensively, as do also foxes, badgers, skunks, and weasels. But for these enemies the mice would overrun the farms with disastrous results.

Microtus pennsylvanicus drummondi (Audubon and Bachman)
Drummond Meadow Mouse

(Pl. 14)

Arvicola drummondii Audubon and Bachman, Quadr. North Amer., vol. 3, p. 166 [1854].

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

General characters.—Similar to *pennsylvanicus*, but much smaller and slenderer, and slightly lighter, more yellowish brown in coloration. Average measurements of adults: Total length, 145 millimeters; tail, 39; hind foot, 17.8.

Distribution and habitat.—None of the North Dakota specimens of the little prairie or meadow mice are typical, but they are too small and slender-skulled to be called *pennsylvanicus* and can best be referred to *drummondi*, toward which they are slowly grading to the northwestward. The large series of specimens now available from many localities over the State show conclusively continuous range and complete intergradation between the two forms, and, *drummondi* is here placed as a subspecies of *pennsylvanicus*. To

it are referred specimens from Crosby, Lostwood, Kenmare, Towner, Turtle Mountains, Walhalla, Pembina, Sweetwater Lakes, Devils Lake, Stump Lake, Portland, Valley City, Lisbon, La Moure, Oakes, Ludden, Napoleon, and Dawson. This carries the range over the high glacial-prairie region between the Red and Missouri River Valleys to the southern boundary of the State and marks its southern limit from a wide range over western Canada to Alaska.

Over their part of the State Drummond meadow mice are very abundant and occupy the high open prairie, rich bottomlands, and grassy meadows. To some extent they are found in woods and thickets, but primarily they are dwellers in grasslands, wherever the low vegetation affords food and cover. In the Turtle Mountains, the writer found them abundant in marshes, meadows, banks, and grassy fields, and even in damp woods, but they were most numerous in the meadows, where the ground was perforated with their runways. In spots nearly half the grass had been cut down for food, leaving the earth strewn with the fragments. At Walhalla, in the Pembina Hills, Williams reported them inhabiting woods, grainfields, and meadows. On Bird Island, in the arm of Devils Lake, where cormorants nest, the grass was full of runways. At Stump Lake the runways were found in the prairie grass apparently without regard to whether the ground was wet or dry. At Valley City Eastgate reported them common along the river valley, around the marshes, and in prairie meadows, and the writer caught them around some seepage springs high up on the side of the bluff. At Lisbon, Doctor Fisher caught one in a swampy thicket; and so on over the State they have been reported from a great variety of localities.

General habits.—If their habits differ at all from those of *pennsylvanicus*, it is only in a more ready adaptation to high open ground, such as the grassy prairies of their range afford. Their more open habitat may well account for this slightly paler coloration. Their little roadways are often conspicuous through the prairie grass, especially where the old grass has fallen down and made a protecting cover over the surface of the ground. Old winter nests are found scattered over the surface, but rarely are they occupied during the summer; the principal nests are then in underground cavities to which the burrows lead.

Occasionally an occupied nest is found in some old haycock or grain shock that has been left out over winter, and at Crosby a nest was found occupied by young in a heap of last-year's weeds by the roadside. The nest, as usual, was made of soft grass blades, built into a neat hollow ball, clean and fresh, and with a soft lining inside. It was placed in a slight depression in the ground, where it was well protected from rain and snow by the mass of matted vegetation overhead. The four small young inside, with their eyes just opened, were of a beautiful golden-brown color, quite different from the sooty, or slaty gray, young of *pennsylvanicus* of the same age.

Breeding habits.—In the latter part of June, 1912, in the Turtle Mountains, great numbers of these mice were caught in traps so that many were thrown away after series were selected for specimens. There were all sizes and ages, from little fellows just out of

the nest to nearly full-grown young of the year, indicating at least two litters of young of that season, while many of the females contained small or large embryos, usually 6, 7, or 8. The mammae are arranged in two posterior and two anterior pairs, so that 8 is probably the normal maximum number of young. Apparently breeding continues throughout the summer, if not throughout the year, and reproduction is so rapid that only through a host of enemies are their numbers kept down to a safe limit.

Food habits.—Grass and weed stems are found cut in little sections near the runways and on the feeding grounds of these mice and over considerable areas where much of the grass has been cut by them. The mice are fond not only of seeds but also of grain, and enter fields readily and help themselves to growing crops. Although never fat, they are always well fed and their stomach contents show various mixtures of green plant tissue, white pulpy root and bulb tissue, and the meal or dough of finely masticated seeds and grain.

Economic status.—Over an immense area of rich grain-producing land these mice swarm in greater or less abundance, varying with the seasons and with the abundance of their enemies. It would be almost safe to predict that at times, through disturbance of normal conditions in the agricultural development of the country, these mice will increase so as to do serious injury to crops. In such case it may become necessary to use artificial means of destroying them, but as with other small rodents, a wise protection of their enemies will generally produce sufficient check on their abundance. The destruction of weasels for fur and too great a reduction of skunks and badgers are likely to have a marked effect on the abundance of these mice, while any wanton destruction of owls and mouse-feeding hawks would certainly be followed by an inordinate increase in the numbers of the rodents.

Microtus pennsylvanicus wahema[16] Bailey

Bean Mouse; Hetunka

(Pl. 11, fig. 2; pl. 14)

Hi^{n}tu^{n}ka of the Dakotas; *Gipápuli* of the Hidatsas; *Sakch* of the Arikaras; *Bidábaho itáhu* of the Hidatsas (all, Gilmore).

Microtus pennsylvanicus wahema Bailey, Journ. Mamm., vol. 1, p. 72, 1920.

Type locality.—Glendive, Mont.

General characters.—A pale form of *pennsylvanicus*, slightly smaller and very much paler and grayer than the eastern meadow mouse, which it represents in the arid Badlands region. Upper parts buffy gray; sides clear gray, underparts and feet and lower surface of tail pale gray or buffy white. Measurements of type specimen: Total length, 178 millimeters; tail, 43; hind foot, 20. Weight of adult female, from Cannon Ball, 30.8 grams.

Distribution and habitat.—Bean mice occupy the Badlands section of the Missouri River Valley and range westward over southwestern North Dakota and eastern Montana. There are specimens from near the mouth of the Cannonball River, Bismarck, Mandan, Fort Clark, 10 miles south of Williston on the west side of the river, Oak-

[16] Omaha name contributed by Doctor Gilmore, *Intshunga wahema*, the burying mouse, from its habit of storing food in the ground.

dale, Glen Ullin, and Sentinel Butte. This indicates a continuous range over the Badlands and sagebrush semiarid section of the State. In places the mice are found in marshy bottoms, but more often in the long grass of draws and on grassy benches of the ridges and buttes. Near the White House Ranch, about 12 miles south of Williston, a fine typical specimen was caught in 1913, on a grassy bench near the top of the Badlands border of the valley. At Fort Clark Jewett found others on high grassy slopes back of the valley bottom, and at Mandan on the high ridges wherever the grass was sufficiently dense to hide the animals and their runways. At Oakdale he found them about a small marshy place near a spring, where they were occupying the tall grass of a limited area. At Glen Ullin he found them common in the tall grass on moist ground along Curlew Creek, where their fresh runways were abundant. At Sentinel Butte he took specimens high up on the grassy slopes of the large butte south of town and others in the grass of a small slough near the station. Near Cannon Ball, Sheldon took specimens on the flats near the mouth of the Cannonball River and also on the high buttes to the north. In June, 1916, the writer collected them on the river flats near the mouth of the river and saw abundant signs in grassy places over the prairie and fields; and on October 30, 1919, took two of the mice at their nest and bean cache on the flats near the mouth of the river.

General habits.—In habits these mice differ from *pennsylvanicus* and *drummondi* only as their more arid habitat places them more in the open, sparsely covered, and grayer soil of this semiarid region, where they are evidently more exposed to light and to the numerous enemies overhead. The light-colored soils and minerals and general gray tone of sagebrush and prairie plants is evidenced in the color and, to some extent, in the habits of these little animals. They are less uniformly distributed over the area than are species in more fertile regions and in places they seem almost colonial, so locally are they gathered in the most favorable spots. In summer they were not easily caught in traps, as they seemed not to care for any bait that was offered them, and the few specimens taken merely ran through the traps set in their little runways under weeds and grass.

There has long been a question of whether these could be the bean-storing mice of the Indians of the Upper Missouri River, mentioned by Lewis and Clark and other early explorers as laying up such ample stores of wild beans, bulbs, and tubers, for a winter's supply of food that they formed one of the important sources of food supply for both Indians and whites. To decide this question many specimens of these, as well as of the other species of mice living along the Missouri Valley, were collected in localities where the Indians said the mouse stores were especially abundant. Some of the Indians and white men, who were familiar with the mouse stores, picked out the present species as the one which they had seen running away from the beans, but others were just as positive that the storers were the red-backed mice, white-footed mice, harvest mice, grasshopper mice, and pocket mice, while some thought the deposits were made by pocket gophers, ground squirrels, or chipmunks. Even the weasel was accused of storing these winter sup-

plies. The stores were frequently described and all seemed to agree as to their contents.

With pockets filled with underground beans of *Falcata comosa* (*maka ta omnicha*) and long tubers of wild artichoke, *Helianthus tuberosa* (*pa"gi*), and the little white tender roots of wild morning-glory, the writer was able to question the Indians intelligently about the stores and the way they were found and gathered and cooked. Although the mouse bean seemed to be the principal part of the stores that were sought by the Indians, the artichokes and morning-glory were said to be usually found with them, and one Indian insisted that the tipsin, *Psoralea esculenta*, was also sometimes found in the caches. One man insists that when driven away from their stores the mice often climb and take refuge in trees.

In describing the cache the Indians say that the mouse burrows enter the ground from several sides and the cavity where the food is stored often holds a peck or a pailful of beans and tubers. One Indian, who makes a special business of gathering these beans in the autumn, positively asserted that he could find enough in a day to fill a 2-bushel sack. The method of finding the stores is by noting either the burrows and runways centering at a certain point, or the tracks of the mice in the fresh snow leading to and from them. With a sharp stick the ground is probed, the cavities are soon discovered, and the beans removed. The fresh and wholesome vegetables were at one time an important adjunct to the meat diet of these hunting Indians, but at the present time their fields of vegetables and grain furnish an ample variety of food and the mouse stores are sought only by a few. The Indians claimed that it would be impossible to find the stores until late in October or early in November.

In October, 1919, six years later, the writer returned to the mouth of the Cannonball River in the hope of being able to settle the question of identity, and on next to the last day of the month succeeded in finding his first cache of beans and capturing the mouse with them. The night before he had trampled down the soft snow and in the morning found several fresh mouse holes made during the night, entering different sides of a mass of snow and leaves. Digging in one of these holes with the left hand the writer saw a mouse soon pop out on the other side, only to be caught in the right hand, and placed in a glove, and carried home alive. The cavity was then carefully dug out and examined. A warm nest of grass and soft plant fibers was found about 6 inches below the surface in a cavity where an old stump had decayed. In another cavity near the nest was a small collection of the mouse beans or ground peanuts, with artichokes and a few roots of the wild morning-glory. As the season had been very dry and both mice and beans were scarce, the cache was meager, but the cavity, which would have held several quarts or a peck, showed the old skins and remains of the previous year's collections. The store would doubtless have been added to until the ground froze so hard that no more beans could be dug. Though there may be other mice which store these beans, this meadow mouse is the first one actually caught at its cache and identified.

The Indians describe the cache as easily recognized by the little roads leading up to it from all sides, and tell how the mice drag

home loads of the beans on leaves. They have many legends and stories relating to these mice and their stores, which have been well translated by Doctors Beede and Gilmore, stories telling of the respect and reverence of the Indians for their little helpers, the mice people, of the payment in corn or other food for the beans taken, of the punishment of the hard-hearted woman who took all of the beans and left no exchange in food, and of the threat to fight any white man who attempted to capture or injure the mice or take their stores.

History.—The use of these ground beans evidently dates far back. Mr. Will (1917, p. 66) in speaking of the mythical origin of the Hidatsas from a hole in the ground in the vicinity of Devils Lake, says: "At that time the people cultivated ground beans and wild potatoes, two crops that were not really cultivated at all but merely gathered."

Apparently the first white men to mention the beans were Lewis and Clark (1893, p. 161, 263), in 1804, on their visit to the "Ricaras" (Hidatsas), when among other presents of food they were given "a large rich bean which they take from the mice of the prairie, which discover and collect it." The next spring their "Bird Woman," Sacagawea, gathered these food stores of the mice, which must have lasted over winter.

In 1833 Maximilian (Wied, 1843, p. 276) includes this bean among the plants used by the Mandan Indians as food under the name "feverolles (*Fabia minor equina*), a fruit resembling the bean which is said to grow in the ground but which I did not see."

Again, Father De Smet (1905, p. 655), an early missionary to the Indians of the Upper Missouri, as he left Fort Union in 1851 wrote in his journal:

> The earth pea and bean are also delicious and nourishing roots, found commonly in low and alluvial lands. The above-named roots form a considerable portion of the sustenance of these Indians during winter. They seek them in the places where the mice and other little animals, in particular the ground-squirrel, have piled them in heaps.

In 1855 Lieut. G. K. Warren (1856, p. 78) wrote:

> The groundnut, or *Apios tuberosa*, is very useful to the Indian. It grows very abundantly along the river bottoms, and is gathered in large quantities by a kind of wood-mouse for his winter store. The squaws make a business, during the months of October and November, of robbing these little animals, and I have often seen several bushels of the tubers in a single lodge. They are boiled with dried buffalo meat, and make a rich and palatable dish.

Thus a long and useful career has been shown for these little animals and we can well appreciate the feeling of regard for them still held by the older Indians. Now, however, that most of their range has become valuable grain land, their services are no longer needed and their inroads on grain, grass, and other crops are likely to prove as serious as those of other related species in agricultural areas. It is safe to say, however, that they will not be exterminated nor their numbers greatly reduced by the presence of the white man's civilization. The only danger is that under cover and stimulus of cultivated crops they may increase to such abundance as to become a menace, but if their natural enemies, owls, hawks, and weasels, are given a fair chance any overabundance will be effectively checked.

Microtus ochrogaster haydenii (Baird)
Western Upland Mouse

(Pl. 14)

Arvicola (*Pedomys*) *haydenii* Baird, Mamm. North Amer., p. 543, 1857.

Type locality.—Fort Pierre, S. Dak.

General characters.—A medium-sized field mouse of the subgenus *Pedomys*, with short ears, legs, and tail, the tail about twice as long as the hind foot. Color dull gray with a cinnamon tone, only slightly paler below. Fur long and lax, giving a pepper-and-salt effect of light-tipped hairs over dark underfur. Measurements of adult female from type locality: Total length, 180 millimeters; tail, 47; hind foot, 22.

Distribution and habitat.—The pale western form of *Microtus ochrogaster* of the central prairie States occupies the semiarid Plains region from Kansas to Montana, and comes into North Dakota west of the Missouri River. There are specimens from Cannon Ball and Wade, and the writer saw runways and burrows near Stanton that undoubtedly belong to this subspecies. Unlike the meadow mice, they avoid low or wet ground and usually are found on the high, dry prairie in rather open situations. In many places they occupy little thickets of rose and wolfberry bushes, but their characteristic runways and burrows are often found on the open ground, fully exposed to view.

General habits.—At Cannon Ball, the upland mice were found to be common over the prairie and on the dry valley bottoms. In places they were living under a good cover of prairie grass, where their little roadways over the surface of the ground led to the burrows and some old surface nests that had evidently been used during the winter. In other situations they lived in the thin prairie grass, where their runways were easily followed. In some locations they were living near the edges of thickets, where it would have been an easy matter for them to gather the mouse beans had they been inclined to store them. Specimens were easily caught by setting traps across the runways, baited with rolled oats, or even set unbaited, as in running along their roads the mice would trip over the trigger and spring the traps. To a certain extent they seemed colonial in habits, but probably this is merely because in a good location the family increases until the place is well stocked before the members of the colony begin to scatter out. At times they become very numerous locally, but, generally, the open nature of their habitat exposes them to so many enemies that they do not last long.

Food habits.—The food of this mouse is largely green vegetation, including the stems and leaves of grass and a great variety of little plants that are found cut in sections in their runways. It also eats the flowers and seeds of many plants, is usually eager for rolled oats or other kinds of grain used as trap bait, and will often eat its own kind found dead in traps. Preference for high and dry ground brings it much in contact with cultivated fields, where it finds choice food in the green or ripening crops.

Breeding habits.—Females taken for specimens often contain four to six embryos and the mammae are arranged in two posterior and one anterior pairs. Apparently they breed many times during the season and are only a little less prolific than meadow mice.

Economic status.—In North Dakota these mice have been so little observed that any injury to crops has escaped attention, but in other parts of their range, where farms and orchards have been of longer standing, they have been known to occasion serious losses by killing fruit trees and by destroying grain and grass in fields and meadows. Potentially they are dangerous occupants of any agricultural region and with unchecked abundance might become a serious pest.

Microtus minor (Merriam)
Little Upland Mouse

(Pl. 14)

Arvicola austerus minor Merriam, Amer. Nat., vol. 22, p. 600, 1888.

Type locality.—Bottineau, N. Dak.

General characters.—Smaller even than *drummondi*, with short ears, short tail, and coarse, lax fur. Color, coarse pepper-and-salt gray, produced by pale-buff tips of long hairs over black underfur; underparts but little paler. Adults measure in total length approximately 140 millimeters; tail, 33; hind foot, 17.

Distribution and habitat.—In a range extending from southern Minnesota to Edmonton, Alberta, the little upland mice cover approximately the eastern half of North Dakota. There are specimens from Bottineau, Kenmare, Starkweather, Goodall, Devils Lake, Stump Lake, Valley City, Sherbrooke, Oakes, Lidgerwood, Fairmount, Hankinson, and Blackmer. Over the prairie they are usually found on dry ridges or sandy soil, in which they delight to burrow. They seem to avoid low, damp ground and their habits as well as their fur mark them characteristic upland mice, a group quite apart from typical meadow mice.

General habits.—Apparently colonial in habits, the upland mice are usually found abundant in favorite spots and in no others for long distances. Often their burrows enter the ground in groups of half a dozen or more and are more or less connected below the surface. Some of these groups suggest a family colony, and others are more extensive and scattered along for a considerable distance in irregular formation. At Bottineau, in the summer of 1887, these mice were abundant over the dry prairie in small colonies, usually on mellow, somewhat sandy soil. At Kenmare, near the top of a high ridge or point of the prairie running out on the edge of Des Lacs Valley, their little runways and burrows were found numerous over the dry slope. The ground was covered with a network of fresh trails through the short prairie grass and there were three sets of burrows, in each of which 10 or 12 holes entered the ground within a radius of 2 or 3 feet. These seemed to be family or colony dens and several of the mice were caught around each group. Fresh earth was being thrown out on all sides and from each opening a trail led off to the feeding grounds or to other dens and burrows.

A number of traps were set and in one night about 20 of the mice were caught. Many were young of the year and of various sizes, but enough adults were obtained for a good series of specimens. Mouse traps were sunk in the ground across their runways and baited with rolled oats and ripe and green wheat, all of which were eagerly

accepted as bait. Near Blackmer, Sheldon and the writer found four distinct colonies in an alfalfa field and one on the prairie sod on the Clarey farm, not far from the station. Those in the alfalfa fields were the most extensive, covering from 2 to 3 square rods of ground each and consisting of 20 to 50 burrows and innumerable trails. The ground was thickly perforated by the burrows and generally half the alfalfa had been killed over the range of the colony. Much was cut and eaten on the surface, but considerably more was killed from below, evidently by having the roots eaten off in winter. As pasturing kept the crop low, there was no trouble in finding the mice, observing their habits, and obtaining a good series of specimens. A pair of short-eared owls were nesting in the adjoining field, and served to keep the mice within bounds, but if the alfalfa had been allowed to grow to full height the mice could have increased without interference.

At Valley City, the writer caught one on the high prairie under tumbleweeds, where a few of their old trails were found, though the mice seemed to be scarce. At Sherbrooke, Loring took six specimens in traps baited with meat and rolled oats, set along their beaten runways through the weeds. On the Peterson farm, 10 miles west of Portland, he took two in the daytime in runway traps, and at Portland caught others in similar manner. At Towner, Kellogg secured a specimen in an upland meadow, and at Goodall he found a colony on the sandy flats close to the river bank.

On the short-grass prairies these mice are exposed to view from overhead, but on the dark prairie soil in their little roadways they are protectively colored, and their habit of keeping close to their burrows and darting quickly from one burrow to another seems to be their main protection against numerous enemies.

Breeding habits.—As in other members of this subgenus (*Pedomys*) the mammae of the females are arranged in two pairs inguinal and one pair pectoral. Females have been taken containing four and eight embryos, but the normal maximum number of young is probably not more than six. Evidently the young are born at irregular times throughout the season, but the length of the breeding season and the number of litters have not been definitely determined.

Food habits.—Grass stems and many prairie plants are found cut in sections along the runways of these mice and near the burrows, while in numerous places little prairie bulbs, as those of the wild onion and the blazingstar, have been dug up and eaten. In the alfalfa field at Blackmer both the green leaves and tender stems of alfalfa plants were eaten, and underground the roots had been extensively gnawed. The fondness of the mice for rolled oats, grain, and meat, used for baiting traps, indicates a wide range of food.

Economic status.—From the nature of their habitat in fields and on the uplands these mice are likely to prove as injurious to crops as any of the other species, and under favorable conditions of food and cover, such as are found in extensive alfalfa fields, they might well become a serious pest. Where exposed to their natural enemies, however, they are not likely to do more than merely swell the total loss chargeable to small rodents.

Microtus pallidus (Merriam)

Pale Mouse

(Pl. 14)

Arvicola (Chilotus) pallidus Merriam, Amer. Nat., vol. 22, p. 704, 1888.

Type locality.—Fort Buford, N. Dak.

General characters.—Recognized by its small size, compact form, and very short tail, which is but little longer than its hind foot; fine soft fur of a light buffy gray color over the upper parts and creamy white below; ears and nose conspicuously yellow. The type, an adult female, measures in total length, 121 millimeters; tail, 20; hind foot, 18.

Distribution and habitat.—The rare little pale mouse (subgenus *Lagurus*) is known from only a few scattered localities from western North Dakota, Montana, and Alberta. Two localities only are represented by specimens from North Dakota—Fort Buford and Glen Ullin. In September, 1887, the writer first found them on a Badlands butte, 2 miles east of Fort Buford, where they seemed quite common in the half-barren ground just below the top on the north slope. The only reason that could be suggested for their choice of location on the north sides of the hills was that the twilight, their favorite time for activity, was longer on the shady slopes. The vegetation seemed to be about the same all the way around the summits of the hills and at best was only scantily represented. At Glen Ullin, Osgood collected three specimens in September, 1901. This is on the high dry prairie, but no report was made of the exact location at which they were caught.

Apparently this is one of the rare species which occurs only at widely scattered localities, and may be nearing extinction. No mammal has been more sought for by collectors in the region where it occurs, and with so little success. In 1915, and 1919, the writer again visited the butte where the type was collected, but could find no trace of burrows or runways on this or any of the neighboring buttes.

General habits.—Apparently all that is known of the habits of the pale mouse is the little gleaned from the few specimens collected at the type locality, where they were living in a colony along the shady slope of the butte. The little round burrows entered the side-hill at frequent intervals along the well-worn runways leading around the slope. In places the runways passed over grassy ground, where they were well packed by the little feet constantly using them. In other places they passed over naked soil and were only detected by the smoothly worn surface. At that time no suitable traps for catching such little animals were available and the mice seemed strangely suspicious of the clumsy box traps. Only four specimens were taken, although the colony was quite extensive and probably contained a dozen or more individuals. Rolled oats and traps now used had not been invented in those days and the mice did not care for any of the baits offered them.

Food habits.—A large part of the food of these mice seemed at that time to consist of the flowers of the little silver sage (*Artemisia frigida*) and the blazing star (*Liatris graminifolia*), and the stems and pieces left from these plants were scattered along the runways and about the entrances of the burrows; heads and seeds of winter-fat (*Eurotia lanata*) also were eaten. Many grasses and other plants

had been cut, apparently for food. A partly eaten bulb of the blazingstar was found near a runway, where it had been dug up. Corn and oats, and the seeds of cactus and other plants and also bread, cake, and cheese, were placed around the burrows, but it all remained untouched. None of the specimens taken showed any signs of becoming fat and it is improbable that they hibernate, even in this northern latitude.

As a young naturalist, for the first time away from his home fauna and among new and strange animals where the thrill of discovery was not infrequent, the writer recognized this mouse as something strange and probably new, and it was with the keenest pleasure that a communication was received from Doctor Merriam, stating that he, also, had been unable to identify it as a member of any described species.

Fiber zibethicus cinnamominus Hollister

Great Plains Muskrat

Zih-zirukka of the Hidatsas (Maximilian); *Sinkpé* of the Dakotas (Gilmore): *Shantshuke* of the Mandans (Will): *Citakh* of the *Arikaras* (Gilmore).

Fiber zibethicus cinnamominus Hollister, Proc. Biol. Soc. Washington, vol. 23, p. 125, 1910.

Type locality.—Wakeeney, Trego County, Kans.

General characters.—Size medium for a muskrat, not so large as the more northern nor so small as the southern species. Fur, dense and soft; ears, short; tail, long, nearly naked, flattened and rudder-like; hind feet, large and webbed; musk glands, well developed. Measurements of adults: Total length, about 496 millimeters; tail, 240; hind foot, 73 or 74. Weight, about 2 or 3 pounds.

Distribution and habitat.—The bright-colored Plains form of the muskrat, as defined by Hollister (1911), covers the central Plains region from Oklahoma to Manitoba, including all of North Dakota. There are specimens in the National Museum collections from Fairmount, Oakes, Lisbon, Valley City, Grafton, Fish Lake, Wood Lake, Towner, Elbowoods, Grinnell, Buford, and Dawson. It is safe to say there are muskrats in every suitable slough and lake, marsh and stream in North Dakota, in numbers ranging from a few individuals in the smaller ponds to thousands in some of the extensive marsh and lake areas. While it is impossible to obtain a reliable estimate of their numbers, or of the numbers taken for fur each year, they certainly are the most abundant and valuable fur-bearing animals of the State, as they are of the whole United States.

General habits.—In the lakes and extensive tule marshes near Hankinson, the writer found muskrats abundant in 1912, and there were many old muskrat houses along the shores and numerous bank burrows leading up from under water along the margins of the lakes. As usual, much trapping kept the animals down to a small part of the number that the lakes could profitably carry. They were common at Wahpeton in the river and sloughs, and at Fargo, where they live in the Red River banks, and at Stump Lake and Devils Lake in the tule-bordered sloughs over the prairie; they were scarce, however, in the brackish and alkaline water of the lakes.

In the Turtle Mountains they were found in the lakes and sloughs with which this hilly and forested region abounds, and were especially numerous in the beautiful clear water of Gravel Lake, where a novel use was found for them near the fish hatchery, and where trapping was not allowed. The lake had been stocked with trout, perch, and bass, and the muskrats were protected and allowed to build their houses along the shores in order to keep breathing holes open to prevent the ice from closing up so completely as to smother the fish. Both fish and muskrats were thriving and multiplying rapidly and the system seemed to be working remarkably well. The muskrats were comparatively tame and it was a pleasure to watch them swimming, diving, and feeding out in the water. They would often lie stretched at full length on the surface, eating roots which they held in their hands above the water. Others would sit in round furry balls on the ends of logs or on the edges of their half-submerged houses, munching the green plant stems or tender roots and bulbs, which they had procured from the bottom of the lake or from the grassy banks.

Just across the ridge from this lake, at the fish hatchery, other muskrats were doing considerable mischief in the fish-breeding pond by tunneling through the banks and letting out the water. The half dozen animals that were doing this mischief could have been caught with very little trouble and the banks protected, but the feeling seemed to be growing that the muskrats were a great nuisance, fostered probably by the lake full of valuable fur just over the ridge. Wherever the lake banks are high enough for burrows the muskrats live mainly in bank dens, but in the wide tule-bordered lakes and sloughs, where the water is so deep that the winter ice will not reach the bottom, they build large winter houses out in the water. Thus the abundance of muskrat houses in one situation is no indication of a greater number of the animals than in adjoining lakes where none are seen.

Around the Sweetwater Lakes muskrats are generally abundant in spite of much trapping, as the marshes are very extensive and the conditions ideal for them. About Castleton, Loring reported them wherever any water could be found. Sheldon reported them common along the lake shore near Dawson, and Kellogg reported them in Wood Lake, and especially abundant in Muskrat Lake, Sullys Lake, along Shell Creek, in Turtle Creek, and at many points along the Missouri River and adjoining sloughs and streams, from Grinnell to Bismarck. In 1915 Sheldon found them abundant across the southern part of the State, from Fairmount and Oakes to Napoleon and Cannon Ball and the Badlands farther west. Along the Little Missouri River Valley, in 1913, Jewett found comparatively few in the creeks and sloughs.

Although leading mainly aquatic lives, muskrats are perfectly at home on dry land, and often when their stream or pond dries up will strike out across the prairie to find a new home. Their peculiar tracks, showing the large hind feet and small front feet, with a narrow line where the tail drags, are often seen in dusty roads and in trails between sloughs. They are sturdy fighters, and if cornered will combat anything that comes along, but if taken when young and tamed they make gentle and interesting pets.

They are great builders and work industriously to make the walls of their houses thick and firm before cold weather comes. It is often said that the larger the houses and thicker the walls, the colder the winter is going to be, but even muskrats sometimes make mistakes in their forecasts. As long as open water is available underneath, cold weather has no terrors for the animals in their winter homes; but the thicker and icier the walls of their houses, the safer they are from all enemies except man and his traps. Usually two or more openings lead from the nest chamber in the center of the house down into the water, and as long as these openings are kept clear the animals are free to come and go as far as water extends under the ice. Air holes through the ice are kept open in the vicinity of the houses or bank burrows and apparently the animals obtain plenty of oxygen from these and the bubbles lying under the ice, or from the air carried in their dense coats of waterproof fur.

Breeding habits.—The young are usually brought forth in bank burrows, apparently sometime in May, and in June they are first seen swimming about as little quarter-grown muskrats. Apparently six to eight to a litter are the usual numbers; some credit them with two or three litters during a season. Half-grown young occasionally caught in fall are generally supposed to be from second litters, but they may be merely the first litters of late young of the previous year. Apparently the young of the year do not attain full size and weight the first fall, but by the following spring it is difficult to distinguish between most of the yearling and older animals. They are very prolific, have few enemies except man, and will quickly and abundantly restock suitable grounds where they are given protection. Like other rodents, they show no signs of mating for more than a brief temporary period. The whole care of the family devolves upon the mother, for after the young are born the male has no further place in the family life. Apparently the males fight for supremacy, as occasionally one is caught with its skin cut full of slits, evidently by the incisor teeth of an opponent.

Food habits.—In summer the muskrats feed on the tender shoots and stems of numerous grasses, tules, cat-tails, and water plants along the shores, on roots and bulbs, which they take from the bottoms and banks, and to some extent on mussels and other animal food. In July, 1893, Doctor Fisher reported that in the Sheyenne River, near Lisbon, where they were common, he found piles of mussel shells at various places along the banks where the muskrats were in the habit of feeding. In Apple Creek, near Bismarck, they were found in the same ponds with the beavers and several were caught in beaver traps. Many little heaps of fresh-water mussel shells were found along the banks where muskrats had been feeding, and Doctor Bell actually saw a muskrat bring up and cut open one of these shells. In many places where they are in the habit of feeding, the accumulation of grass and plant stems builds up little mounds or platforms on which they sit while eating their meals. They are said to be very fond of carrots and parsnips, which are often used for trap bait.

Economic status.—Under certain circumstances muskrats do serious damage, as when they get into irrigation ditches, artificial ponds with dams or raised banks, or in roadways through marshes.

Their burrows will quickly destroy ditch banks and dams. In 1916, they had nearly ruined a graded road running west from Devils Lake for about 2 miles through a large marsh. In about 50 places they had burrowed into the sides of the grade and in many cases clear across under the road, causing the surface to break through into the soft mud below. They had also made hollow dens under the road into which passing horses had broken through. The road was graded only about 2 feet above the surface of the marsh, but even if it had been raised much higher the burrows and dens would have been a constant menace. It would have taken at least $100 to repair this road at the time it was examined, and repairs would have been useless as long as the muskrats were left there. This seemed a serious situation, but it could have been controlled with no expense, merely by allowing and encouraging thorough trapping, in this particular marsh, where every muskrat could have been caught at a profit. In very few places in North Dakota, however, is there any complaint of mischief done by muskrats, while the annual income from their fur reaches many thousands of dollars, well distributed among the residents of the State.

Fur farming with the muskrat in its native marshes has been successfully carried on in many sections of the country, as fully described by Lantz (1910, 1917), in Farmers' Bulletins 396 (issued in 1910) and 869 (issued in 1917) of the United States Department of Agriculture.

Family CASTORIDAE: Beavers

Castor canadensis canadensis Kuhl

Canada Beaver

Ah-mik' of the Ojibways; *Ah-misk'* of the Crees (Seton).

Castor canadensis Kuhl, Beitr. Zool., p. 64, 1820.

Type locality.—Hudson Bay.

General characters.—Beavers, largest of all our rodents (sometimes weighing 60 pounds or more), are heavy-bodied, strong, powerful animals, with large, webbed, hind feet; broad, flattened, naked, scaly tails; dense, fine underfur, and long coarse outer hair of a dark chestnut-brown color; and short ears and huge chisel-like incisor teeth well adapted for cutting wood. In fresh fall fur they are dark, rich chestnut-brown in color, which fades to a somewhat lighter brown before the spring molt. An adult female from Mouse River, near Towner, collected by Remington Kellogg, July 30, 1915, measured: Total length, 1,150 millimeters; tail, 400; hind foot, 195; and weighed 53 pounds; it is unusually dark brown, but otherwise seems to be typical of the northern beaver. The young of all ages agree closely with the adults in coloration.

Distribution and habitat.—Although there is very little material from which to judge, it seems safe to assume that all beavers in the Hudson Bay drainage, including the Mouse River and Red River Valleys, are of the typical form (*canadensis*), and very different from those of the Missouri River drainage (*missouriensis*). Formerly beavers were abundant in all the streams and many of the lakes of North Dakota, but to-day they are restricted to a few scattered localities where colonies have received sufficient protection to enable them to regain a foothold since the days of overtrapping.

In 1800 Alexander Henry (1897, pp. 117, 143, 145, 154, 175, 177, 408) said that beaver houses were numerous along Red and Goose Rivers, near Grand Forks, and more numerous than elsewhere on the upper Sheyenne River. Two of his trappers, from a trip up the Red River, brought in 60 beaver skins on November 17, two others, 60 skins from the Hair Hills on Park River, and the next spring two men brought in 30 skins from the vicinity of Grand Forks. Two other trappers on Park River took 25 skins in two days, and so for six years Henry's bands of Indian trappers scoured the branches of Red River and trapped in the Pembina Hills and Turtle Mountains for the furs that were poured out through the waterways eastward, to be shipped to England. As a result of this systematic destruction, Henry, in 1806, further records that where formerly plentiful beavers were becoming very scarce. Following is a partial record of beaver skins taken by his parties from the Red River Valley during the years 1801–1808: In 1801, Reed River, 832, Park River, 643. For the winter of 1802, Grand Forks, 410; Hair Hills, 200. In 1803, Turtle River, 337; Hair Hills, 30; Pembina River, 550. In 1804, Grand Forks, 356; Hair Hills, 182; Park River, 147; Pembina River, 211. In 1805, Hair Hills, 121; Park River, 160; Pembina River, 829. In 1806, Grand Forks, 342; Pembina River, 776. In 1807, Pembina River, 565. In 1808, Grand Forks, 150; Hair Hills, 53; Pembina River, 339. Although these localities merely indicate the camps from which his men worked out in all directions, the records give a good idea of the fur harvest in its prime, and also of the rapidity with which the beaver was reduced to numbers that no longer paid the trappers for their time and effort. As early as 1848 David Thompson (1916, p. 249) wrote that the beaver had become very scarce in the Red River Valley near the mouth of Park River.

The former abundance of beavers in these streams shows conditions favorable to their habits and in many instances marks the places where they could now be maintained in considerable numbers as an attractive and profitable form of livestock.

In 1887 no trace was found of beavers along the Red River Valley nor were any colonies heard of on the way down the valley to Pembina.

In 1893 Doctor Fisher noted a few in the Sheyenne River, near Lisbon, but in 1912 Eastgate reported them as extinct there 16 years before, although he found old cuttings and dams. It is possible that there are still a few beavers along the banks of the Red River, but no one has been able to get any trace of them in recent times.

In the Turtle Mountains, in 1912, only one colony of beavers was found, and that was carefully protected by the owner of the property, who was anxious to have them multiply as rapidly as possible. All through these mountains, however, old traces of the former abundance of beavers was found, while dams closing the outlets of ponds, marshes, and lakes showed where they had been responsible for retaining the richness of the land and spreading it out instead of having it washed away by the spring floods. The best of the meadows in this region are all old beaver ponds that have been filled up with silt. There are also numerous lakes where the beavers used to live in the banks, as shown by old burrows, and where to-day

the interesting animals might live in considerable numbers without doing harm. If adequate protection could be afforded they would soon increase and restock this whole region, once a trappers' paradise.

One morning before daylight in 1915, Kellogg counted 15 beavers about 8 miles north of Towner, where they had built a big brush house on the bank of the Mouse River. At this place the water was about 15 feet deep, but a dam had been built part way across the river to increase the depth. In the early days beavers had been very numerous along this stream, and old settlers told Kellogg that its course had often been changed by their dams. At the time of Kellogg's visit there was another colony 4 miles farther up the river.

At Kenmare, in 1913, there were complaints of beavers doing great damage to property on Carl Swensen's place on Mouse River, about 20 miles northeast of there. On the bank of the river just below the McKinney Bridge, three or four beaver houses and the places where timber had been cut along the borders of the stream were examined. Apparently there were 20 or 30 beavers occupying the half mile of stream examined, and they were said to be equally numerous below there and above to the Canadian line. C. E. Booth, a taxidermist, reported later that beavers were common in the Mouse River near Minot, and that there were eight dams across the stream just above Burlington. There is considerable small timber scattered along the course of this river and in a great prairie region even small timber is highly prized. At Mr. Swensen's place the beavers had built winter houses along the banks of the stream by piling up the sticks which they had cut, often a wagonload or more, in a heap 5 or 6 feet high, above their rooms and nest chambers in the bank and plastering them over with mud. During the visit the houses were not used to any extent, as the beavers were living mainly in bank burrows, but before winter all of these houses would be repaired and put in good condition to protect the dens from freezing during the winter.

The beavers were not cutting many trees at that time, but seemed to be feeding mainly on the green vegetation along the river banks and on willow stems and roots. Mr. Swensen showed the bank where they had cut trees the previous fall and the writer counted about 40 stumps of small ash, 2 to 6 inches in diameter, about 20 boxelders, and a dozen elm stumps of the same general size. The largest ash which they had cut was about 10 inches in diameter and another about that size had been killed by being girdled. Seven boxelders 8 or 10 inches in diameter, entirely or partly girdled, were either dead or dying. Most of these trees were in a narrow strip about 40 rods long on the bank of the river opposite the ranch house. Mr. Swensen estimated that the beavers had killed 200 or 300 trees for him and more for some of his neighbors. A few of these trees were large enough for fence posts but the greater number were too small to be of any value except for shade and protection from the cold winter winds. The Swensens were much interested in the beavers and their work, but strongly objected to feeding so many of them on their choice trees.

It would seem a simple matter for State officials or game wardens to be detailed in such cases to control the abundance of beavers

where they were doing mischief, and to capture alive and remove any surplus to other parts of the State where they would be of value in stocking suitable waters.

Castor canadensis missouriensis Bailey

Missouri River Beaver

Capa of the Dakotas (Gilmore); *Midapa* of the Hidatsas (Matthews); *Wahrapa* of the Mandans (Will); *Citukh* of the Arikaras (Gilmore); *Zhaba* of the Omahas (Gilmore).

Castor canadensis missouriensis Bailey, Journ. Mamm., vol. 1, p. 32, 1919.

Type locality.—Apple Creek, 7 miles east of Bismarck, N. Dak.

General characters.—Slightly smaller than *canadensis;* colors, paler and duller brown; back, bright hazel brown; sides, duller brown; and underparts, smoky gray. Young, same color as adults. Measurements of type (about 18 months old and not full grown): Total length, 900 millimeters; tail, 270; hind foot, 170. Weight estimated at 35 or 40 pounds.

Distribution, habitat, and general habits.—Apparently the light-brown subspecies of beaver occupies the Missouri River drainage, at least from Nebraska north and west to Montana. In North Dakota it still occupies the Missouri River and many of its tributary streams. A number of skulls in the National Museum were collected by Lieutenant Warren, along the Upper Missouri, probably in North Dakota. There is also a skull from old Fort Stevenson, part of a skull from the Little Missouri, and a broken skull from Medora, besides the type and one immature specimen from Apple Creek, but much more and better material is needed before a satisfactory diagnosis of the form can be given or the details of its distribution fully made known.

In 1804–5 Lewis and Clark (1893, p. 194) found beavers abundant along the Missouri River throughout the North Dakota section of their journey, even in close proximity to long-established Indian settlements. At the Mandan villages they speak of two French trappers coming into camp with 20 beavers that they had caught near there. Trappers were then just beginning to find this river a rich field for their fur harvest.

In 1833, Maximilian reported 25,000 beaver skins bought during the year at Fort Union (now Buford). Among his many observations along the Missouri River he (Wied, 1839–1841, Bd. 2, pp. 54, 55, 1841) wrote on November 5, from just above the mouth of the Little Missouri:

* * * we lay to for the night on the south bank where the forest was completely laid waste by the beavers. They had felled a number of large trees, chips of which were scattered about on the ground. Most of the trees were half gnawed through, broken down, or dead, and in this manner a bare place was formed in the forest. Not far off we saw in the river a beaver den, or as the American sometimes call it a beaver lodge. to which there was a very well trodden and smooth path, which we availed ourselves of to go to and from our boat. Nature appears to have peculiarly adapted these remarkable animals to the large thickets of poplar and willow of the interior of North America, where the whites on their first arrival found them in countless numbers and soon hastened to sacrifice these harmless creatures to their love of gain.

Ten years later Audubon (1897, p. 76) at Fort Union, wrote in his journal about the beavers "once so plentiful, but now very scarce. It takes about 70 beaver skins to make a pack of 100 pounds; in a good market this pack is worth $500, and in fortunate seasons a trapper sometimes made the large sum of $4,000."

Already the quest for rich fur harvests had swept beyond this region, but fortunately, where the beavers had the protection of the deep water and high banks of the larger rivers, it had not quite exterminated them. With characteristic tenacity they still cling to their old haunts or merely scatter out to establish new colonies in tributary streams, but the love of gain has not entirely disappeared from the land and these new colonies are rarely able to keep their coats on their backs for any great length of time.

At Buford, in 1910, Anthony reported a few in the Missouri and Yellowstone Rivers, apparently about as many as were found there in 1887. In 1913, Doctor Bell and the writer found many signs of their presence along the Missouri River near Williston and about 18 miles to the southeast, on the west side, found a dam where a few were living in a creek.

At Fort Clark, in 1913, Jewett reported beavers common along the Missouri River and one colony located on a small creek about a mile south of the town. The willows had been cut for houses and dams, and some were also scattered along the river shores, where they had been used for food. In the Killdeer Mountains, Jewett reported beavers common in all suitable creeks in the region; there was a small colony on Jims Creek, 3 miles south of Oakdale, and another colony on Charlie Bob Creek on the east slope of the mountains. Their dams and houses were well protected by the owners of the land. At Medora he saw several fresh cuttings along the banks of the Little Missouri and beavers were reported to him as common in places above there.

From Medora down the river to Quinion, Jewett found beavers in several localities along the Little Missouri and on Magpie Creek. In the river at the mouth of Magpie Creek a few had been caught the previous fall, and on Magpie Creek, near Quinion, a beaver dam of aspen, willow, and chokecherry bushes had been built across the creek. The dam was about 8 feet high and 20 feet long between the creek banks and had formed a pond from 5 to 8 feet deep and half a mile long. The colony had been there for several years and was well protected by the ranchers.

In the deep ponds of the Little Missouri River, near what was then the North Dakota National Forest, about 25 miles south of Medora, Doctor Bell and the writer found where beavers had been cutting cottonwood trees and building houses on the banks. Just below the camp they had a large house on the bank of the river made mainly from the branches of several cottonwoods which they had cut down near by. The largest tree cut was about 10 inches in diameter, and others still larger had been cut half way through or the bark eaten from one side. Only cottonwoods and willows had been taken, and as these were abundant and of little value the beavers were not doing serious damage in this section. Along Deep Creek, on the national forest, where there was no timber and only willows and chokecherry bushes, the beavers had made numerous dams and

some good-sized ponds. On Bullion Creek, south of Sentinel Butte, a colony had built a dam of willow and chokecherry bushes and maintained a large pond, which kept the creek flowing throughout the year where it had formerly gone dry in summer.

In Apple Creek, just east of Bismarck, in 1914, beavers were reported to have destroyed $1,000 worth of timber. To get at the facts, a trip was made to Bismarck and their work all along the stream carefully examined. The beavers were not numerous at that time, but the half dozen old dams that had been cut and broken out showed that the animals had previously been there in much greater numbers. In a distance of about 6 miles, the writer estimated 15 to 20 beavers, including two families of young, but there had probably been twice as many the previous year. In all about 75 stumps of small trees that had been cut down were found mainly elm and ash, but 1 oak and 1 boxelder had been cut and 1 cottonwood had been girdled and killed. Most of these were not 5 inches in diameter, and they would average about 2 inches. Most of the wood, probably 3 or 4 cords, had been hauled to the ranches. The majority of the bushes cut were diamond willows and chokecherry, which are used both for food and for building dams and houses. The actual value of all other timber cut along this creek would not exceed $20. In a prairie country where timber is scarce every little tree has a value for shade and protection as well as for the relief it gives to the monotony of open country, but the beavers also add life and interest to the country, and in addition have a cash value usually greater than that of a few small trees.

Other complaints were made of damage done at the same time by beavers along Sweet Briar Creek, just west of Mandan, but when Doctor Bell went to investigate he found a few small trees cut for food and building purposes, but very few beavers were left. Most of them had been caught and the trappers and farmers were clamoring for permission to catch the rest. In other places, however, the beavers are given adequate protection by residents who are interested in having them on their farms.

In 1915 Kellogg found traces of beavers along the Missouri River and Antelope Creek near Goodall, and reported a fair-sized colony near Expansion, a large colony below Independence, a freshly built dam across Deep Water Creek below Shell Village, and another colony on a lagoon at Armstrong. On the Knife River he found two beaver houses, and near Sather, in Burleigh County, a few houses and some fresh beaver work. Near Sawyer he reported one small colony, and another in a bend of the river near Painted Woods, while from there to Bismarck he found the houses at almost every bend of the river where there were groves of diamond willow and small cottonwoods.

At Cannon Ball, in 1916, the residents said that there were still some beavers along the Missouri River and also along the Cannonball River, its side streams, and old sloughs and channels. At Parkin, about 8 miles above the mouth of the Cannonball, there were a number of beavers in the deep parts of the river, with dens in the high banks. They were cutting willows and cottonwood brush along the shores. One evening as it was getting almost dark a big old fellow came up on the bank of the river and, climbing out

on a stump, reached up and quickly cut off a cottonwood branch about 6 feet long, dragged it to the water, and then swam down the river, towing it after him, eating it under cover of a steep bank below. Farther up the Cannonball, at Wade, in 1913, W. B. Bell reported a considerable number of beavers in both branches of the river and photographed a dam on the south fork just above the juncture of the two streams. They had done some damage here by cutting down cottonwood trees up to 18 inches in diameter. One ranchman, Mr. Twigg, estimated that 300 trees had been cut on his ranch. On October 23, 1910, O. N. Dvergsten wrote to the Biological Survey from still farther up the Cannonball, near Stowers, inquiring what he could do with beavers that were destroying his little trees along the creek. A few of the animals had come there the previous year, built their winter home, and kept on building and cutting his trees in spite of his efforts to discourage them. Their house had been torn out, but they had rebuilt it and insisted on remaining.

In 1919, after two years of open season on beavers, many of the colonies had disappeared or had been sadly reduced in numbers. A few traces of their work were found along the Missouri River at Sanish and Bismarck, and there were said to be a few beavers still in Apple Creek and Burnt Creek. Near the mouth of the Cannonball River they were very scarce, although they had been fairly common up to 1916.

In a deep loop of the Heart River near Mandan late in October there was still a small colony. Here they had cut down a few scrubby cottonwoods and a large number of willows along the bank and had stacked the green branches and sections of trunks in deep water for winter food. The top of this mass of green wood and brush reached to the surface and was securely held together by several inches of ice. There was one beaver house on the bank and many burrows and dens in the steep banks, which were about 15 feet above the water. Several vent holes opened out from 50 to 80 feet back from the river and warm air was steaming out of them on cold mornings. These beavers were well located for an experimental beaver farm or for a wonderful city-park colony at the edge of Mandan.

Beaver houses.—Large beaver houses are often built out in ponds where the surrounding water is 6 or 8 feet deep, with walls of matted sticks and mud rising 4 or 5 feet above the surface of the water, inclosing safe and comfortable living rooms. The nest chamber, usually just above the water level, has its only doorway leading down through deep water under the house to the pond outside.

Bank houses are generally smaller but equally well-built structures of sticks and logs well plastered with mud. They are commonly built on low banks to protect the dens from outside enemies. In high banks the burrows generally enter water and come up well back in the banks into nest chambers that are unmarked by any external building material.

Beaver dams.—The dams are generally built of brush, sticks, limbs, and trunks of trees that have been cut into sections of a convenient size to be carried, dragged, or floated to the desired spot, pushed into place, and covered with mud from above the dam. Well-built dams

show a steep lower face of crisscross sticks and a sloping upper face of mud or firmly packed earth. They offer a wonderful resistance to floods and the wear of time, and many old beaver dams may be found to-day that have not been used for a century or more.

On small streams beaver dams are usually of a simple type, built across the channel so as to raise the water above them to sufficient depth for good ponds. A depth of 6 or 8 feet is required to protect the houses, dens, and bank burrows, and to insure a winter swimming pool under the ice. Much deeper water is preferred and the beaver will usually leave and hunt for better quarters if a depth of a least 6 feet can not be maintained.

Large and rapid streams are rarely dammed, except by large colonies of beavers left undisturbed for a long term of years. Some of the old dams show great skill and industry, but the best results seem to be due to persistent efforts in the face of many failures, rather than to the high order of mentality usually attributed to the beavers.

Food habits.—The food of beavers varies with the season. In summer it is mainly grass and other green vegetation. At Apple Creek, in August and September, the beavers were feeding on coarse water grasses and sedges along the shores of the creek. The grass blades were scattered over the surface of the ponds and lodged against the dams and in many places the banks were well cropped. All of this was waste material that could not be cut for hay or grazed by stock. The stomachs of the beavers collected contained large quantities of green pulp, apparently of this material, with the addition of a little of the bark and twigs and roots of willow, and some other plants that could not be identified. The trees and bushes cut at that time had been used mainly for building material rather than for food.

In fall beavers begin to cut down bushes and trees to be stored under water for winter food. Sometimes tons of green brush mixed with limbs and sections of tree trunks are sunk to the bottom in deep, still water, where under the ice it keeps fresh and green and is available all winter. The bark is eaten off the larger stems and the twigs and buds are browsed where they lie or are carried into the houses to be enjoyed at leisure.

That willows are the principal winter food, as well as the favorite building material, is evident from the food stores, the remains of meals and structure of houses and dams. Cottonwoods and aspens are preferred for food where available. The hardwoods—elm, ash, boxelder, birch, and even oaks—are sometimes cut for building material, but rarely for food. On Apple Creek, some elm and ash, one small bur oak about 2 inches in diameter, a small boxelder, a thorn-apple bush, and a few hop vines had been cut, all of them evidently for building material, as they showed no indications of having been eaten. Boxelder and bullberry bushes were abundant along the stream, but were rarely touched by the beavers. One thorn-apple bush full of red fruit had been cut and placed on the dam. The rootlets of willows, which grow in dense masses under water along the banks, are also a choice food for both summer and winter, and in deep water, where beavers are scarce and timid, they get much of their food from these tender roots without exposing themselves on the surface.

Breeding habits.—Usually four to six young are raised at a time and it is doubtful if more than one litter is raised in a year. Increase is therefore not rapid and the young do not get their full growth for several years.

Beaver parks.—Near Jamestown, in 1914, W. B. Bell visited a beaver colony that had been protected for a number of years and allowed to build a good dam across the Dakota River. The animals were comparatively tame and could be watched at their work on the dam or on the banks, or swimming about in their pond during the daytime, and were a source of much interest and pride to the community.

The beginning of a valuable and educational zoological park was here developing spontaneously without any expense or trouble beyond the mere protection of the animals. Unfortunately, a grainfield extended down to one edge of the beaver pond and naturally the beavers accepted the grain as a part of their food supply. Even after the grain was cut they pulled the bundles out of the shocks and carried them to the water for food and building material. The loss of grain, though scarcely appreciable, naturally irritated the owner and roused a sympathetic feeling for him and against the beavers, until, as a result, the colony was destroyed.

If a woven-wire fence had been placed along the river bank and woven wire wrapped around the bases of a few trees, the beavers might have remained as a harmless and delightful interest for the public. No more interesting or simple and inexpensive zoological park can be maintained by any community than a good beaver colony.

Beaver farming.—In many sections of North Dakota conditions are excellent for raising beavers under control and partial or complete domestication in small lakes or ponds or in fenced sections of creeks and small rivers on owned or leased land. If beavers were included in the list of fur-bearing animals permitted to be raised under special license (North Dakota, 1923, pp. 317–318), a valuable industry might be added to the State, and much waste and unprofitable land made to yield returns to the owners. The selection of stock for beaver farming is of great importance, since the dark, richly colored animals, as found in the Hudson Bay drainage or, still darker, from northern Michigan and Wisconsin, have far greater fur value than the light-brown beavers of the Missouri drainage, and as far as possible should be used for breeding stock.

Beaver meat.—If properly prepared, beaver meat is good and wholesome. In the adults it is dark, tender, rich, and of good flavor. There is usually a layer of fat over the surface next to the skin, and the tail is always of a soft, fatty tissue which if well cooked is especially delicious. Among the trappers beaver tail has always been considered a luxury equal to buffalo tongue.

Lewis and Clark (1893, p. 276), in their journal of April 17, 1805, say, "Around us are great quantities of game, such as herds of buffalo, elk, antelopes, some deer and wolves, and the tracks of bears. * * * We obtained three beavers, the flesh of which is more relished by the men than any other food which we have." This is almost the unanimous testimony among trappers.

In skinning the beaver care must be taken not to get on the flesh a trace of musk from the large gland located under the skin of the

belly. The beaver should be hung up by the head and skinned without touching the meat with the hands. It is impossible to handle the skin without getting the hands scented by this very clinging, although not unpleasant odor.[17]

Family ERETHIZONTIDAE: Porcupines

Erethizon epixanthum epixanthum Brandt

Yellow-haired Porcupine; Rocky Mountain Porcupine

Pahi of the Mandans (Will); *Pahi* of the Dakotas (Gilmore); *Apadi*^{n} of the Hidatsas (Matthews); *Suunu* of the Arikaras (Gilmore).

Erethizon epixanthus Brandt, Mém. Acad. Imp. Sci. St. Pétersbourg, t. 3 (ser. 6), pt. 2 (Sci. Nat.), p. 390, 1835.

Type locality.—Northwestern America.

General characters.—Heavy, wide-bodied, short-necked, short-legged animals with short, stout tails, long curved claws, flat, naked soles and an armor of quills; upper parts densely covered with very keen barbed quills, embedded in black fur and partly concealed by long yellow-tipped outer hairs; underparts mainly without quills. An adult male from Montana measures in total length 875 millimeters; tail, 314; hind foot, 112. Weight, approximately 20 to 30 pounds.

Distribution and habitat.—From a wide range in the Rocky Mountain region the yellow-haired porcupines reach their eastern limit, so far as known, in North Dakota. They are fairly common in the Missouri Valley and westward in the State, but east of the river valley they are rare and scattered. A specimen collected by U. S. Ebner in the Turtle Mountains in 1914, and now in the collection of the North Dakota Agricultural College, at Fargo, marks the easternmost authentic locality for the species. Near Warwick, just south of Devils Lake, in 1915, Kellogg reported a yellow-haired porcupine killed by two boys the previous year; at Towner on the Mouse River, one killed by Almond Larson in 1905, and another found dead by Clyde Coss in 1911. In 1913 there were reports of porcupines having been killed near Kenmare and Minot, but there was no real clue to the form represented. It was undoubtedly, however, the yellow-haired. At Buford and all the way down the Missouri River through the State porcupines have been reported common from 1910 to 1915 by Anthony, Kellogg, and Jewett, and apparently their numbers have not changed much since the days of Lewis and Clark, Maximilian, and Audubon. In 1913, Doctor Bell reported them fairly common at Wade, on the Cannonball River, where two had been recently killed near Mr. Wade's ranch and a skull of one obtained for a specimen. In 1919 they were found common about Sanish, in the brushy gulches on both sides of the Missouri River.

General habits.—Although well safeguarded by their own spiny armament, the porcupines often seek additional safety in the Badlands and brushy stream bottoms, in the protection of little caves and hollows in the banks or the dense, thorny cover of buffaloberry thickets. Near Williston, the writer found their characteristic oval

[17] For further information on the habits and control of beavers, see U. S. Dept. Agr. Bul. 1078 (Bailey, 1922) and Misc. Circ. 69 (Bailey, 1926).

pellets in the little caves of the Badlands, which seemed to be their favorite dens. Often, however, the animals are met in the open and at night they follow trails and roads for long distances, as shown by their double rows of oval, flat-footed, denticulate tracks in the dust.

Although their ordinary gait is not much faster than that of the turtle, they are patient and persistent travelers and sometimes their tracks may be followed for miles. When met with, the porcupine usually attempts to escape, but if crowded, bristles up, erects its quills, and stands at bay awaiting attack. The quills are pointed out at all angles and as the enemy approaches within reach, fierce blows of the heavily armed and muscular tail are struck sideways or upward and the barbed quills thus driven into anything within reach.

The common belief that the quills are thrown to a considerable distance has no foundation in fact, although some are occasionally scattered on the ground if the animal is roughly handled. Porcupines evidently realize that their lower surface is unprotected, as any effort to turn them over is frantically resisted, and when threatened the quickness with which they will wheel and strike is surprising in animals so clumsily built.

Their long, very hooked claws enable them to climb trees readily, and the animals are as much at home on the trunks or branches as on the ground. They also climb about in the bushes and seem to enjoy the tops of the very spiny buffaloberry bushes, which probably give them a feeling of added protection along their own lines of defense. The tops of these bushes are often eaten bare of bark, leaves, and berries and left in a very mutilated condition. The writer has never seen any evidence that porcupines dig burrows, but quite probably they dig out or enlarge some of the cavities in which they dwell.

Breeding habits.—The mating season is said to be in October and one or sometimes two young are born early in spring. At birth the young are unusually large and well developed: their eyes are open, and they are provided with a good set of fur, quills, and incisor teeth. They follow the mother until weaned and apparently before they are half grown each one is able to shift for itself and to begin its solitary life. With this slow rate of reproduction the species would soon disappear but for its armored protection.

Food habits.—During the summer, porcupines feed on a great variety of green vegetation, accepting apparently almost anything that comes in their way and stuffing their enormous stomachs to the limit of their capacity. At Stanton, Kellogg found one feeding in an alfalfa field with its stomach well filled with alfalfa; he said they were reported to do some damage in the grainfields between Washburn and Bismarck. Jewett reported them as fairly common in the brushy gulches near Sentinel Butte, where they had gnawed the bark from many of the chokecherry bushes. Near Sanish they had eaten the bark and twigs from buffaloberry, black haw, chokecherry, and rose bushes. In 1913, on the former Dakota National Forest, about 25 miles south of Medora, they were found fairly common in the Badlands gulches and on the forested ridges. Many of the yellow pines had been gnawed more or less extensively by

them. On some of the forested ridges about half of the small trees showed peeled spots from which the bark had been eaten and some had been completely girdled and killed. Most of the old trees showed some scars from earlier gnawings.

Still farther south, along the Little Missouri, near Marmarth, where yellow pines grow irregularly over the buttes, the writer found fully a fourth of the young trees damaged through having the bark gnawed from them by porcupines. In some cases the bark had been eaten from the tops and branches; in others the trunks had been girdled, so that many of the trees were either ruined or killed outright. The old pines showed a long struggle with their enemy, the bushy tops and gnarled forms being largely due to the girdling of tops or branches at different times during their lives. Here, as in many other parts of the country, the bark of yellow pines seems to form the favorite food of the porcupines, at least during the winter season. The rough outer coating of bark is rejected and the tender inner growth eaten as it is scraped clean from the wood of the trunk. Apparently the bark from a space the size of a hat is required for a square meal. Any tree that happens to be conveniently near the porcupine's den is sure to suffer and may be stripped of all of its bark from top to bottom.

Economic status.—Although most wild carnivores have become sufficiently accustomed to porcupines either to let them alone or, by taking advantage of their unprotected bellies, to kill and eat them with little harm to themselves, many dogs gain their first knowledge of the species by sad experience. The greatest complaint of the settlers against the porcupines comes from this injury to their dogs, for if a dog attacks one recklessly as it would any other animal it may be seriously or fatally injured by the quills. The destruction of crops by porcupines is usually of small consequence, but their destruction of many species of pines and other conifers often causes great loss to the forests within their range. It is not improbable that they are largely responsible for the scarcity of timber in the Badlands region; were it not for them a fair stand of pines might have spread over this rough country. If reforestation of these areas is attempted, it will be necessary to first eliminate the porcupines, as where they are common no young trees can reach a well-developed maturity.

Erethizon dorsatum dorsatum (Linnaeus)

Black-haired Porcupine; Canada Porcupine

[*Hystrix*] *dorsata* Linnaeus, Syst. Nat., ed. 10, t. 1, p. 57, 1758.

Type locality.—Eastern Canada.

General characters.—Color, black and white instead of black and yellow; upper parts covered with white, black-tipped quills, mixed with black fur and obscured by long black, white-tipped hairs. Usually not so large as the yellow-haired porcupine from farther west. An adult male from Minnesota measures in total length 740 millimeters; tail, 195; hind foot, 115; an adult female, 735, 195, and 100 respectively. Weight of female, 16 pounds; of male, probably 20 pounds.

Distribution and habitat.—The black-haired porcupines occupy the timbered Canadian Zone area of the northeastern United States and Canada west to the Great Plains, where they probably meet the range of the yellow-haired porcupines. They are common in northern Minnesota, but for North Dakota there seem to be only two or three

probable records and these unsubstantiated by specimens. M. A. Brannon writes that while at the university, at Grand Forks, he had a small black-haired porcupine for a pet, but it met with an untimely death and was not preserved for a specimen. It was given to him and was said to have come from the Red River Valley, near Pembina. H. V. Williams reports a porcupine of the small dark-colored type, almost black, killed at Hamilton, in Pembina County, on July 31, 1916. The description fits this species, which on geographic grounds ought to be found there rather than the large yellow-haired species which has been taken no farther east than the Turtle Mountains; but the young of both species are blackish, so that identification depends in part on age. The boys at the Indian school near Wahpeton killed a porcupine on the river bank near town in 1914 and described it but no specific characters could be gathered from the description. Others will probably be found along the Red River Valley, and it is hoped that a specimen may be preserved to determine the species positively.

Family ZAPODIDAE: Jumping Mice

Zapus hudsonius campestris Preble

Prairie Jumping Mouse

(Pl. 13)

Zapus hudsonius campestris Preble, North Amer. Fauna No. 15, p. 20, 1899.

Type locality.—Bear Lodge Mountains, Wyo.

General characters.—A medium-sized mouse with very long, slender hind legs and feet and small front feet; tail, very slender and longer than head and body; ears, small. Upper parts, bright buffy yellow along sides, darker along the back; underparts, pure white. Average measurements: Total length, 222 millimeters; tail, 135; hind foot, 30.5.

Distribution and habitat.—As its name implies, the prairie jumping mouse is a plains species covering practically the whole of North Dakota and the surrounding prairie country. There are specimens in the National Museum from Wahpeton, Fairmount, Blackmer, Hankinson, Ellendale, Fargo, Harwood, Lisbon, Pembina, Neche, Turtle Mountains, Devils Lake, Fort Totten, Valley City, La Moure, Ludden, Cannon Ball, Fort Clark, Grinnell, and Buford. Specimens have also been recorded in the Field Museum from Bottineau, Minot, and Jamestown. Although generally distributed over the State, these jumping mice are found mainly in thickets, weed patches, meadows, or tall grass areas rather than on the high open prairie, where the grass is short and the cover scant.

General habits.—Under the protecting cover of bushes, weeds, and tall grass, these timid little jumping mice make their summer homes on the surface of the ground and their winter homes in burrows deep underground. They do not make roads or runways, but go through the grass with long leaps or little hops and occasionally with a slow creeping motion on all fours. When startled, they go bounding away with long jumps, suggesting frogs, and usually make two or three leaps before stopping to see if they are pursued. Generally, if the last leap is well noted, one can creep up cautiously and catch the mouse by clapping the hand over it. When caught in this way the mice rarely offer to bite or make much effort to escape,

but may be handled and examined freely if held gently in the hollow of the two hands. Evidently they are not entirely nocturnal, as they are often startled from their feeding grounds in the daytime, but more often they are disturbed in their nests, from which they bound away when one steps close to them in the grass.

The summer nests are placed on the surface of the ground, well concealed under grass or other vegetation; they are neat little balls of fine grass with a tiny opening at one side and a soft lining in the central chamber. When the grain is cut and the hay mowed the nests are disturbed and the jumping mice go to live in the shocks of grain and cocks of hay, where they are discovered when the hay and grain are being loaded on wagons. As they bound from under cover to the open ground they are somewhat dazed by the light and can usually be watched for some time as they sit blinking in the open or progress by long leaps through the air.

Hibernation.—Unlike most of the mice, these little fellows become excessively fat in autumn and with the first frosty nights retire to their warm underground nests and curl up for a long winter's sleep. The thin oily fat is deposited in a layer of white fatty tissue over the whole inside of the skin as well as over much of the surface of the body and fills the inside cavities until the animal is about twice its natural size and weight. This fat supplies sufficient nutriment and fuel for the long winter sleep and probably carries the animal through the early springtime of breeding activities when food is scarce.

Breeding habits.—The five or six young are brought forth in the nests usually in May or June, and are barely full grown by the time their winter sleep is to begin. In this latitude it is doubtful whether more than one litter of young is raised in a summer.

Food habits.—In the examination of a great many stomachs of these jumping mice, nothing has been found but the fine white pulp of carefully shelled, well-masticated seeds. Generally these are from grasses, although grain and a variety of other plant seeds are eaten. The mice are fond of rolled oats used for trap bait, and are easily caught in a variety of traps set where they are in the habit of running. To obtain the seeds of grass, on which they mainly subsist, they cut off the tall stems as high up as they can reach, draw them down and cut them off again, and repeat this until the seed-laden tops can be taken. Little heaps of grass stems cut in sections about 3 inches long are found through the meadows where the jumping mice live and are unmistakable evidence of their presence, being always much longer than the grass cuttings of meadow mice and other short-legged species. Apparently these rodents do not store up food, but live a very care-free life in the midst of abundance while the summer lasts.

Economic status.—Generally the jumping mice are not sufficiently abundant to do any great harm to the yield of grass and grain, but in places over limited areas in the meadows their cuttings might aggregate 2 or 3 per cent of the grass. They cut down and eat or destroy a small quantity of grain along the edges of some fields, but on the whole are far less numerous and injurious than the meadow mice. Still, they help to swell the total of the tax levied by rodents on farm products and only fail through lack of numbers to form one

of the serious rodent pests. Their natural enemies are the same as those of the other nocturnal mice, chief of which are owls, weasels, badgers, and skunks, through the good offices of which their numbers are kept within bounds.

Family HETEROMYIDAE: Pocket Mice, Kangaroo Rats

Perognathus fasciatus fasciatus Wied
Maximilian Pocket Mouse

Apapsá of the Hidatsas, *Zhizhina* of the Dakotas (Gilmore).

Perognathus fasciatus Wied, Nova Acta Acad. Caes. Leop.-Carol. Nat. Cur., t. 19, pt. 1, p. 369, 1839.

Type locality.—Upper Missouri River near its junction with the Yellowstone, northwestern North Dakota.

General characters.—Considerably smaller than the white-footed mice, with small ears, slender tails, and conspicuous fur-lined pockets on the cheeks, opening externally and not connected with the mouth; hair, short and glossy; upper parts, olive gray; underparts, pure white, bordered by a buffy line along each side. Average measurements: Total length, 135 millimeters; tail, 65; hind foot, 17.

Distribution and habitat.—Maximilian pocket mice are scattered over a large part of western North Dakota and adjacent areas of the semiarid plains. There are specimens from Buford, Crosby, Minot, Dunseith, Fort Clark, Cannon Ball, Wade, Dawson, Oakes, Bowdon, and the Little Missouri River north of Medora, but the range is probably more extensive and continuous than these scattered localities indicate. They are animals of the open prairie, where they live in tiny burrows in the barest situations or on the short-grass plains, for, unlike most mice, they avoid the cover of vegetation.

General habits.—In 1833, Maximilian, Prince of Wied (1839, p. 373), found this anomalous little pocket mouse near Fort Union, at the junction of the Yellowstone and Missouri Rivers, and in 1839 first described it as a new genus and species of rodent. For more than 50 years no more specimens were obtained, and the name was confused under another species and not put in its proper relationship until 1889, when Doctor Merriam (1889, pp. 2, 4, 11) published his revision of the North American pocket mice.

In 1887 the writer visited Fort Buford and collected a small series of specimens that served to verify Maximilian's excellent description of the genus and species. At that time he was unacquainted with animals of their general habits and had only common steel traps, old-fashioned choke traps, and little tin box traps, and knew of no more tempting bait than cheese, bread, cake, or meat, none of which they would touch, so that although instructed to look out for them and get specimens, he then failed to catch any in his traps. Their characteristic little burrows were common and their tiny tracks recognized as undoubtedly belonging to the species, were found every morning about the traps, although no attention was paid to the bait. Other methods were evidently necessary to obtain specimens.

During the dusk of evening as the writer walked over the prairie, sometimes one of these little mice would dart over the ground near

him, and by dropping his gun and making a quick spring he could catch it in his hands. All but one of those seen were caught in this way, but in that one case his fingers came down on the mouse's tail and the rest of him escaped. This kind of hunting, though exciting at times, nearly ruined his shotgun, which invariably was dropped on the ground at the first move of the mouse, although he resolved each time to lay it down carefully when the next one was seen. The half dozen specimens obtained served to reestablish the identity of the species, but they did not add much to knowledge of its general habits. Only in later years was it learned that with modern traps baited with rolled oats the mice could be caught in abundance wherever they occurred; since then naturalists have been able to learn more of their habits.

Their little burrows are usually found in groups of two or three on some dry, open spot, often at the edge of a cactus or sunflower patch, or close to sagebrush, and are easily recognized by their very small size. A little fresh earth is occasionally found thrown from some of the burrows, but in most cases the entrances are unmarked and inconspicuous. In 1910, Anthony collected specimens at Fort Buford and reported burrows found sparsely on the prairies and hilltops, usually in the sides of banks or slight elevations. One specimen was taken in an open space in the sagebrush near the river. At Crosby, in 1913, the writer caught one under some old Russian thistle at the edge of a flax field. At Minot, on October 12, 1919, he tracked one over a soft snow from a strawstack to a hole under a furrow, and digging back about 2 feet found it in a cup-shaped nest of soft plant fibers, captured it alive, and kept it for several months for study. At one edge of the nest cavity it had a small collection of seeds, mainly pigeon grass and Russian thistle seeds, which proved its favorite food in captivity. At Fort Clark, Jewett found these mice fairly common about the wheatfields and high dry prairies back from the river, where they were readily taken in traps baited with rolled oats and set near the small burrows. At Cannon Ball, Sheldon found them common in the grainfields on the sandy places and along the flats of the river. At Wade, farther up the Cannonball River, W. B. Bell collected a specimen for the agricultural college museum. In 1892, Theodore Roosevelt caught a specimen on the Little Missouri River, 40 miles north of Medora, which he contributed to the Biological Survey collection.

Small, inconspicuous, and mainly nocturnal in habits these little pocket mice, even where most abundant, generally escape the notice of all but naturalists or keen observers. It has remained for a local naturalist, Stuart Criddle (1915), of Treesbank, Manitoba, to study their habits in a careful and thorough manner. In excavating their winter burrows he learned more of them than was ever known before. He found their burrows penetrating as far as 6 feet below the ground, where the winter nests and stores were well protected from frost. Apparently enough seeds were provided to carry them through the winter. Their winter stores consist mainly of seeds of noxious weeds, and Criddle's conclusions were that the mice are mainly beneficial in their foods habits. Such careful studies of mammal habits by local naturalists are of inestimable value for the better understanding of native species.

Hibernation.—These mice are rarely if ever found with sufficient accumulation of fat to suggest hibernation, but Criddle says that when exposed to moderately cold atmosphere they become very sluggish and he thinks that they spend much of the winter in sleep. The writer has found them active up to October 6 in Montana, and to October 12 in North Dakota, and they have been taken even later farther south. A captive specimen was active well into the winter, but in a warm house. The question of hibernation is not yet fully settled.

Breeding habits.—A female caught on May 13 contained six embryos, and Criddle reports one containing four. The mammae are arranged in two pairs of inguinal and one pair of pectoral on four distinct mammary glands. It seems probable, therefore, that six is the normal maximum number of young. There are no data to indicate more than one litter in a year.

Food habits.—In 1887 these pocket mice were found feeding mainly on the seeds of pigweed and knot grass, and at Crosby in 1913, they were living under the Russian thistle, which apparently furnished them food as well as cover. At Buford, Anthony reported their pockets filled with small angular seeds, which were probably of knot grass, and at Fort Clark, Jewett reported several caught at the edges of wheatfields with grains of wheat in their pockets. Others have been taken with their pockets filled with grass seeds, lambsquarters, red root, and tumbleweed, and Criddle found in their homes and pockets seeds of grass, blue-eyed grass, bug seed, wild buckwheat, and puccoon. He also discovered grasshopper eggs stored in their tunnels and found many places where these had been dug out of the ground. One of the mice that he kept in captivity preferred meal worms to seeds.

Economic status.—From the evidence gathered it seems that these mice are very slightly, if at all, harmful, while in many ways they are decidedly beneficial; but there still remains much to be learned of their habits and tastes.

Perognathus flavescens perniger Osgood

Dusky Pocket Mouse

(Pl. 15)

Perognathus flavescens perniger Osgood, Proc. Biol. Soc. Washington, vol. 17, p. 127, 1904.

Type locality.—Vermilion, S. Dak.

General characters.—About the size of *fasciatus*, but more intensely colored, with the rich buff on the upper parts much obscured by a wash of bright black, and the underparts chiefly rich, buffy ochraceous. Measurements of type: Total length, 140 millimeters; tail, 68; hind foot, 17. Weight of live adult, 10 grams.

Distribution and habitat.—The silky little dusty pocket mice come into southeastern North Dakota from their range over the prairie country of western Minnesota, eastern South Dakota, and the adjoining corners of Nebraska and Iowa. There are specimens from Hankinson, Blackmer, Lidgerwood, Napoleon, and Finley, and the writer picked up a dead one in the town of Parkin, about 10 miles above the mouth of the Cannonball River, too mangled to be saved for a specimen. The range of the form somewhat overlaps that of

fasciatus, from which it is entirely distinct. Apparently this is merely a dark-colored prairie form of the paler *flavescens* of the semiarid Plains region farther south and west. Sandy prairie soil is their favorite habitat and their little burrows are usually found in the mellow and often barren soil among prairie grasses.

General habits.—In the old lake-shore sand dunes, a little south of Hankinson, these little animals were found fairly abundant. On the crests of many of the low ridges or mounds that had once been dunes, from one to a half dozen of their burrows or groups of burrows were found. There was generally a little mound of sand like a small gopher hill, and, whether freshly made or old, the entrances to the burrows were invariably closed. Often two or three other burrows, just large enough for the end of the finger, would be found near the closed one, but these were inconspicuous and rarely showed any trace of dirt having been thrown out. Traps baited with rolled oats and set at any of these holes, or across a long trail made by scraping the foot in the sand, readily caught the mice, for while they do not make trails of their own, they invariably follow any clear road through the grass. Often in the morning their tiny tracks were found over the open, drifting sand. A few specimens were taken in traps set near the tracks which led from the burrows to the feeding grounds. Although more easily located on the open sand, the mice were much less numerous there than in the scattered vegetation, which afforded some cover.

At Blackmer two were caught in a sandy field where boys said mice were often turned out by the plow. At Lidgerwood, Sheldon found them common in the grainfields and a series of specimens was taken in traps set in the fields. At Parkin the writer found many of their characteristic burrows and tracks in sandy ground near the edge of the town that had just sprung up on the prairie and picked up a dead mouse in the grassy street.

Breeding habits.—Three females collected at Elk River, Minn., on July 30 and August 12, 1912, contained four embryos each. The mammae are arranged in two pairs of inguinal and one pair of pectoral, which for the present constitutes our total knowledge of the breeding habits of this species.

Food habits.—At Hankinson the traps were baited with a mixture of rolled and whole oats, but as ants carried away most of the rolled oats during the day the whole grain was usually the only attraction for the mice. Most of the specimens caught had in their pockets some of the whole oats, from which they had removed the hulls, and some had also the seeds of needle grass (*Stipa spartea*), while the pockets of others were entirely filled with these long grass seeds, hulled and neatly packed in little bundles. There were occasionally also a few seeds of bindweeds and small wild beans. Of course, their food varies with the time of year, and at this season, July 19 to 27, the abundant *Stipa* seeds were just falling to the ground and the mice were busy gathering their harvest. At Lidgerwood, Sheldon found that the pockets of all of those caught in wheatfields contained weed seeds, with the exception of one that had gathered up a few particles of cracked corn; some of them also had included a few kernels of oats from his trap bait. The one picked up at Parkin had its cheek pouches full of little bean seeds, probably of *Astragalus*,

which was common there. In Minnesota the writer found where the mice had been feeding extensively on the seeds of sand bur, one of the most troublesome of weed grasses.

In the underground winter storerooms of these mice there were seeds of two species of pigeon grass, a few other grasses, and wild buckwheat. In captivity their favorite food has proved to be first of all the pigeon-grass seeds from their own winter stores, then Russian thistle seed, millet, wild sunflower, hemp, and rolled oats. They nibble a little cabbage, turnip, cooked potato, lettuce, celery, or green grass, but apparently more for the moisture than for food, as in a dry, furnace-heated house, they become very thirsty and eagerly suck water from saturated cotton or drink from a small dish.

None of the animals caught showed any indications of becoming fat as in hibernating species, but it is evident that they store up much food in the form of small seeds.

Economic status.—Too scattered in their distribution to be of any serious consequence one way or another, the habits of these little mice appear to be mainly harmless. Their consumption of weed seeds probably counterbalances any possible mischief in grainfields.

Perognathus hispidus paradoxus Merriam

Kansas Pocket Mouse

(Pl. 12)

Perognathus paradoxus Merriam, North Amer. Fauna No. 1, p. 24, 1889.

Type locality.—Banner, Trego County, Kans.

General characters.—Size, large; tail, long; ears, small; pelage, glossy but coarse and hispid; external cheek pouches, conspicuous; upper parts, yellowish-brown with scattered black hairs over the back; sides, clear yellowish; underparts, white. Average measurements of adults: Total length, 222 millimeters; tail, 108; hind foot, 26.

Distribution and habitat.—These large pocket mice have an extensive range from Mexico over the Lower and Upper Sonoran semiarid plains region to western South Dakota, and one specimen has been taken in North Dakota. This was collected by Doctor Bell, in August, 1913, at Wade, on the Cannonball River. The specimen is now in the agricultural college collection, at Fargo, and is of special interest as marking the northern limit of the known range of this species. It is a large female, measuring in total length 220 millimeters, tail 114, and hind foot 27, and was caught in a trap set on the prairie at the edge of a sandy area on the Wade ranch. At this locality the species represents an element of the Upper Sonoran Zone, which is sparingly shown also by the native vegetation.

General habits.—Over their wide range these mice are generally scattered and not abundant, but occasionally get into the collector's traps set in open country. They live in burrows of their own construction, which are often recognizable by their size and form, as they are larger than ordinary mice burrows and not so large as those of kangaroo rats. Moreover, they often go straight down into the ground like a smooth auger hole, around the entrance of which no trace of earth is found. Always at some place not far away, however, is a burrow at which considerable earth has been thrown

out, showing that the unmarked openings are those that have been opened from below. Sometimes the burrow at which the earth is thrown out is closed at the entrance; at other times it is left open.

The underground habits of the pocket mice are little known, except that specimens taken often have their cheek pouches well filled with seeds, grain, or trap bait, which they are carrying home, evidently to be stored for food. They are very fond of rolled oats and are readily caught in traps baited with them. A great variety of seeds is eaten, but the mice do not usually show any signs of accumulating fat for winter, and it is doubtful whether they regularly hibernate. Over most of their range farther south they may be caught at any time during the winter.

Perodipus montanus richardsoni (Allen)

Richardson Kangaroo Rat

(Pl. 11, fig. 3)

Dipodops richardsoni Allen, Bul. Amer. Mus. Nat. Hist., vol. 3 (1890–91), p. 277, 1891.

Type locality.—Beaver River, Beaver County, Okla.

General characters.—Big head and short body, long brush-tipped tail, long hind legs and feet, small hands, and ample fur-lined cheek pouches combine to produce a most unique and striking appearance. Upper parts, bright buffy-yellow with a white band crossing each flank and white spot over each eye; underparts and stripe along each side of tail, white. Measurements of Montana specimen: Total length, 264 millimeters; tail, 145; hind foot, 40.

Distribution and habitat.—Richardson kangaroo rats are common in eastern Montana and western South Dakota, and undoubtedly occur in North Dakota, although no specimens have been taken and the only actual evidences of their presence are some groups of burrows described by Doctor Bell, at Wade, on the Cannonball River. He describes groups of large burrows on a strip of sandy ground on the Wade ranch, with considerable earth thrown out around the entrances, exactly as had been found around their dens at Glendive, Mont., and in other parts of their range. The species can only tentatively be included in the North Dakota list, but should be watched for and will undoubtedly be found in a few localities over the western part of the State. The animals can not fail to be recognized, and usually their burrows and the long-paired tracks of their hind feet are unmistakable.

General habits.—As indicated by their large, dark eyes, the kangaroo rats are strictly nocturnal, and for this reason are rarely seen except as caught in traps or accidentally driven out of their burrows. They are gentle, timid little animals, depending entirely on speed and their deep dens for protection. In running they hop along on their hind feet, and when hard pressed take flying leaps through the air, balanced by their long, tufted tails. The little front feet are used as hands and rarely allowed to touch the ground.

Food habits.—The food of this species consists of a great variety of seeds and grain, which are gathered and carried in the cheek pouches to the dens, to be eaten at leisure. Most of the rats collected for specimens are found with more or less food and sometimes with the pouches distended with various seeds or grains.

FIG. 1.—DUSKY POCKET MOUSE (PEROGNATHUS FLAVESCENS NIGER)

Photograph of captives kept for study. Slightly reduced

E1321M

FIG. 2.—BADGER (TAXIDEA TAXUS TAXUS)

"Topsy," a pet at the Agricultural College (photographed by W. C. Palmer)

MISSISSIPPI VALLEY POCKET GOPHER (GEOMYS BURSARIUS BURSARIUS)

Photographed in the act of digging a burrow in the prairie. About one-fourth natural size

Economic status.—It is perhaps fortunate that these interesting rodents do not reach farther into the State, as in grain-producing country they often levy a considerable tribute on the crops. Where they are abundant, the quantity of grain carried away, eaten, and stored in their dens for future use is sometimes a serious loss.

Family GEOMYIDAE: Pocket Gophers

Geomys bursarius (Shaw)

Mississippi Valley Pocket Gopher

(Pl. 16)

Mus bursarius Shaw, Trans. Linn. Soc. London, vol. 5, p. 227, 1800.

Type locality.—Unknown; somewhere in the Upper Mississippi Valley.

General characters.—Characterized by heavy build, large front feet, and long, heavy, digging claws, conspicuously grooved upper incisors, and deep fur-lined pockets on the cheeks extending back under the skin to the shoulders; eyes and ears, small; tail, small and nearly naked at tip; fur, short, smooth, and glossy. Color, light chestnut-brown above, slightly paler on the belly. Average measurements: Total length, 270 millimeters; tail, 80; hind foot, 35. A large female at Grand Forks measured 290, 75, and 35 millimeters, and weighed 14 ounces.

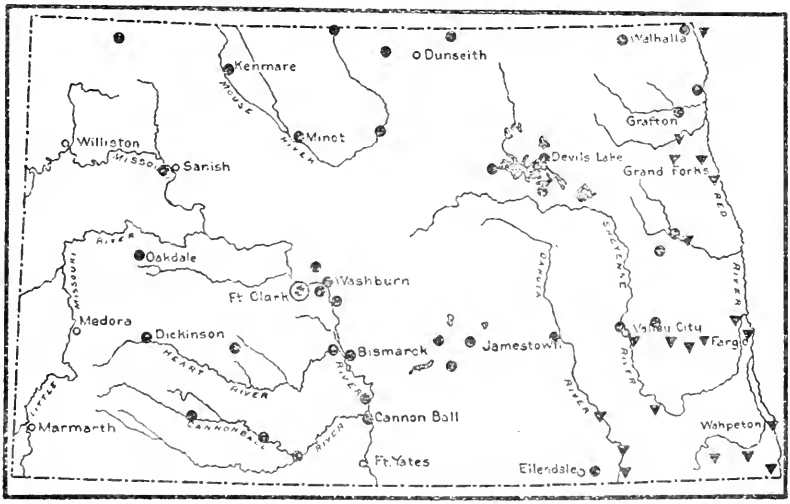


FIG. 7.—Records of two species of pocket gophers in North Dakota: Triangles, the Mississippi Valley pocket gopher; circles, the Dakota pocket gopher; dot in circle, type locality. The paler sagebrush pocket gopher from the extreme western part of the State is not shown on this map

Distribution and habitat.—The Mississippi Valley pocket gophers enter eastern North Dakota and range as far west as Ludden, Oakes, Larimore, Valley City, 10 miles west of Portland, Manvel, Grand Forks, and to the vicinity of Pembina (fig. 7). At Hankinson, in 1912, the writer found them abundant over the prairies, especially in mellow, sandy soil. On the high clay hills south and west of Lake Elsie they were scarce or entirely absent from extensive areas. A fondness for mellow soil seems to be a potent factor in outlining the range of the species. At Fairmount, Sheldon found them occupying mellow

soil along the river and a few scattered out on the wide, low prairies. At Oakes he found a few and at Lidgerwood they were abundant and very destructive to crops. At Wahpeton, Kellogg and the writer found them common along the river valley, and noted a few over the prairies, where they were doing considerable mischief in grain and alfalfa fields. At Lisbon, in 1912, Eastgate took a few specimens, but reported the animals scarce. In 1892, Loring took specimens at Valley City, Castleton, Wheatland, Buffalo, Erie, Portland, and vicinity. At Fargo, in 1912, their hills were abundant over the valley, except on some of the farms where the pocket gophers had been trapped. The hills were large and a long row of them across a green field of young wheat showed up strikingly. At Larimore, in 1915, Kellogg was told by the residents that these large pocket gophers had been the original species there, but the little gray form, *Thomomys talpoides rufescens*, had come in recently; at Manvel, Grand Forks County, he collected a specimen of *Geomys* and reported it as the common gopher of that region and especially numerous along railroad tracks. At Grafton only *Thomomys* was caught, but the large hills of *Geomys* were seen at Minto, 10 miles farther south. In 1916, the writer took *Geomys* just across the Red River from Pembina, where gopher hills were common on a strip of mellow soil, and specimens have been taken at Emerson, just above the Manitoba line. Thus the range has been rather fully worked out and found to extend on the west little beyond the old beach lines of post-glacial Lake Agassiz.

General habits.—For a distance of more than 1,000 miles, roughly from Pembina to El Paso, the ranges of *Geomys* and *Thomomys* meet without any extensive overlapping, *Geomys* occupying generally the mellow soil of the fertile valley country and *Thomomys* the higher, drier, and often more sterile soils to the west. The reasons for this division of territory have caused much speculation, and to obtain some evidence on the question, the writer made a special effort to get living specimens of both to test their dispositions when placed together. A live *Thomomys* was placed in the cage with the larger *Geomys*. Without a moment's hesitation the old 14-ounce *Geomys* pounced upon the 5-ounce *Thomomys* and began to chew it up, catching it by the ribs and crushing its bones, ribs, neck, skull, shoulders, and legs. When convinced that it was entirely dead the *Geomys* left it and showed no further interest in the victim. Its bones were broken to bits, but the skin was not cut through, probably because the teeth of the *Geomys* had been dulled on the wires of its cage. This fierce animosity seems to afford a reasonable explanation of the division of range between the two genera, the larger and more ferocious occupying the choice, fertile portion of the country and leaving the rest to its weaker relative.

To test further the disposition of *Geomys*, two that had been caught alive were placed near together, the old female that had chewed up *Thomomys*, and a half-grown young male caught near her home and quite probably one of her last spring's young that had been long ago sent out to dig its own way in the world. As they met face to face both hissed, struck out with their hands, and clashed their incisors together, the larger forcing the smaller one backward, but they did not clinch, and neither gave the other a chance to get

a hold. Again and again they jumped at each other, hissing and blowing, striking or pushing with their hands, and striking their incisors together with loud clicks, but doing no damage. The smaller animal was constantly forced backward and evidently would have retreated into its burrow had it been within reach. They were separated before any damage was done, but not until they had fully demonstrated the fact that they are not sociably inclined.

Later, while in a cold room in a little hotel, the writer placed a meadow mouse, *Microtus drummondi*, in the glass bowl with the smaller *Geomys*. Both were chilly and it was hoped they would keep each other warm. At first "Mike" jumped at "Geo" and bit and squeaked at him, but did not stir up any trouble, so he went over to one side of the bowl and made a nest for himself in the grass. It was thought they were going to be friendly and would be company for each other, but later in the evening Mike was heard to squeal; when the writer reached him Geo was making his bones crack. It was too late to intervene, and when Geo let go Mike was limp and dead. He was left to see what would happen, and in the morning the victim's bones were found broken to bits, although his skin was intact and no attempt had been made to eat him. While the *Microtus* may have started the trouble, for its disposition is not amiable, this further demonstration of the unsociable nature of *Geomys* is worth recording.

Later, after Geomys had become perfectly tame and was no longer interested in eating the writer nor in running away from him, its real nature and disposition were more apparent. It had no objection to being picked up and petted, but if startled would throw up its head as if ready to bite, so that it seemed safer to avoid its nose. If not startled, it would take food and climb into the hand to be taken up and carried about.

It would make a large, warm nest in its nest box by carrying in grass, paper, cotton, or any soft material until the box was well filled, then going in would stuff the doorway full and remain buried in its nest, sometimes for 12 or 24 hours at a time. It would sleep longer and eat less in cold weather than in warm.

When awake it would insist on strenuous exercise, eating, chewing up nest material, digging, scratching, and gnawing, or, if out of its box, running around the room for an hour or more at a time at a steady, rapid trot. At first it would butt into every object encountered as it followed the walls around and around, but later seemed to recognize and avoid every obstacle. Finally it became so familiar with the room that it would run in a large circle, missing all the furniture, unless something was moved into its path, when it would promptly bump into it. Its eyes were generally kept open while running, but in a lighted room they seemed to be of little help. In the dark it seemed to see well at close range, and when a nut was held in the fingers well inside its nest door it would take the nut gently without touching the fingers with its teeth. This, however, may have been due to the sensitiveness of its abundant short mustache more than to sight.

Its hearing seemed very dull, except for certain sounds. A touch, scratch, or jar on his house or its nest box would rouse the animal instantly from sleep and put it on the alert, while loud talking,

music, or open-air sounds seemed to make no impression on it. At first a puff of air or a door being opened across the room would attract its attention, and it could be stopped in its headlong race across the room by a quick puff of the breath.

Mentally it seemed dull and apathetic, although physically powerful and energetic. It has never shown any play instinct, but was probably too old when captured.

The animal was unable to swim. When put in a bathtub half full of water it floated with its head and back well out, but kicked or tried to run with its usual one-foot-at-a-time gait, and made no progress whatever. Apparently pocket gophers are unable to swim, and this may account for some peculiarities in their distribution in other parts of their range.

Pocket gophers have been supposed to have no voice. When caught in a trap or held in the hands against their will they make a hissing or blowing sound by forcing the breath rapidly out and in. This was supposed to be their only sound, but the tame pet on several occasions when hurt or troubled made a low, throaty *chur, chur, chur* in a complaining tone that seemed to be a real voice.

These powerful little burrowing animals live solitary lives almost entirely below the surface of the ground, and most of the time in total darkness behind closed and well-packed doorways. Their eyes and ears are of little use to them and have become almost rudimentary, but their tails, with sensitive tips, serve an important function in guiding their retreats in their shuttlelike motions back and forth through their extensive tunnels.

With their powerful claws they dig up the earth and push it before them to some point where a temporary opening is made through which it is thrust to the surface of the ground. The little mounds, or gopher hills, that dot the fields and prairies where they live are rapidly made. Load after load of the loose earth is pushed in front of the hands and breast to the entrance and thrown out with a little toss until the gallery is cleaned, and the last few loads are firmly packed in the entrance to close the burrow. Sometimes a few quarts and sometimes a bushel of earth are thrown out in one heap, but there is always the little circular dent, where the last load was pushed up and left in the mouth of the burrow, and often the direction of slope to the burrow below may be known from the greater quantity of earth on one side of the doorway. Later another doorway is opened up to the surface 10 or 20 feet away and another hill thrown up, and so on, day after day, until a long line of hills is formed, or a group if the burrows wind about and among each other.

In 1887, the writer counted the fresh hills thrown up by three pocket gophers 12 days after a rain, and the number of mounds that had not been rained upon were 28, 35, and 40. These hills averaged about 6 quarts of earth each, or approximately 17 quarts a day thrown out by one pocket gopher.

In summer the tunnels are about 10 inches or a foot below the surface, but in winter they run deeper and probably keep below the frozen earth, except at the entrance, where many are kept open to the surface. From these openings the animals push their way through the snow along the surface of the ground, leaving tunnels that later are filled with the loose earth from their burrows.

Pocket gophers do not become fat or actually hibernate, but they store up food to some extent, probably for winter use.

Breeding habits.—Long and widely known as these animals have been, it seems strange that there is so little information available regarding their breeding habits. Once on a Minnesota farm, two naked young were found in a nest chamber in the burrow. Their eyes were closed, their skin was delicate, pink, and hairless, and their little round heads and fat chubby hands were almost baby-like. The number of young, as shown by embryos in females collected for specimens, is 2 to 6, with apparently 4 the most common. The mammae of the females are arranged in two pairs of inguinal and one pair of pectoral. Only the small young are found in the burrow with the mother. As soon as they are old enough to dig for themselves, and before half grown, they branch off into new galleries, which finally become closed behind them when their solitary careers begin. Most of their lives are solitary, but in the mating season in spring a male and female are occasionally caught in the same burrow. The male soon leaves, however, and takes no further interest in the family affairs. Their reproduction is not rapid, but they are so well protected from enemies above that they increase steadily unless their abundance is controlled by artificial means.

Food habits.—The food of pocket gophers consists entirely of vegetable matter, largely roots encountered in their underground tunnels but also a great variety of green plants from above ground. When the opening is first made to the surface, the pocket gopher examines the plants close by and usually cuts them and fills its pockets before throwing out the earth, sometimes making several trips back to empty its pockets and fill them again before it throws out the earth and closes the doorway. Thistles, dandelions, clover, alfalfa, and leguminous plants generally are favorite foods, but grass, grain, and a variety of other plants are taken as encountered, and the pockets are often stuffed with leaves and stems intended for food or nest material. The many little bulbs, as wild onions, lilies, and the tuberous roots of native plants, are sought for food, but the soft and tender roots of many other plants are eaten, as well as the bark from even the woody roots of shrubs and trees. The contents of stomachs of pocket gophers usually show a combination of green plant tissues and the finely chewed white or light-colored pulp of roots and bulbs. At times ripe grain is eaten, but generally green food seems to be preferred, or is more easily obtained.

Economic status.—In many localities pocket gophers are among the most destructive of rodent pests, as they prefer many of the cultivated crops to wild food and steadily gather into fields where potatoes, turnips, or other root crops are raised, and also into fields of clover and alfalfa and the best of tame-grass meadows. In grain-fields they do extensive damage, but are partly kept out by the plowing of the land and by the long period of scant food in the stubble. In orchards and dooryards they also do much damage, eating the roots from fruit trees and ornamental shrubs, and often killing many of the choicest varieties. Their destruction is imperative in any well-kept agricultural land, and in limited areas this is not difficult. They are easily trapped or poisoned, and detailed methods for their

most economical destruction have been worked out by the Biological Survey. Circulars or leaflets giving the best methods can be had on application.

Thomomys talpoides rufescens Wied

Dakota Pocket Gopher

Machtóhpka of the Mandans (Maximilian); *Mánica* of the Dakotas (Gilmore); *Cipans* of the Arikaras (Gilmore); *Kípapudè* of the Hidatsas (Gilmore).

Thomomys rufescens Wied, Nova Acta, Acad. Caes. Leop.-Carol. Nat. Cur., t. 19, pt. 1, p. 378, 1839.

Type locality.—Fort Clark, N. Dak.

General characters.—Smaller and slenderer than the Mississippi Valley pocket gopher, which comes into eastern North Dakota. Upper incisors, not noticeably grooved except in a fine line near inner edge of each tooth; large fur-lined cheek pockets on each side of face reaching back under skin to shoulders; front feet and claws, large; hind feet, comparatively small; tail, nearly naked at tip; fur, short, smooth, and glossy. Color of upper parts, dull brownish-gray; underparts, buffy-gray, often with white markings on chin, throat, and breast. Measurements of adults: Total length, about 240 millimeters; tail, 70; hind foot, 31. Weight of adults, 5 or 6 ounces.

Distribution and habitat.—The Dakota pocket gophers cover the greater part of North Dakota and extend into eastern South Dakota and southwestern Manitoba. Their range covers practically the whole State except the low part of the Red River Valley, south of Grafton, and the western edge of the State, where a slightly different form occurs at the junction of the Yellowstone and Missouri, and probably along the Little Missouri River Valley. The eastern border of their range in the State is marked by Pembina, Drayton, Grafton, Larimore, Portland, Valley City, and a point 4 miles southeast of Ellendale, in an irregular line following closely the old shore line of Lake Agassiz, and also marking the western edge of the range of the larger Mississippi Valley pocket gopher, *Geomys bursarius*. The cause for this limitation of range may be due to antipathy of the two species, or to combination of factors; nowhere do the two overlap to any great extent. The fact that *Thomomys* avoids low or wet ground and is partial to high, dry prairies may be one of the determining factors of this border line.

Over all the high open prairie country and often in the timbered areas of the Turtle Mountains and Pembina Hills, these pocket gophers are found in dry meadows, fields, clearings, openings in brushy land, and sometimes even in scattered timber. At Pembina, in 1887, the writer found them common everywhere, except in the thickest growths of trees along the river, and took specimens on both sides of the river as well as on both sides of the border line. A few were found in fields, but they were most abundant over the unbroken prairie, where their favorite food plants were growing. In 1892, Loring succeeded in trapping a specimen at Portland, but in six days' subsequent trapping found no others, so that evidently this was somewhat beyond their regular eastern limit. At Larimore he found them abundant 4 miles west of town, but none farther east, and at Sherbrooke he found them common, as also at Valley City and Jamestown. In the northwestern corner of the State,

about Kenmare and Crosby, pocket gophers were comparatively scarce in 1915, as their characteristic little mounds were noticed only in scattered localities.

At the type locality of the species, which was visited in 1909 to obtain specimens for determining the validity of Maximilian's name, the pocket gophers were common over prairie and river flats on both sides of the river, occupying both the dry, sandy bottomlands and the high heavy-soiled prairie. Later in 1913, Jewett also found them common over that part of the valley, in the Killdeer Mountains, and farther south in the vicinity of Glen Ullin and Mandan. In 1893, Fisher reported them very common at Bismarck. In 1915, Sheldon traced them across the southern part of the State, from a point 4 miles southeast of Ellendale, westward continuously to Napoleon, Dawson, and Cannon Ball. The same year Kellogg traced them across the northern part of the State from Grafton to Devils Lake, Towner, the Missouri River at Oakdale, and thence down the river to Bismarck. Thus the reports cover practically the whole State and indicate fairly definitely the range and abundance of the species.

General habits.—In many places throughout their range these pocket gophers will average one or more to the acre and their total numbers over the State are enormous. Their presence can always be recognized by the little mounds of earth heaped up in the prairie grass and containing usually from 2 quarts to a peck of earth. Many of these mounds, however, are enlarged by repeated excavations until they contain a bushel or more, and some measured at Pembina, in 1887, were 3 by 3 feet, and 7 inches high; 4 by 4 feet, and 10 inches high; 4 by 5 feet, and 6 inches high; and 4 by 5 feet, and 7 inches high. These, however, were all composite mounds where the earth had been thrown out several times on successive days.

Practically the whole life of the animals is spent underground, where they burrow continuously from point to point, usually 6 inches to a foot below the surface of the ground, bringing out the loose earth by pushing it to the surface in the familiar little mounds, then securely closing the doorways, so that no enemy can enter their homes. Sometimes the row of mounds stretches away for 50 to 100 yards in almost a straight line; they are usually 6 to 8 feet apart, but sometimes 10 to 20 feet, while between some of the larger hills a space of 27 feet has been measured. More often the tunnels wind about and they sometimes form groups, where one of the animals has worked all summer on a few square rods of ground, so that the lines of old and new mounds crisscross and overlap.

The burrows pass through ground that is full of choice food in the form of roots, bulbs, and tubers. Some green food is gathered and tucked into the pockets at the entrance of their burrows, but aside from this the animals rarely come out on the surface of the ground unless for a few seconds at a time when they are throwing out the earth. The earth is pushed out in front of them in little loads about half the size of their bodies, and so quickly that it has the appearance of being thrown from them. Most of the people living in the country where they are abundant never see them, and often their rightful name of pocket gopher is misapplied to the ground squirrels. In winter they go deeper so as to escape the

frost, but keep their burrows open to the surface and often come out under the snow and tunnel long distances to obtain green vegetation, afterwards filling these surface tunnels with earth from below. They do not become very fat and evidently are active throughout the winter.

Breeding habits.—Apparently but one litter of young is raised in a season and judging from the immature specimens caught in July and August these are born some time in June. A record of five embryos, about one-third developed, taken at Carberry, Manitoba, June 29, 1892, by Ernest Thompson Seton (1909, vol. 1, p. 567), seems to furnish the only positive data available for this subspecies, although records for other forms of the same group, with the same arrangement of mammae, two pairs of inguinal, two pairs of abdominal, and one pair of pectoral, indicate a normal litter of six young. Practically nothing is known of the nest and underground habits of these animals, and the small young seem not to have been recorded. Few animals are more solitary in habits, and only during the mating season in spring are a male and female occasionally trapped from the same burrow. The male soon leaves, however, and probably never sees the young. The mother cares for her family until they are about half grown, when they start burrows of their own and are soon shut off from parental care, each beginning a life that is to be mainly solitary. Although breeding but once a year, their increase is comparatively rapid, as they are unusually well protected from enemies.

Food habits.—These pocket gophers live almost entirely on roots and green vegetation, and although they are very partial to certain species of plants, they will eat almost anything that comes in their way if better food is not available. The prairie clover (*Psoralea argophylla.*), prairie turnip (*Psoralea esculenta*), and wild licorice bush (*Glycyrrhiza lepidota*) are apparently their favorite wild foods over much of the prairies, and their mounds often become very numerous where these plants are abundant. In their pockets are found the leaves and stems of a great variety of other plants, including grass, lupines, and other legumes, and occasionally roots and tubers, but apparently these are not often brought to the surface. Sometimes the pockets are found stuffed so full of green vegetation that they more than double the apparent size of the animal's head. They are used only for carrying food and not, as is sometimes reported, for carrying earth out of the burrows. To what extent roots, tubers, and bulbs are stored for winter food is not well known, but occasionally well-filled storage cavities are found along the lines of the tunnels.

Economic status.—Next to the ground squirrels, these gophers are generally the most destructive rodent pests of the region where they live. Although for ages they have been industriously plowing and mellowing the prairie soil, burying the surface vegetation and enriching and improving the land, they at once become the farmer's enemy when occupying the ground with his crops. Even on the prairies they destroy or consume much of the choice grass that would otherwise be available for stock, and cover up and prevent the economical cutting of much of the wild hay on the prairie and the best parts of the dry meadows.

In fields, gardens, and orchards, however, they do the most harm. Entering through their safe tunnels, they find choice food in the clover and alfalfa fields, and if nothing better can be found will live all summer on the green stems, leaves, and heads of grains. In vegetable gardens they are even more destructive, cutting the peas and beans above the ground and drawing them into their burrows to be eaten, or, without the risk of appearing at the surface, taking the onions and turnips or following a row of potatoes and cleaning the tubers from each hill in succession. Nowhere is their mischief more exasperating than in a clean and well-kept orchard, where, lacking other food, they often eat the bark from the roots of the trees and leave them to die, or even cut off so many of the roots that the trees dry up and tip over with the first wind.

Fortunately, pocket gophers are easily controlled, and it is only necessary to know how to poison or trap them in order to protect crops and trees. Where only a few are doing mischief, the simplest method is to trap them by merely opening their doorways and setting traps that will catch them as they come out to close the openings. Armed with a few modern traps and an old table knife, anyone can, with a little practice, catch all the pocket gophers in an ordinary garden or orchard without much loss of time. Where the mischief is on a larger scale, poison is a more rapid and economical control measure. Simple directions can be obtained from the Biological Survey for the most effective methods of administering poison.

Although excellent food and in every way perfectly suitable as a food animal, pocket gophers are not large enough to be of importance as game. In places where it is necessary to catch considerable numbers of them, however, they can be used to advantage as food, and if properly dressed and cooked are as good as rabbit or squirrel.

Thomomys talpoides bullatus Bailey

Sagebrush Pocket Gopher

Thomomys talpoides bullatus Bailey, Proc. Biol. Soc. Washington, vol. 27, p. 115, 1914.

Type locality.—Powderville, Mont.

General characters.—Very similar to *rufescens* but noticeably lighter and brighter colored, with conspicuously larger audital bullae. Measurements of type specimen; total length, 238 millimeters; tail, 72; hind foot, 30. Weight of female, from Buford, 5 ounces.

Distribution and habitat.—The arid sagebrush-valley form of pocket gopher occupies mainly the Yellowstone and Missouri Valleys of Montana, but comes into North Dakota at Buford and is probably the form occupying the Badlands part of the Little Missouri Valley, as specimens have been referred to it from the valley just below the southwest corner of the State. In an arid, open habitat, often with sandy or light-colored soils, these pocket gophers have become adapted to their environment in coloration, but in general habits show only such differences from *rufescens* as are occasioned by the conditions under which they live. Over the open range country they are of little economic importance, but as many of the valleys are brought under irrigation with intensive cultivation, they become of serious consequence and their destruction is necessary to satisfactory returns from the cultivated areas.

Order LAGOMORPHA: Rabbitlike Animals

Family LEPORIDAE: Rabbits

Sylvilagus floridanus similis Nelson

Nebraska Cottontail

Wahboos of the Chippewas (Wilson); *Ma^{n}shti^{n}-sapana* of the Dakotas (Gilmore); *Mo^{n}stinga* of the Omahas (Gilmore), generic term.

Sylvilagus floridanus similis Nelson, Proc. Biol. Soc. Washington, vol. 20, p. 82, 1907.

Type locality.—Valentine, Nebr.

General characters.—Rather compact, with relatively short ears and short legs. Colors essentially similar in summer and winter. Upper parts, rusty gray, darkened by numerous long, black-tipped hairs; rump, clear dark gray; throat, belly, and under surface of tail, pure white. Adult measurements: Total length, approximately 408 millimeters; tail, 52; hind foot, 99; ear from notch, 50. An adult male taken at Fargo by O. J. Murie on November 7, 1919, measured 405, 52, 98 millimeters, and weighed 2 pounds 1½ ounces.

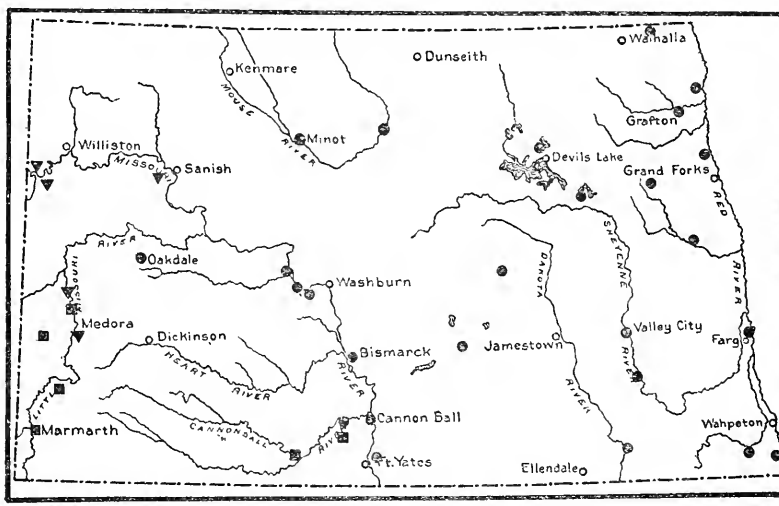


FIG. 8.—Three species of cottontail rabbit in North Dakota: Circles, the Nebraska cottontail; triangles, the Black Hills cottontail; squares, the Wyoming cottontail

Distribution and habitat.—Over the central Great Plains from Kansas to near the Canadian line Nebraska cottontail rabbits occupy the stream valleys and thickets of a mainly prairie region (fig. 8). In North Dakota there are specimens from Fairmount, Oakes, Fargo, Kathryn, Portland, Valley City, Larimore, Grafton, Hawks Nest, Dawson, Stump Lake, Sweetwater Lakes, Towner, Oakdale, Stanton, Fort Clark, Deapolis, Bismarck, Cannon Ball, and Winona. These are mainly brush rabbits, not commonly found at any great distance from the wooded or brushy bottoms. Apparently they have not yet reached the Turtle Mountains, although since the settlement of the country their range seems to be slowly extending northward in the

State. In 1887 there was found no trace of them in North Dakota, nor nearer than Fort Sisseton, S. Dak., and Browns Valley, Minn. Eastgate says they first reached Larimore in 1900.

In 1913 Mr. Booth, a taxidermist, reported that cottontails were abundant at Minot, and had first arrived about 1890. No trace of them was found farther north, at Kenmare, Crosby, or Bottineau. In 1912, on a wagon trip from Linton, in the southern part of the State, to Stump Lake, no trace of cottontails were found until Hawks Nest Butte was reached, where a specimen was obtained and tracks were seen in the timber, and on the south side of Stump Lake the rabbits were common in the timber. In 1919, at Walhalla, Eugene D'Heiley told the writer that cottontails came there in 1912, but soon disappeared, though they were still found at Neche, 20 miles farther east. In 1913 Jewett collected a specimen at Fort Clark and one at Oakdale in the Killdeer Mountains, and reported them as fairly common in the thickets and brushy gulches. In 1915 Kellogg took specimens at Larimore and reported them common at Manvel, Grand Forks County, and at Grafton, Walsh County. He was told that they were common at Drayton, Pembina County, although he did not find any. At Towner he took one immature specimen in the meadow and saw several others, and he reported the species common along the Missouri River from Stanton to Bismarck.

General habits.—These little short-legged rabbits are such an easy prey to dogs, wolves, and foxes that it is necessary for them to keep within the protecting cover of thickets or dense vegetation. Usually where they occur their roadways or trails may be found in every thicket or leading from one thicket to another. At Hankinson, they were found abundant in the woods and brush patches around the lake shores and in the thickets among the sand dunes. On the Hankinson ranch cottontails were frequently seen in the dooryards and about the buildings, in spite of several dogs and cats which were constantly hunting them. A family of half-grown cottontails living in some burrows under the roots of a tree gave the dogs a great deal of exercise in chasing them to cover and digging and barking at their burrows. The rabbits did not seem to care and were getting the best kind of training for life on the ranch.

At Fairmount, Sheldon reported them as frequenting farms and deserted buildings. At Lisbon and Valley City, Eastgate reported them as very common in the thickets and in both the natural timber and planted groves. As the country fills up with farm buildings, orchards, and garden shrubbery, these rabbits seem to increase in abundance and extend their range on the open prairie, where formerly it was impossible for them to exist because of numerous native enemies.

In the older, more settled parts of the State they are conspicuously most abundant. Along the Missouri River bottoms, where the thickets are dense and often thorny, they find the most perfect protection and satisfactory conditions of environment. At Washburn, in 1909, the writer found them abundant all over the brushy river bottoms, where in summer they had the added protection of hosts of mosquitoes, which rendered hunting almost impossible. At Fort Clark, in 1913, Jewett reported them common in the wooded and brushy bottomlands, to which they were closely restricted; on a

short walk along the river-bottom roads in the evening, he would usually see five or six. At Cannon Ball, in 1916, they were found very common in the brushy bottoms along the Missouri and Cannonball Rivers, and at Parkin, a few miles up the Cannonball, they were common in the wooded and brushy bottoms. One was living in a lumber pile in the middle of the new town just starting up on the prairie, and a bulldog spent much of his time chasing it from one lumber pile to another, but the rabbit seemed to realize its advantages and not to worry over the noisy demonstrations of the dog.

Breeding habits.—Cottontails are prolific breeders and usually raise several litters of young in a season. At Fairmount, on May 28, Sheldon collected a female which was nursing young. On the Sheyenne River, north of Valley City, Eastgate took one on May 17, 1912, which contained seven embryos; and at Grafton, on May 10, 1912, Williams took one containing six small embryos; one collected by Jewett at Fort Clark, on July 22, 1913, contained five small embryos. Although born in a naked, blind, and helpless condition, the young develop rapidly and are soon able to shift for themselves, leaving the mother to resume her parental duties with a new family.

Food habits.—Rabbits are mainly grazing animals, and their list of food plants includes in large proportion both native and cultivated vegetation. They take the leaves and tender blades from grasses, clovers, and most of the wild leguminous plants with which they come in contact, and are especially fond of the cultivated clovers, alfalfa, and most garden vegetables. They also eat the bark and buds of many shrubs and small trees in summer and in winter depend largely upon browse and bark for their food. At Kathryn, in Barnes County, Eastgate reported them feeding in the evenings along the edges of the grainfields, where it was common to see six or eight at a time. They always find an abundance of food and as one kind of vegetation dies or dries up, other plants are accepted in its place.

In times of deep snow the rabbits forage out from their well-protected burrows and pick buds and green tips and branches from the shrubs and such plants as are exposed above the snow, every increase in the depth of snow lifts them to a fresh supply. Their runways in the snow are always packed and frozen, so that a rapid retreat to safe cover is assured, and as more food is needed the runways are extended farther out through the brush or from one thicket to another.

Economic status.—Numerous inquiries among farm residents made it evident that these rabbits are not generally considered a pest, although where abundant they occasionally do considerable mischief. The small quantity of grain that they cut along the edges of a field, the forage crops eaten, and the fruit trees and shrubbery occasionally killed or damaged, is readily forgiven them because of their value as food and game. To many of the country boys they furnish the only available hunting, and usually before the winter is far advanced they have become so scarce as to leave barely enough to restock the country the following spring. In this northern clime they accumulate considerable fat during the fall, and are

among the choicest rabbits for food, being especially healthy, plump, tender, and well flavored. They have also a market value, and if they ever become overabundant, ample protection against damage to crops and trees may be had by extending the hunting season. In rare cases it may be necessary to poison those around orchards and gardens. Full directions for destroying them in this way will be furnished by the Biological Survey on request.[18] Generally, however, the few individuals that are doing mischief can be shot and utilized for food. The young of the year are especially delicious, broiled or fried, while the old individuals, well stewed with a little bacon or fat pork, afford an acceptable variety for any table.

Sylvilagus nuttallii grangeri (Allen)

Black Hills Cottontail

Nis of the Arikaras, and *Itakshipisha* of the Hidatsas (Gilmore).

Lepus sylvaticus grangeri Allen, Bul. Amer. Mus. Nat. Hist., vol. 7, p. 264, 1895.

Type locality.—Hill City, S. Dak.

General characters.—About the size of *similis*, but lighter gray, with slightly longer ears and distinctive skull characters. Slightly smaller than *baileyi*, with shorter ears and feet. Very similar in color, but brighter rusty on nape and legs. Average measurements: Total length, 385 millimeters; tail, 46; hind foot, 95; ear (measured dry), 56.

Distribution and habitat.—The little pale-gray Black Hills rabbits barely reach into extreme western North Dakota from their wide distribution over the arid interior of Nevada, Utah, Wyoming, and Montana (fig. 8). There are 5 specimens from Buford, 2 from Goodall, 2 from Medora, and 1 from Mikkelson on Roosevelt Creek, 23 miles north of Medora. They occupy the same Badlands country with *baileyi* but appear to confine themselves mainly to the dense thickets along the stream courses. At Medora, Jewett reported them as not common, but a few were found in the banks of the Little Missouri River, where a female was shot on January 15 as she sat in front of her burrow. Only three were seen in this locality. Farther down the river a few were seen usually in thick growths of buffaloberry bushes. In other localities the writer has found them taking shelter among rocks and in hollow banks, but more often under dense growths, as sagebrush or thorny thickets of bullberry bushes. The three distinct species of cottontails of North Dakota have amicably or otherwise divided the ground among themselves, in a way that seems best to fit the needs of each, *grangeri* taking the place of *similis* in the arid brushy bottoms, while *baileyi* occupies the rougher and more open uplands.

Sylvilagus audubonii baileyi (Merriam)

Wyoming Cottontail

Lepus baileyi Merriam, Proc. Biol. Soc. Washington, vol. 11, p. 148, 1897.

Type locality.—Spring Creek, Bighorn Basin, Wyo.

General characters.—Size about the same as *similis*, but with ears and legs conspicuously longer and colors lighter. Upper parts, light gray with a buffy tinge, neck clear buffy; underparts, white; tail, large and puffy and three-

[18] See Farmers' Bul. 702 (Lantz, 1916).

quarters white, with relatively narrow stripe of gray above. Measurements of adult male, from Little Missouri River: Total length, 399 millimeters; tail, 48; hind foot, 102; ear (measured dry), 67. Measurements of type specimen, 418, 50, 100, and 94.

Distribution and habitat.—The long-eared Wyoming cottontails come into extreme western North Dakota along the Little Missouri Valley (fig 8). There are specimens in the Biological Survey collection from Marmarth, the former from North Dakota National Forest, Sentinel Butte, and the Little Missouri River, 25 miles north of Medora, and one in the agricultural college collection, at Fargo, collected by Doctor Bell, at Wade, on the Cannonball River. At Parkin, near the mouth of the Cannonball, the writer recognized these long-eared rabbits as common in 1916 around the Badlands buttes, and Sheldon reported one seen at the Palace Buttes a little north of the mouth of the river.

General habits.—To a great extent these are Badlands cottontails, and instead of keeping to the brushy bottoms they are more often found along the broken slopes and among the rock piles and Badlands gulches of the roughest parts of the country. At Parkin the writer found them along the steep slopes of the high butte near town, running from one rock pile to another and taking refuge under the rocks and in washed-out cavities of the Badlands slopes. Their long ears, big white tails, and yellow-gray color mark them at once as different from the short-eared and more compact little Nebraska or Black Hills cottontails of the brushy bottomlands. Along the northern edge of the North Dakota National Forest early in August of 1913 they were found abundant in the banks of the river valley and in the rough gulches of the rocky slopes of the Badlands, where they would quickly gain cover in some rock pile or washed-out hollow in the banks or else take refuge in an impenetrable jungle of buffaloberry bushes or tangle of brush that offered equally good protection. About 8 miles south of Sentinel Butte Jewett obtained a specimen at the entrance of a deep crevasse in a rocky gulch on the side of the big butte. In an open country, where life frequently depends on getting quickly to safe cover, these rabbits have developed long ears and long legs for quick hearing and rapid flight. In other ways they have the general habits of most cottontails. As food they are equally as good as the brush-inhabiting species and as game generally more difficult to shoot.

Lepus americanus americanus Erxleben

Varying Hare; White Rabbit; Snowshoe Rabbit

(Pl. 17, fig. 3)

[*Lepus*] *americanus* Erxleben, Syst. Regni. Anim., p. 330, 1777.

Lepus bishopi Allen, Bul. Amer. Mus. Nat. Hist., vol. 12 (1899), p. 11, 1900; type from Mill Lake, Turtle Mountains, North Dakota.[19]

Type locality.—Fort Severn, Keewatin, Canada.

General characters.—About midway in size between jack rabbits and cottontails. Ears and legs, moderately long; tail, small; feet, large and hairy, especially in winter. In summer upper parts dark buffy gray, with blackish on tips of ears and top of tail; feet, buffy brown; chin and middle of belly,

[19] This form, based on an abnormal skull in the type and only specimen available at the time of its description, appears on examination of a good series of specimens from the type region to be typical *americanus*.

whitish; lower surface of tail, gray. In winter pure white, except black narrow border of ear, and dark eyes. Fur, very long and soft; on soles of feet, long, dense, and coarse. During change from white winter coat to gray summer coat, after loss of the long white cover-hairs and before gray summer coat comes to the surface, there is a short time when the yellow underfur is exposed; also during the fall change from gray to white the color is much mixed and often patched. Average measurements of adult specimens from North Dakota: Total length, 451 millimeters; tail, 34; hind foot, 125; ear from notch (measured dry), 60. Weight, 3 to 3½ pounds (Seton).

Distribution and habitat.—Snowshoe rabbits, which turn from gray in summer to white in winter, are more or less common in the forested areas of the Turtle Mountains, Pembina Hills, around Devils Lake, and along the wooded parts of the valleys of the Red, Mouse, and Missouri Rivers. There are specimens in the Biological Survey collection from Grafton,[20] the Turtle Mountains, Devils Lake, Stump Lake, Elbowoods, and Buford. Throughout the timbered and brushy areas of the Turtle Mountains they are especially abundant and specimens have been collected near Metagoshe Lake, Fish Lake, Diansley, Birchwood, and Mill Lake. On January 21, 1913, W. B. Bell reported one collected near Fargo and mounted for the agricultural college collection, and in 1919, Murie reported them as occasionally found there. In 1887, the writer was told that they were found in the woods near Grand Forks, and at Pembina he found them common. At Kenmare, in 1913, he found them common in the thickets and woods of the side gulches along the Des Lacs Valley, where their trails and signs were abundant and several of the rabbits were seen. C. E. Peck said that in the fall and winter the boys killed them there by dozens in the thickets of aspens and other northern trees and shrubs. Mr. Booth, a local taxidermist, was certain that they were common in the woods along the Mouse River near Minot. At Buford, in 1910, Anthony reported them common in the brushy river flats, where their well-beaten runways and patches of peeled willow brush were conspicuous and where several were seen and one specimen obtained. At Elbowoods, in 1915, Kellogg collected one specimen and reported them as quite common in the forest along the river bottoms. At Stanton and Sather he reported them scarce. At Cannon Ball, in 1916, the writer found their unmistakable signs and trails in the thickets along the river bottoms and was told by the residents that they were not very common. At a spot where one had been killed and eaten and its fur scattered about, the writer collected the tail as positive proof of the species. At Devils Lake, in 1916, Kellogg found one of these rabbits dead on Sullys Hill and saved the skull for a specimen. The following year a young one was taken on the north shore of the lake about a mile from the town of Devils Lake and signs of them were found throughout the woods along the north and south shores. Williams reports them abundant at Grafton at times.

[20] Two specimens collected at Grafton on March 30, by H. V. Williams, are in the yellow spring coat after the disappearance of most of the white outer fur. In one of these a spot of the new summer coat is shown and this agrees with the buffy-gray color of *americanus* rather than with the warm brown of *Lepus americanus phaeonotus* Allen of Minnesota. Although the type locality of *phaeonotus* is just across the Red River Valley at Hallock, Minn., the specimens from Grafton are evidently nearer to the typical subspecies than to the Minnesota varying hare.

General habits.—The varying hares are strictly woods rabbits, depending on dense forest and thickets for cover, protection, and food. They rarely come into the open, except along the edges of brush patches, where they can quickly dash back out of sight into their well-beaten trails and runways, which carry them under the brush in perfect safety from most of their enemies. In summer their dusky-gray colors render them invisible in the brushy shadows, and as they sit with ears low on their backs they seem fully aware of the advantage of their protective coloration and often allow passersby almost to step on them before bounding away into the thickets. Though mainly nocturnal in habits, they are usually seen in the evening or early morning sitting in the roads or trails that wind through the forest, and in a good rabbit year, when their numbers are at the maximum, a late or early drive along the wood roads usually sends them hopping out of the way at frequent intervals. At times they become very scarce, and often for a period of several years are seldom seen. Many theories have been advanced to account for the waves of abundance and scarcity, which seem to be more or less periodic, but much remains to be learned by close and continuous observation of the real causes. A very full account of their fluctuations through the north country is given by Preble (1908, p. 199), in North American Fauna No. 27; Seton (1909, vol. 1, pp. 621–652) also gives an interesting account of their habits in his Life-histories of Northern Animals.

Breeding habits.—On June 18, 1916, some one found a very young rabbit that had been killed by a dog in a patch of silver-leaf bushes on the shore of Devils Lake, about a mile from town. It was not so large as one's fist and had evidently been dug out of the nest or hollow in the leaves of the little brush patch, and as it had just been killed it made an excellent specimen and showed the beautiful long crinkly, coarse gray fur of the juvenal coat. Although apparently not a week old, its fur was very long, soft, and full, and the color even more highly protective than in the adults. Apparently the dog had eaten or carried away the other members of the family, so the number in the litter could not be determined. Usually with this species there are 3 or 4 young at a birth, and farther north in Canada Preble records 2 to 6 embryos. A female examined at Fort Clark by Maximilian in 1833 contained 4 embryos. The species is generally supposed to raise 2 or 3 litters of young during a summer, but data on this point are meager.

Food habits.—In summer these rabbits feed on a great variety of green vegetation, including grasses, grains, many of the wild and cultivated clovers and leguminous plants, and some buds and leaves of shrubbery. In winter they depend mainly upon the bark and buds of a great variety of shrubs and eat higher up as the snow becomes deeper. In spring the bushes neatly clipped at various levels show the depth of snow from which the rabbits fed at different times during the winter; often these clippings reach 4 or 5 feet above the surface of the ground. The large chisel-like incisors of the rabbits will cut bushes up to the size of lead pencils as smoothly as if done by a knife, and they also serve to remove the bark from fallen branches and even the trunks of small trees when other food is not abundant. Sometimes whole thickets of willow and aspen

are denuded of bark as high as the rabbits can reach, and even some of the young forest trees are thus injured or killed. Except in years of unusual abundance the rabbits find an ample food supply in the buds and tender tips of the winter browse without doing much harm. They are usually plump and sometimes show considerable fat even during the coldest of winter weather.

Economic status.—In newly settled sections of wooded country where the snowshoe rabbits are abundant they sometimes do considerable harm in cutting the young trees and shrubbery in winter, and may take a small portion of the growing crops in summer. Their value as food and game animals, however, is sufficient to outweigh by far the little damage they occasionally do. In many parts of the country where once common, they have been practically exterminated from extensive areas by persistent hunting. There is great danger that, without reasonable protection in restricted areas of their range, such as that about Devils Lake and in the scattered timber patches along the Mouse River, and even in the brushy bottoms along the Missouri, they may be killed off to the point of extermination. Among all the rabbits of the State they are the most desirable as food and game and from their habit of keeping entirely within the brush they are less likely to do serious harm to crops. Except in years of extreme abundance, their seasonal protection with that of other game would seem a wise precaution. At any time when their numbers become too great the protection could be removed and they would soon be reduced by local and market hunters.

Lepus townsendii campanius Hollister

White-tailed Jack Rabbit

Warchu of the Arikaras, and *Ma^{n}sti^{n}ska* of the Dakotas Gilmore).

Lepus townsendii campanius Hollister, Proc. Biol. Soc. Washington, vol. 28, p. 70, 1915.

Type locality.—Plains of Saskatchewan, probably near Carlton House, Saskatchewan.

General characters.—A large, heavy-bodied jack rabbit with long ears and legs and large white tail. Color in summer, light buffy gray above, back of ears white with black tips; tail, large and usually pure white or with an obscure gray line down the top; underparts, except throat, white or grayish white. In full winter coat, usually pure white all over except black tips of ears and dark eyes, but sometimes with a buffy tinge on feet, face, and back. Average measurements of adults from North Dakota: Total length, 648 millimeters; tail, 108; hind foot, 154; ear (measured dry), 95; Seton (1909, vol. 1, p. 654) records specimens weighing from 6 to 12 pounds. H. V. Williams, of Grafton, gives the average weight of 12 specimens as 8 pounds, and the greatest weight as 14 pounds. A large old female shot near Medina in June weighed 7¼ pounds.

Distribution and habitat.—The big white-tailed jack rabbits are generally distributed over the plains and prairie region from New Mexico to Saskatchewan and from Iowa to the Continental Divide, including all of North Dakota except the forested areas, into which they do not penetrate to any great distance. There are specimens from Lidgerwood, Ludden, Forbes, Valley City, Lisbon, Napoleon, Dawson, Harrisburg, Devils Lake, Towner, Buford, Mandan, Medora, Grinnell, Cannon Ball, and Sentinel Butte. They have

been reported from almost every locality in the State where field work has been carried on, except in the wooded part of the Turtle Mountains; at Little Prairie, an open area in the midst of the forest, Eastgate says they are common. In the smaller strips of forest they often gather in winter storms to feed on the bushes and escape the blizzards, but usually they are found on the wide, open prairie. Generally they are not numerous, and only occasionally is one seen to spring from its grassy form and go bounding over the wide expanse. Their big tracks are conspicuous in the dusty trails and roads, and their well-worn trails can often be followed for a long distance through the grass. Their abundance can also be estimated from the numbers of large round flattened pellets found scattered over the prairie. Some years they become much more numerous than others, but never multiply into the great numbers of the southern black-tailed jack rabbits. They hold their own well as the country settles up and are as much at home in the grainfields as on the prairie.

General habits.—These jack rabbits are animals of the open country, where speed and protective coloration save them from their enemies. As they sit crouched low in their shallow forms, even in the short prairie grass, they are so nearly invisible as to be rarely seen until they move. Depending on their invisibility, they will often lie close until almost stepped upon, then spring into the air and bound away at full speed with a startling flash of white tail, legs, and ears. Usually, they run with long, high leaps, head and ears held high as if in play, tail cocked on one side, patting the ground lightly with their feet, and at first often appearing to limp or run on three legs. It is only when badly frightened or closely pursued that they get down to real speed and stretch out in low, long form, with ears laid back as they glide close over the surface of the ground.

From a passenger train the writer once watched an interesting race with one that a dog had chased across the prairie directly toward the middle of the train. As it turned parallel with the train it raced along for about a mile, straining every nerve, stretching long and low and occasionally making two or three long leaps, then stretching out again at its best speed. As nearly as could be estimated, the train was going at about 40 miles an hour and for at least two minutes the rabbit held its own. The dog had given up the chase and finally the rabbit turned back into the prairie and with a few long, high bounds went over the top of the nearest swell. With an automobile on good roads, the speed of these rabbits could be measured, but no opportunity has been presented to give it a fair test. It is probable that these animals are excelled in speed only by good greyhounds. In their white winter coats, on big, furry feet, they run over the top of the snow in perfect safety from all pursuers except those with wings.

As the snow becomes deep they burrow underneath and usually sit fully concealed in their snow tunnels, where they are safe from even the large hawks and eagles. In the shallow snow they will sit nose to the wind on the open prairie or in plowed fields, as invisible as a speck on the great white snowfield. Speaking of their winter habits, H. V. Williams, of Grafton, says:

Plowed fields are their favorite places in winter. One of their peculiar habits, which usually warns a hunter of their presence, is that of zigzagging before digging a form and lying down. It is a sure sign that the rabbit is not far away when the trail begins to zigzag or the tracks turn back over themselves; one will often follow down a furrow, then turn and backtrack for 30 or 40 yards and make a long leap to one side before lying down within a few yards of the trail. Then as the hunter follows the trail past them they will get up behind him and get a good start before being seen.

Breeding habits.—At Buford, Anthony took a female on May 31, 1910, which contained 5 full-haired fetuses. The number of young is usually given as 3 to 6. The mammae are arranged usually in 4 pairs, generally considered 1 pair inguinal, 2 pairs abdominal, and 1 pair pectoral. While nursing young there is a copious supply of milk and the young up to quarter grown are found with a mixture of curd and green vegetation in their stomachs, but by the time they are half grown they seem to be entirely independent, relying on their ears, eyes, and legs for protection. Apparently in the northern part of the range but one litter is raised in a year, and these are born in May or June and are practically full grown at the beginning of winter. Seton (1909, vol. 1, p. 664) gives an interesting account of two fetuses taken from a mother that had been shot. They were found to have their eyes open and to be very active, and when set on the ground they ran about so quickly as to be hard to catch. They were taken home and raised by spoon feeding and became perfectly tame and very playful pets, living until 3½ months old, when they were accidentally killed. The young are usually found in some shallow burrow or concealing cavity in the ground, and up to the time when they are half grown and able to distance most of their pursuers they often run to a badger hole and disappear in its depths. If no burrow is near they often run to the nearest brush or weed patch and squat close under the protecting cover, but even on the short-grass prairie they absolutely disappear from view when squatted flat with ears laid low and tail tucked in.

Food habits.—In summer the white-tailed jack rabbits feed largely on grass, growing grain, and the prairie plants. They are very fond of clover, alfalfa, and many garden vegetables, as well as the tender shoots of growing grain. In winter their food is largely buds and browse, including the tips, branches, and bark of a great variety of shrubs and small trees. Young fruit trees and berry bushes afford favorite winter food. Until the ground is buried in snow they find an abundance of food among the dry winter plants, and as the snow becomes deep they hunt for thickets or brush patches where buds and branches are always within easy reach. Often they gather around hay or straw stacks, or follow the roads for scattered straws, which have been dropped by passing teams.

Economic status.—Unlike the southern black-tailed jack rabbits, which are often excessively numerous and of comparatively little value for food or game, these big northern hares are generally considered valuable game animals. In North Dakota they are rarely so abundant as to do any serious mischief, and their toll in forage is largely compensated for by their furnishing good sport and wholesome meat during fall and early winter. In orchards, groves, and yards they sometimes cause considerable loss and annoyance by cutting off or eating the young trees and bushes, but in most cases this

can be prevented by shooting the spoilers or by encouraging hunting in the vicinity. At Grafton, in 1912, Williams reported that they were hunted for food and sold a great deal in the markets. In the Sheyenne River Valley, in 1912, Eastgate wrote that during the winter many were shot and sold to be shipped abroad. Some years they were shipped by hundreds to commission merchants in St. Paul, Minn. In winter great numbers find their way to the markets of eastern cities, where they sell at a good price. Locally also they have considerable importance as game, and from midsummer on, when other fresh meat is scarce and expensive, the half-grown young form many delicious meals on the farms and ranches. They seem to be holding their own over the State surprisingly well.

In covering a good deal of North Dakota in 1912, the writer found these rabbits fully as common as when he first crossed the State in 1887. Even near the larger places, as Fargo, Grand Forks, Devils Lake, Bismarck, and Williston, they were almost as common as in the less settled sections, but in 1919 they were noticeably scarce in the Red River Valley. In some places many are shot at night in the roads as they run in front of automobile lights. One man told of shooting 16 in front of his machine one night "just for fun." If this unsportsmanlike practice should become general, it might seriously diminish the numbers of these useful animals, but generally they need little protection other than their own alertness and speed.

In rare cases where they become overabundant as they did in 1923 and 1924 in western Hettinger County, their numbers are reduced by organized hunting parties. Lewis F. Crawford sent a photograph of 7,550 of these great white hares in one pile at New England, N. Dak., killed in December, 1924. They were hunted with guns, dogs, and automobiles over an area of 20 to 30 miles square, both in the daytime and by the light of the moon. If rightly used the food value of the rabbits is a safeguard against any overabundance of the species.

Order CARNIVORA: Flesh Eaters

Family FELIDAE: Cats

Felis hippolestes Merriam

Mountain Lion; Cougar; Panther

Inmu-tanka of the Dakotas (Gilmore); *Shunta-haⁿska* of the Mandans (Will); *Itupa-ichtia* of the Hidatsas (Gilmore); *Wachtas* of the Arikaras (Gilmore).

Felis hippolestes Merriam, Proc. Biol. Soc. Washington, vol. 11, p. 219, 1897.

Type locality.—Wind River Mountains, Wyo.

General characters.—Largest of the mountain lions; body, long, light, and powerful; tail, long and slender; color, reddish brown, darkest along the back, and darkening at tip of tail to black; underparts, with areas of soiled white. Measurements of type specimen, adult male, taken from well-made skin: Total length, 2,600 millimeters; tail, 930, hind foot, 270; in feet and inches, approximately 8 feet 6 inches, 3 feet and 10.6 inches, respectively. A large male measured by Colonel Roosevelt in Colorado was 8 feet in total length and weighed 227 pounds; a large female was 6 feet 9 inches in total length and weighed 124 pounds.

Distribution and habitat.—Mountain lions undoubtedly ranged over all of North Dakota, as they have over practically all of the United States, but apparently they have always been scarce in this open prairie country. There seems to be no definite record for the State east of the Missouri River Valley. Even Alexander Henry, with his bands of trappers in the Red River country from 1800 to 1808, makes no mention of them. Maximilian (Wied, 1839–1841, Bd. 2, pp. 87, 302, 1841; Bd. 1, p. 395, 1839) in 1833 says in his journal, "Der panther (*Felis concolor*) ist jetzt am Missouri selten," and apparently he did not find any trace of them himself, although their skins were frequently mentioned among the Indians at Fort Clark and other places along the Missouri River. In one place he speaks of a Minnataree chief (Yellow Bear), who had a beautiful ornamented quiver made of panther skin. Again he speaks of a party of Crow Indians visiting Fort Clark on horseback, with beautiful panther skins for saddles. Farther west he found the Blackfeet Indians also using their skins for saddle cloths, but these were obtained from the Rocky Mountains. A high price was often paid for the skins, sometimes a good horse or even several horses, and seldom less than the equivalent of $60. This may in part account for the evident scarcity of the panthers along the Missouri River Valley, which was well occupied by tribes of hunting Indians.

Audubon, in 1843, on a trip up the Missouri River to Fort Union, does not mention them, but later one collected at Fort Buford, by A. Culbertson, was deposited in the National Museum. Roosevelt (1900a, p. 48), in 1883, at his ranch on the Little Missouri River, says: "The cougar is hardly ever seen round my ranch; but toward the mountains it is very destructive both to horses and to horned cattle."

At Cannon Ball, in 1916, Beede, who had lived among the Sioux Indians at that place until thoroughly familiar with their language and traditions, told the writer that the Indians say there have been no mountain lions in that region for many years. He says they showed him the spot in some of the buttes west of the town of Cannon Ball where an Indian boy was killed and eaten by one about 100 years ago. The boy had gone out in the buttes to fast and go through the test to become a brave. On the third night some of the young men who were watching for his return heard cries and in the morning they found only his bones that had been left by the big cat. The story is fresh and vivid in their history, which has been carefully kept for generation after generation ever since.

In 1889, W. B. Mershon (1925), in his hunting trips on the Little Missouri beyond Dickinson, reported mountain lions common and killing many deer, of which he saw the remains.

In 1913, Mr. Crawford, of Sentinel Butte, told the writer that there were still a few mountain lions in the Badlands region along the Little Missouri. In the same year Jewett, while in the Killdeer Mountains, was told by some of the old settlers that the animals once did considerable damage to stock in that section, but that they were then believed to be extinct. At Goodall, in McKenzie County, in 1915, Remington Kellogg was told that several were killed by Bill Black in 1895, and that in 1899 one had killed a colt of Mr.

Goodall's. In 1914, the writer saw a fine mounted specimen of mountain lion in the Leland Hotel, at Minot, and after making inquiries, wrote to the manager, Clarence H. Parker, then at San Antonio, Tex., asking for information in regard to its capture. The following reply was received from him:

The mountain lion which you write about I killed November 20, 1902, about 25 miles down the Missouri River from Williston on the south side of the river. I had killed lots of bobcats and some lynxes along the same grounds previous to the shooting of this lion. This is the only lion ever killed by anyone in the State to my knowledge. My father, who trapped the winter of 1887 on this same ground, says there were some grizzly and silver-tip bears, lots of bobcats and lynxes, but he never saw any sign of mountain lions in that country. The day previous to killing this lion I followed the tracks of three lions, and the next day shot this big fellow. He measured 9 feet 5½ inches,[21] his weight being about 143 pounds one week after he was killed. I did not see anything of the tracks of the other two for a few days after and then ran across them farther down the river. I followed them one day, but the animals kept in the thick cover and were hard to get at. That same winter an old trapper by the name of Yankee Robinson caught another lion and later a rancher trapped the young one. Yankee Robinson made a raft and floated down the Missouri to St. Louis, taking with him the two lions. He exhibited them at the World's Fair and afterwards sold them to a show company. The winter these lions were in this point the deer were scarce, and the following winter they were very plentiful. It has always been a question as to where these lions came from, but I figured they came over from the Little Missouri River, which is a very rough country about 50 miles south of the Missouri River. I was hunting in that country the winter of 1900 and saw a few lion tracks.

At Elbowoods in 1915 Kellogg was told of a pair of mountain lions seen at Sullys Lake in 1907, but they only staid there a short time. It is not improbable that a few may still lurk in the very rough Badlands country in the western part of the State, but it is more probable that the last record for the State has been made. Much interesting information is probably still available among the early settlers in regard to these big cats, and it is very desirable that more of it be placed on record before too late.

Lynx canadensis canadensis Kerr

Canada Lynx

Inmu-chota of the Dakotas (Gilmore); *Wach* of the Arikaras (Gilmore); *Sihtachache* of the Hidatsas (Maximilian).

Lynx canadensis Kerr, Anim. Kingdom, Mammalia, p. 157, 1792.

Type locality.—Eastern Canada.

General characters.—A large cat with long legs, large feet, short tail, tasseled ears, and crested cheeks. In winter, upper parts light hoary gray; underparts whitish with dark mottling on middle of belly; whole tip of tail, edges of ears, ear tassels, and part of cheek crests black. In summer, general color brownish gray more strongly marked with black. Readily distinguished from bobcats by the big feet, long legs, and solid black tip of tail. Owing to the long legs and long fur they look much larger than the bobcat, but often are not so heavy. A large individual measured by Preble near Fort Simpson, Mackenzie, was in total length 950 millimeters; tail, 100; hind foot, 250. A large one caught in Glacier Park, Mont., weighed 28 pounds.

[21] These measurements must have been taken from the skin, as the animal was not very large, judging by the weight and the appearance of the mounted specimen.

Their fur when prime is one of the most beautiful to be found—long, light, silky, and pale blue-gray of a peculiar frosted appearance. It is often used for capes and muffs, with the long flank hairs at the edge, where they rise and fall in beautiful undulations. Choice skins are always ranked among the valuable furs.

Distribution and habitat.—Some years the Canada lynx is common over the northern part of North Dakota and occasionally one is found wherever timber and brush offer cover and hunting grounds. The main range, however, lies in the Canadian Zone north of the border and south into the mountainous districts. From 1800 to 1804, Alexander Henry (1897, pp. 184, 198, 221, 245, 259) records in his journals, among other furs brought in by trapping parties in the Red River Valley country, 9 lynx skins from Reed River, 19 from Park River, 28 from Pembina River, 13 from Turtle River, 59 from the Hair Hills, 4 from Salt River, and 15 from the Grand Forks region. These undoubtedly included a few bobcats, but were all listed under the generic name "Lynx." Charles Cavileer in his "Story of '53," gives the highest number of lynx skins taken by the fur company in a good rabbit year as 4,000. In 1839 Maximilian (Wied, 1839–1841, Bd. 1, pp. 431, 432, 1839) reported 1,000 to 2,000 lynx skins, brought in to the fur trader at Fort Union (now Buford). These were listed separately from the bobcat skins, which were given as approximately the same number. In 1850, Mr. Culbertson collected a skin at Fort Union, later recorded in Baird's Mammals of North America. In the early eighties Roosevelt (1900c, pp. 173, 192) recorded lynxes from the Little Missouri country. Clarence H. Parker, of Minot, writes under date of March 13, 1914, that previous to 1902 he had killed many bobcats and some lynxes on the Missouri River bottoms below Williston, and that his father had trapped numbers of both on the same ground in 1887.

In 1878 they were reported by Doctor McChesney (1878, p. 201) at Fort Sisseton, just below the southeastern corner of the State. In 1909 they were said to be fairly common in the Turtle Mountains, and in 1912 Eastgate reported two killed near the boundary line, though he did not see the skins and so could not be sure whether they were Canada lynxes or bobcats. A mounted specimen in the agricultural college collection, at Fargo, was killed at Arrowwood Lake, May 26, 1907. At Devils Lake in 1916, Mrs. Falger told the writer of one that had been killed just south of the lake the previous winter. At Buford, in 1910, Anthony reported a few occasionally taken in winter, and at Sentinel Butte, in 1913, Mr. Crawford said that one was occasionally taken in that part of the country. In 1913 Jewett was told by a trapper living on Spring Creek, west of Oakdale, in the Killdeer Mountains, that he had caught four lynxes during the winter of 1912–13. In 1915 Sheldon obtained from E. F. Underhill, at Cannon Ball, a skin from one that had been caught on July 25 by an Indian, Jerome Elk, about 6 miles south of town. In 1915 Kellogg reported one killed at Lakota on July 25, 1915, by Fred Hensey and Charles Trounicek, and another seen in the timber near Larimore that year. At Grafton he was told of one killed by Frank Welch, 3 miles east of there, in 1909, and of one killed 8 miles west of the town in 1911. At Towner he heard that tracks were often seen

and that in 1914 a pair had been in the timber near there. He also obtained a general report of their having been known in the country south of Devils Lake, but without any definite record, and was also told of a few seen near Elbowoods. At Kenmare and Minot, in 1913, the writer was told that many had been captured from that part of the State in 1908 and 1909, apparently when wandering in search of new hunting fields. Trappers caught numbers of them and many were brought into the taxidermist shop to be mounted.

General habits.—Over a wide range in Boreal zones, Canada lynxes are stealthy forest hunters, keeping mainly within the shelter of timber and brush, where the snowshoe rabbits are most abundant and furnish their principal game. In the open country they may be considered accidental and wandering, and they are often seen and captured, while in their brushy haunts they are rarely seen except when taken in traps. In summer their dull-gray fur melts into the brushy shadows and in winter their frost-colored coats are almost as difficult to see on the shadowy surface of the snow as those of the white rabbits. Their big woolly-bottomed feet enable them to run over the surface of the snow almost as lightly as the snowshoe rabbits, and their big, round tracks are more often mistaken for those of the mountain lion than for those of their nearer relative, the bobcat.

In the far north the Canada lynx is one of the important fur animals, and large numbers are taken in traps and snares each season, although some years they are much more abundant than others. In North Dakota, on the thin edge of their range, they are not in sufficient numbers to be of much importance, and it is, perhaps, fortunate that they are not. Their serious inroads on game birds and mammals are more than suspected, although they are so stealthy that they are rarely caught in the act.

Lynx uinta Merriam

Northern Bobcat; Mountain Bobcat; Spotted Wild Cat

Itupa-púzi of the Hidatsas; *Mantóka* of the Mandans; *Bidábaho Pusika* of the Hidatsas (all, Gilmore).

Lynx uinta Merriam, Proc. Biol. Soc. Washington, vol. 15, p. 71, 1902.

Type locality.—Bridgers Pass, Carbon County, Wyo.

General characters.—More than twice the size of the common house cat, with short tail, tasseled ears, and crested cheeks, and readily distinguished from the Canada lynx by its smaller feet and legs and by the white tip of the tail. Upper parts yellowish gray, obscurely mottled, striped, or specked; most of underparts white, heavily spotted with black or brown or throat, belly and legs; back of ears with light gray patch, bordered by black, which runs into the black-tasseled tips; tail, white below and at the extreme tip, gray above with one to three black bars near the end. The type, a large old male, measured in total length 1,030 millimeters; tail, 165; hind foot, 200; and weighed 31 pounds. Few individuals, however, are so large.

Distribution and habitat.—In the western part of the State, along the Missouri River Valley and in the Badlands, the northern bobcats are fairly common, but good specimens are lacking to show positively which form is represented. A few mounted specimens seen at Williston and some skins at ranches, as well as specimens collected in eastern Montana, indicate the large, yellow-spotted *uinta* as the bobcat of this region. At Buford, in 1833, Maximilian

(Wied, 1839–1841, Bd. 1, pp. 431–432, 1839) recorded 1,000 to 2,000 skins of bobcats among the furs brought into the trading post in the course of a year. In 1910 Anthony was told by the trappers there that they were still a part of the yearly catch. At Williston, in 1913, the writer was told that there were a few, and the same year Jewett reported four caught by one trapper on Magpie Creek, a branch of the Little Missouri River, near where, in 1883, Roosevelt (1919, p. 106) recorded a raid on his chicken house by bobcats. On a trip down the Missouri River in 1915 Kellogg reported three killed at Goodall two years before by Frank Crane; he saw the skin of one which had been killed near Elbowoods and made into a rug, and was told of one that had been killed at Stanton five years before, and near Sather of one that had been seen a few years before. Sheldon and the writer obtained reports of northern bobcats being at Cannon Ball, but neither of them could get any specimens or definite records. One was killed at Parkin in 1915 and sold to some taxidermist, but the writer could not trace it the next year. On the North Dakota National Forest, about 25 miles south of Medora, in 1913, bobcat tracks were found common along the Little Missouri River and in the sandy trails of the Badlands gulches of the national forest. Two years later Sheldon found tracks fairly common on Deep Creek along the southern border of the forest, but was unable to obtain specimens. A record (Bailey, 1888, p. 432) obtained from the Turtle Mountains in 1857, is now considered doubtful, as many of the residents do not distinguish between the bobcat and the Canada lynx. The rough Badlands country and the brushy bottoms of the western part of the State furnish excellent hunting grounds, cover, and protection to these cats, which are rarely found in the open country of the prairie.

General habits.—Catlike, the bobcats are silent, stealthy hunters, always prowling in search of rabbits, ground squirrels, pocket gophers, mice, or any other small game that comes handy, pouncing upon it in the brush or giving chase when necessary. Unfortunately they do not confine their hunting to such small game, but include game birds, poultry, and the young and often adults of many of the species of large game. In places they become almost as destructive as the coyote to the herds of domestic sheep, killing not only lambs but adults freely, and undoubtedly taking many fawns and deer where they are to be obtained. Fortunately they are easily hunted with dogs and are quickly treed or run to cover, so that their numbers are readily controlled in a well-settled country. They are also easily caught in traps, but their fur is of relatively low value, although when prime it is full and soft and makes very light and warm coats and clothing. They are not likely to survive much longer in this open country nor to prove serious pests.

Lynx rufus rufus (Schreber)

Eastern Bobcat; Wild Cat

Felis rufa Schreber, Säugthiere, pl. 109b, 1777.

Type locality.—New York State.

General characters.—Slightly smaller than the Rocky Mountain form, darker, more uniformly gray, less strongly marked with spots and stripes. In summer rusty instead of yellowish gray. Measurements of large male from Greenbank, W. Va.: Total length, 915 millimeters; tail, 153; hind foot, 178.

In eastern North Dakota bobcats are scarce and the only specimen seen is one mounted in the Williams collection at Grafton, killed at Minto, January 11, 1908. It is an adult in full fresh winter coat, plain gray with little trace of spotting, and should certainly be referred to the eastern form. Other rather indefinite records of bobcats from Grand Forks County, Fargo, and Hankinson probably represent the same form, as may also those reported from Stump Lake, McHenry, and Towner.

Family CANIDAE; Dogs, Wolves, and Foxes

Canis mexicanus nubilus Say

Gray Wolf; Buffalo Wolf; Lobo; Loafer

Shuⁿg-tokeca of the Dakotas (Gilmore); *Harrata* of the Mandans (Will); *Tshesha* of the Hidatsas (Matthews); *Stshirita-kusa* of the Arikaras (Gilmore).

Canis nubilus Say, Long's Exped. Rocky Mountains, vol. 1, p. 169, 1823.

Type locality.—Engineer Cantonment, near present town of Blair, Nebr.

General characters.—The size of a very large dog with heavier, more powerful teeth than any dog; ears, erect and pointed; mane, over shoulders, long, and capelike; tail, bushy with black tip; color normally light gray, produced by the black tips of the long hairs, through which the white under color is more or less conspicuous. The black and white varies in different individuals, in extreme cases, from entirely black to entirely white. Measurements of adult male: Total length 1,680 millimeters; tail, 480; hind foot, 320[22]; in inches 66, 18.9, 12.6, respectively; width of nose pad in adults, approximately 1¼ inches; width of heel pad of front foot, 1½ inches; greatest diameter of canine tooth at base, ½ inch; average weight of full-grown males approximately 100 pounds, but extremely large individuals as heavy as 150 pounds have been recorded; females average considerably lighter.

Distribution, habitat, and abundance.—The group of large wolves, which originally covered almost the whole of North America, contains a number of well-marked geographic forms, but until the present time the areas occupied by the different forms have not been fully worked out. The species which originally covered the whole of North Dakota and at present are represented in the western part of the State can undoubtedly be referred to typical *nubilus*, the large, light-colored, northern plains wolf. According to the records of early explorers wolves were extremely abundant over all of North Dakota, but after the disappearance of the buffalo they were poisoned and trapped in such great numbers that they rapidly disappeared from most of their old haunts. From 1800 to 1808 Alexander Henry (1897, pp. 184, 198, 221, 245, 259, 281, 422, 440) recorded in his journal the number of skins brought in each year by his trappers along the Red River Valley, from Pembina and the Pembina Hills to Grand Forks, among them being the following numbers of wolfskins: In 1801, 194; 1802, 190; 1803, 582; 1804, 275; 1805, 563; 1806, 843; 1807, 127; and 1808, 68. These figures undoubtedly include coyotes as well as wolves, as no distinction was made

[22] Measurements from a large black male collected by E. A. Preble at Fort Simpson, on the Mackenzie River, in 1903. An old pure-white female from the Missouri River, recorded by Maximilian in 1833, measured in total length 56.5 inches, tail 14.5 (17 to tip of hairs). A large male from near Arvada, Wyo., measured by H. P. Williams, was 67, 15, and 12 inches.

in his records, but apparently in the buffalo days the large wolves were more abundant than the coyotes. Wolves were frequently mentioned in his journal on his trips back and forth between trappers' camps and the stations over which he had supervision. On February 28, 1801, he (Henry, 1897, pp. 171, 90, 86, 89, 175, 133) says, "Wolves * * * are very numerous, feeding on the buffalo carcasses that lie in every direction. Wolves are numerous and insolent at mouth of Park River. Large droves of wolves seen. Wolves frequently seen and not much afraid—one shot within a few yards. Indians were 'digging young wolves out of their holes' on September 6." On April 9 he says, "one of the men found six young wolves in a hole in the ground; another brought in three young on the 7th, which were very tame and kept for the train." On November 2, 1800, at his winter quarters near where Grafton now stands, he wrote in his journal:

Last night the wolves were very troublesome; they kept up a terrible howling about the fort, and even attempted to enter Maymiutch's tent. A large white one came boldly into the door and was advancing toward a young child, when he was shot dead. Some of them are very audacious. I have known them to follow people for several days, attempt to seize a person or a dog, and to be kept off only by firearms. It does not appear that hunger makes them so ferocious, as they have been known to pass carcasses of animals, which they might have eaten to their fill, but they would not touch flesh; their object seeming to be that of biting. The Canadians swear that these are mad wolves, and are much afraid of them.

On March 5, 1801, at Pembina, Henry (1897, pp. 194, 322) says: "A large wolf came into my tent three times, and always escaped a shot. Next day, while hunting, I found him dead about a mile from the fort; he was very lean and covered with scabs."

On his trip to the Missouri River and the Mandan villages in 1806, on the high bluffs east of the Missouri, opposite the mouth of the Knife River, Henry found deep pits which the Indians had dug for catching wolves and foxes. Some were 10 feet deep and 30 feet wide below, but only as wide as the path above and about 5 feet long. They were made in the trails where the wolves were in the habit of running and the opening was covered over with dry grass. Every morning, he says, these pits were found to contain some of the animals.

On October 20, 1804, Lewis and Clark (1893, pp. 174, 280) on their journey up the Missouri recorded great numbers of buffalo on the flats just below Bismarck with their usual attendants, "the wolves, which follow their movements and feed upon those which die by accident or which are too poor to keep pace with the herd." Later they saw the wolves pursue and catch a buffalo calf that was not able to keep up with the herd. In many places on their journey up the river they spoke of the abundance of wolves.

On June 23, 1811, Brackenridge (1816, pp. 114–115, 135) while near the spot where Mandan now stands wrote:

Great numbers of wolves were now seen in every direction; we could hardly go 40 yards from the buffaloe, before a half a dozen would shew themselves. It was amusing to see them peeping over hillocks, while we pelted them with stones.

Of the dogs at the Arikara Indian village he said:

The dogs, of which each family has 30 or 40, pretended to make a show of fierceness, but on the least threat, ran off. They are of different sizes and

colors. A number are fattened on purpose to eat, others are used for drawing their baggage. It is nothing more than the domesticated wolf.

In 1833 Maximilian (Wied, 1839–1841, Bd. 2, pp. 86, 55, 279, 1841) reported the varied wolf (*Canis variabilis*) very common along the whole of the upper Missouri, and said that it varied in color from wolf gray to pure white. Again, he says:

I obtained many wolves from the quite white to the perfectly gray common variety which the Indians sold for two rolls of tobacco apiece.

On the night of November 6, 1833, just below the mouth of the Little Missouri, while camped near the bank of the river, he wrote:

The night was dark and the loud howling of the wolves was our never-ceasing music.

On the previous night, he said:

Numerous tracks of animals of all kinds, elk, bears, and wolves were observed; wolves prowl around us at no great distance, and at 10 o'clock, when I had the watch, they came between our bright fire and the boat, which was only 40 paces distant, being attracted by the smell of meat. In winter these animals are nearly famished and extremely lean. They closely follow the herds of buffalo, and many sick, young, or weak animals become their easy prey; and when the hunters are abroad, there is a rich harvest for the wolves. They even bite and devour each other, yet they did not meddle with the dead wolves we left on the prairie; possibly they might not have been so ravenously hungry just then. They distinguish the report of a gun so well that they hasten to the spot almost immediately after the shot has been fired. The same is the case with the ravens, and the Indian hunters affirm that the wolves watch these birds in order to ascertain the direction in which the prey is to be found. If a poor animal has only been wounded, they are on the alert, and instantly pursue it and it inevitably becomes their prey. In cold winters they are often so bold that they come into the villages and approach the people's dwellings.

He (Wied, 1839–1841, Bd. 2, pp. 55, 86, 259, 261, 294, 1841) also spoke of the wolf pits in which the Indians were in the habit of trapping these animals. At Fort Clark, in November, 1833, he writes:

One of the Indians was afraid to proceed on this path because he suspected a wolf pit or trap might be in the way, but the patron, or chief, wishing to shame him went before and actually fell into such a pit with sharpened sticks at the bottom, by which he was killed.

Again, he says:

We had here an opportunity of seeing the wolf pits in which the Indians fixed sharp sticks and the hole is so covered with brushwood, hay or dry grass, that it can not be perceived.

In January, 1834, while he was wintering with the Mandans at Fort Clark, Maximilian tells us that during the extreme cold of winter a wolf attacked three Indian women, who fought it off with their hatchets. The Indian dogs, however, proved to be more troublesome and dangerous than the wolves. At Fort Clark, Maximilian (Wied, 1839–1841, Bd. 1, p. 396, 1839) found great numbers of dogs in the Mandan village on his arrival, January 18, 1833, and 500 or 600 in the Crow Camp of 70 tepees near by. These, he says, were wolflike, but of all colors, and it was with difficulty they were kept off by throwing stones.

In 1843 Audubon (1897, pp. 20, 24, 26, 159, 160) found the wolves still abundant about Fort Buford and along the Upper Missouri

River. He saw and heard many at various points along the river, both from the steamer's deck and from his camps and hunting trips on shore, and a number were shot on the way up the river. At Fort Clark on June 8, he wrote in his journal:

> Bell fired at a bird, and a large wolf immediately made its appearance. This is always the case in this country; when you shoot an animal and hide yourself, you may see, in less than half an hour from 10 to 30 of these hungry rascals around the carcass, and have fine fun shooting at them.

On June 10, he said:

> Two buffaloes were shot, and at the report of the guns, two wolves made their appearance.

Again he wrote:

> These animals are extremely abundant on the Missouri River and in adjacent country. Some days we saw from 12 to 25 wolves.

Just below the mouth of Cannonball River he reported eight wolves in one gang, four of them white. At Fort Union, where Audubon remained during the summer of 1843, the wolves were a daily source of interest not only on his hunting trips but at the fort, where they could be seen early in the morning and even during the daytime, prowling about or sneaking close around the buildings for any food that could be obtained. Many were shot, run down with horses, or caught in traps in the immediate vicinity of the trading post. He noted a great variety of colors among the wolves and it seems probable that they were more or less mixed with the wolflike dogs of the Indians and Canadian trappers.

In 1856, Lieut. G. K. Warren collected a large series of wolf skulls at Fort Union, which are now in the United States National Museum. This series includes some that evidently are not full-blooded wolf, as both the form of the skull and the doglike molar teeth indicate hybrid animals. Many stories have been current of the ferocity of these hybrid wolf-dogs, and it is not improbable that their tameness and lack of fear of man, even in Audubon's time, was in part due to their mixture with domestic animals. At the present time and for at least 30 years past, wolves have been among the most wary and rarely seen of our large carnivores. Where most abundant they are rarely seen, even by hunters and trappers, and can be caught in traps by only the most skilful trappers.

Elliott Coues (1875, p. 153), in his trip across the northern part of North Dakota in 1873, said that wolves did not appear to be numerous in summer, at least in that region, and Doctor Allen (1875, p. 37) reported them rare east of the Little Missouri River. In an old number of the Fargo Record, is found a note to the effect that in 1858 George W. Northrup, while trapping on the south side of Devils Lake, poisoned 700 wolves and obtained many beavers, otters, foxes, and minks. In some notes from Valley City, furnished by Morris J. Kernall, is one of John Hailand, who settled there in 1878. At that time he says timber wolves were seen occasionally, though they were not numerous. He saw one killed there that he thought must have weighed more than 100 pounds.

In the early eighties, Roosevelt (1900c, p. 66), on returning to the house at his ranch on the Little Missouri River when it had

been closed for many months, found in the dusty trails in the ravines, many tracks of the timber wolves. "Once or twice in the late evening we listened to their savage and melancholy howling." Even then the great numbers of wolves had gone with the buffalo either to the skin market or farther west. In 1894 Roosevelt sent the skulls of two old and four young wolves, killed 20 miles south of Medora, to the Biological Survey.

In 1887 the wolves were practically gone from most of the country across the State, and even at Fort Buford, which was then the terminus of the Great Northern Railway, they were very scarce. In 1910 Anthony was told that they were still found in the country south of the river, but no definite records were obtained. In 1913, at Minot, the writer was told that a few wolves were still to be found in that part of the country, and the same year Jewett reported them rare in the Killdeer Mountains, but all too plentiful in the Badlands section along the Little Missouri from Quinion to Medora, and he was told of several colts that had been killed by them during the summer. In the vicinity of the former North Dakota National Forest it was stated that the large wolves were then getting scarce but that a few years previously they had killed many calves. The same year at Wade, on the Cannonball River, Bell reported a few, although they had been pretty thoroughly trapped out by professional wolf trappers employed for the purpose by the stockmen's association. In 1915, Kellog reported one wolf that had been followed for three days by a trapper near Warwick, south of Devils Lake. At Elbowoods he saw the skin of one that had been killed on the Indian Reservation, where a drove of six were said to be still at large. Farther down, at Painted Woods, he saw two cross the river and a few tracks on the east side. At Cannon Ball, in 1916, the writer was told that a few large wolves were still in the country a little farther west, but that the great numbers of the animals had disappeared with the buffalo. Doctor Beede told the writer that the old Indians, in talking of hunting trips when the buffalo were still abundant, claim that three wolves would pull down and kill any buffalo, even an old bull.

On January 1, 1922, a large wolf was shot by Mr. Bennett near Harwood, about 10 miles north of Fargo, and the skin, which was said to be 7½ feet long, was tanned for a rug and kept by the hunter. The wolf had been tracked for two days by dogs and hunters from the vicinity of Breckenridge, Minn., but was shot on the North Dakota side of the river.

At the present time there are probably a few wolves left in the least-settled parts of the rough Badlands region west of the Missouri River, but it is to be hoped that a very few years will see the last of these destructive animals in this State.

General habits.—Few animals show greater intelligence and resourcefulness than wolves in adapting themselves to such conditions of climate and environment as will afford them a sufficient supply of food. From the Arctic barrens to the steaming swamps of Florida they have been at home wherever game was abundant, but nowhere more numerous than over the Plains in the days of the great buffalo herds. In habits they are hunters and rovers and often to a con-

siderable extent migratory, although in their home life they are domestic and as closely restricted to their home grounds as any carnivore could well be. The breeding dens, which in this prairie country usually consist of burrows in banks and sidehills, are the home centers from which the faithful parents make regular excursions for food until the young are old enough to leave the den and accompany them on hunting trips. Then they are freebooters until the next breeding season, when the adults generally endeavor again to occupy the old den or dig another in its vicinity. The fact that the old wolves pair for the breeding season is thoroughly proved, and there is much evidence to indicate that the pairing is for life or for as long as the two are able to keep together. While the young are small and as long as they remain in the den, the male is always on guard or foraging for food to bring home for its mate and young, and as soon as the young leave the den it leads the pack and apparently does much of the killing. The wolf pack usually consists of a family, the two adults, and 6 to 10 young of the year, but there are apparently authentic accounts of larger wolf packs where presumably two or more families have temporarily joined.

Breeding habits.—Wolves do not breed until 2 years old, but the family pack keeps together until about midwinter or later. The young are generally born in March, although there are records of pups late in February, and a few late litters are born in April. The young vary normally from 6 to 10, but there are records of 11, 12, and 13 in a den. At first they are dull black in color, but by the time they are a month old and begin to appear at the entrance of the den they have faded to a dull clay color or yellow gray. Usually they do not leave the den until July or August, when nearly half grown and able to accompany their parents on hunting trips and take care of themselves in case of emergency. A pack of growing, hungry young wolves in fall and early winter requires a large supply of meat which is obtainable only from large game or domestic stock.

Economic status.—Apparently a considerable time intervened between the destruction of the buffalo herds and the introduction of domestic cattle in sufficient abundance to provide an easy food supply for the wolves. This scarcity of food, together with the activity of those trapping and poisoning wolves for their skins, reduced the number of wolves and made the cattle industry possible over most of the open plains country. The last of the wolves, however, took up their residence in the roughest and least occupied sections, where they are extremely difficult to dislodge, and with their natural intelligence and long years' experience with man and his traps, guns, and poisons, they have become one of the most difficult animals to capture or destroy. In some sections of the country they had shown their ability actually to increase in the face of all human efforts and inventions for their destruction until the recent concerted efforts of Federal and State wolf hunters proved too much for them. One wolf was known to kill 125 head of cattle in 10 months, valued at the time at $5,000. In Custer County, of the adjoining State of South Dakota, one wolf killed $25,000 worth of cattle in seven years. Although it is probable that

the wolves can never be exterminated over much of the northern forest area of the continent, it has been clearly demonstrated that they can be practically eliminated from the open stock range of the Western States.

Canis latrans latrans Say

Northern Coyote; Brush Wolf

Mes-ta-chá-gan-es of the Ojibways (Seton)

Canis latrans Say, Long's Exped. Rocky Mountains, vol. 1, p. 168, 1823.

Type locality.—Engineer Cantonment, near Blair, Washington County, Nebr.

General characters.—Largest of the coyotes; ears, erect and pointed; conspicuous capelike mane over shoulders; fur, long and soft in winter, short and harsh in summer; color, light brownish-gray, darker and more fulvous in summer; underparts, whitish, tail tipped with black. Measurements of female from Elk River, Minn.: Total length, 1,219 millimeters; tail, 394; hind foot, 179; weight of adult male from Beemer, Nebr., 36 pounds; of one from Fort Dodge, Iowa, 40 pounds.

Distribution and habitat.—In the absence of specimens from the type region of *Canis latrans* it has been customary to refer to this original form of the group, the large brush wolves of Iowa, Wisconsin, and Minnesota. In 1897 Merriam made a study of the coyotes with the material then available, which was not sufficient to establish the matter of intergradation between *latrans* and *nebracensis* of the plains region farther west. The great quantity of material since collected seems to establish this connection, but the definite outlines of areas occupied by each form remains to be worked out in a comprehensive study of the group as a whole. Specimens from near Grand Forks and Grafton indicate that these brush wolves come into eastern North Dakota, but how far west they extend is not at present known. The wolf skins collected by Alexander Henry and his trappers along the Red River Valley from 1800 to 1808 probably included many of these large coyotes or brush wolves.

At Hankinson in 1912 there were said to be a few coyotes, but they were seen only at rare intervals. In the region about Fargo the same year they were said to be very scarce. At Wahpeton in 1915 Kellogg reported them as common, and was told of a litter of five dug out of a den 3½ miles south of town on May 30. At Larimore, in Grand Forks County, he reported them as fairly plentiful, and near Grand Forks he reported one killed during the previous winter and a bunch of six seen at one time; at Grafton a few killed each winter, and at Drayton, Pembina County, as not very common, but a few killed each winter. Near Grand Forks during the winter of 1918–19 they were reported as unusually common and destructive to stock. At Grafton H. V. Williams, in a letter of March 21, 1919, says that several were killed during the winter. In the Turtle Mountain region they have been reported as common by Williams and Eastgate, and while there is some doubt as to which form occurs there, in the absence of specimens the writer is inclined to consider them as probably the large northern form. Some of the residents describe them as a large coyote or small wolf and others says that they are small and pale, but the relative characters can not be reliably determined without actual specimens for comparison. A skull of a small female collected at Valley City by Morris J. Kernall in 1913 is apparently intermediate between *latrans* and *nebracensis*,

as it does not show decided characters of either. Coyotes are still found over practically all the State, but the specimens from the western part seem to be all referable to the smaller, paler *nebracensis*.

General habits.—These large coyotes generally inhabit a partly timbered, partly open country, but readily adapt themselves to either type where game or livestock furnish a satisfactory food supply. In habits they differ little from other species of coyotes except in adapting themselves more readily to forest conditions and in depending more on game and livestock for their food. They are most persistent in the destruction of sheep and calves, and have long rendered impracticable the keeping of small herds of sheep on farms over much of their range. Just how much they have had to do with the destruction of deer and other large game will never be known.

Canis latrans nebracensis Merriam

Plains Coyote; Prairie Wolf

(Pl. 18, fig. 1)

Míca or *Micaksica* of the Dakotas (Riggs and Williamson); Míkasi of the Omahas (Gilmore); *Schéké* of the Mandans (Will); *Mótsa* of the Hidatsas (Matthews); *Stshirits pukatsh* of the Arikaras (Gilmore).

Canis pallidus Merriam. Proc. Biol. Soc. Washington, vol. 11, p. 24, 1897.
Canis nebracensis Merriam, Science, vol. 8 (n. s.), p. 782, 1898. (Substituted for *pallidus*, which was preoccupied.)

Type locality.—Johnstown, Brown County, Nebr.

General characters.—Slightly smaller than *latrans*, with lighter dentition and paler colors; upper parts, light buffy gray, back of ears buffy; tail with black tip; underparts whitish. Unfortunately there are no measurements or weights available from the type region, nor of any specimens that may be considered typical of this form. One measured by Kellogg at Fort Totten was as follows: Total length, 1,193 millimeters; tail, 380; hind foot, 205, but the specimen was not obtained. In distinguishing a coyote from a wolf, the nose, foot, and tooth measurements are always sufficient. In the coyote the nose pad measures approximately seven-eighths of an inch wide, the heel pad of front foot, 1 inch wide, and the greatest diameter of canine tooth at base, 0.3 inch.

Distribution and habitat.—At the present time plains coyotes are distributed over practically all of North Dakota and are especially common over the western half of the State. Apparently they have held their own and even increased since the destruction of game herds, for filling the country with domestic livestock and poultry gives them a food supply often more easily obtained than the original wild game. In the early days of trapping and exploration, little mention is made of coyotes, and apparently they were less common or less conspicuous than the large wolves. Alexander Henry, in the beginning of the eighteenth century, does not mention them, but possibly he did not discriminate between them and the larger wolves. Lewis and Clark, in 1805, rarely mentioned them on their trip up the Missouri River, while they frequently spoke of the wolves seen and killed. On April 24, 1805, at a point about 13 miles above the mouth of the Muddy River (1893, p. 280), they spoke of the hunters returning "with four deer, two elk, and some young wolves of the small kind." In 1833 Maximilian (Wied, 1839–

1841, Bd. 2, pp. 97, 98, 278, 307, 1841) frequently refers to them and gives the Indian names used by the Mandans, Minnetarees, Arikarees, Dakotas, and Blackfeet. He says, "The prairie wolf is numerous over the prairies and in winter comes occasionally into the Indian villages to pick up whatever he can in the way of refuse." Again, in December, he writes, "During the night we heard the barking of the prairie wolves (*Canis latrans* Say) which prowled about looking for any remains of provisions." On February 26, 1834, he notes, "The prairie wolves now prowl about in couples."

In 1843 Audubon (1897, p. 160), on his trip up the Missouri River to Fort Union, made little mention of coyotes, but reported one seen at Fort Union and one shot by Harris, on September 3, below the mouth of the Cannonball River. A series of skulls from the upper Missouri River in North Dakota, collected by F. V. Hayden in 1850, are still in the National Museum collection. Roosevelt (1900c, p. 63), at one of his hunting camps in the Little Missouri River country, in the eighties, enjoyed the "wild, mournful wailing of the coyotes. They were very plentiful round this camp; before sunrise and after sundown they called unceasingly." At Valley City, Major White told Morris J. Kernall that the coyotes were more abundant there in 1882 than in 1913, and John Hailand, who settled at Valley City in 1878, told him that they were then more numerous than in 1913. In 1887 coyotes were reported as common at many localities over the State, and in 1893 Doctor Fisher, in stopping off at various localities from Bismarck to Fargo, reported them more or less common at all places visited. In 1912 Eastgate reported them at Tolna, on the south side of Stump Lake, along the Sheyenne River, 30 miles north of Valley City, in the sand hills near Kathryn in Barnes County, and that a few were shot every winter near Lisbon, in Ransom County, where they did considerable damage to sheep and poultry.

In 1909 the writer found them common about Marmarth, in the southwestern corner of the State, and in 1912 was told that at Tolna one man had brought in 50 scalps during the winter for the bounty, and that a den of young had been found a year before near Stump Lake. At Kenmare, in 1913, they were said to be fairly common over that general region. At Minot, Mr. Booth said that they had been scarce in that vicinity until the sheep industry developed in 1890, when they became unusually numerous. Since the country has settled up, however, few sheep are kept and the coyotes are becoming comparatively scarce. At Crosby the writer was told that they were scarce, but that a man living there, hunting with a couple of wolf hounds, occasionally brought in one. At Williston and Buford, in the same year, they were said to be fairly common and a considerable number of tracks were seen. In the Killdeer Mountains, in 1913, Jewett reported them in numbers over the entire region, as also along the Little Missouri River south to Medora. He also found them common about Fort Clark, where they were heard barking nearly every evening in July, and their tracks were found in the mud along the river flats. At Mandan they were reported common, and a few skins were seen. At Glen Ullin, in July, Jewett heard them barking near the town. At Sentinel Butte he found them fairly numerous all over the region, but doing little damage on the farms, which were mainly devoted to raising grain. On June

5 he located a den containing young in a rocky slope on the side of Sentinel Butte, but was unable to get the animals, which were then well grown. On the former North Dakota National Forest, about 25 miles south of Medora, in 1913, coyotes were found abundant, as also along the Little Missouri River near there, where their tracks were seen and the animals heard barking and howling every night. At Wade, on the Cannonball River, in August, 1913, W. B. Bell reported them abundant.

In 1915, Sheldon reported them as fairly common at Cannon Ball, Dawson, and Ellendale, and Kellogg reported them at Tokio, on the Sullys Hill National Park, at Towner, Grinnell, and all the way down the Missouri River to Bismarck. At a point several miles above Shell Village he saw six at one time running up a steep slope of Badlands. Near Elbowoods he saw five one evening, and while camping heard them every evening at dusk on both sides of the river. At Elbowoods he saw one looking at him through the willows, and at Stanton found them hunting rabbits, which they dug from the burrows. Near Sather he reported them common and doing considerable damage by killing turkeys at the farms. At Cannon Ball, in 1916, Mr. Underhill said that they were common and had troubled him a good deal by killing his chickens at his farm on the river flats. At Devils Lake in June, 1916, the writer found coyotes common in the timber of Sullys Hill Park and all around the lake. Mrs. Falger told him that they howled every night around the dump heaps near the Chautauqua grounds, and their tracks were found everywhere on the sandy patches. On the south side of the lake they were common in and around the park, which was then being fenced.

General habits.—Unlike the large wolves, coyotes adapt themselves readily to conditions of civilization, and if a food supply is available they seem to thrive as well in a thickly settled country as on the open range. They are always ready to match their wits against dogs, traps, and guns, and usually have no trouble in holding their own and increasing if enough poultry, sheep, pigs, young stock, and dead animals can be found for food. They are not entirely dependent on such food, however, as they will get along comfortably on ground squirrels, pocket gophers, mice, rabbits, game birds, eggs, grasshoppers, and fruit. They are sly and to some extent foxlike in their habits, will come close to buildings at night, and usually are not permanently deterred by being chased away by dogs.

Breeding habits.—Coyotes are prolific breeders, usually producing five to nine young in a litter. They often live in close proximity to farms and ranches, raising their young successfully, unless hunted with unusual persistence by one familiar with their habits. A few miles south of Ellendale, in the spring of 1915, Sheldon reported nine young captured by a farmer. On May 12, 1913, an old coyote and nine pups with eyes not yet open, were taken from a den about 20 miles west of Valley City. The old one was killed and two of the pups were kept alive in the Valley City Normal School grounds, where they were seen when they were about half grown. Two of the young and the skull of the mother were saved for specimens by Morris J. Kernall.

The young are born in burrows or cavities among rocks or in the sides of Badlands buttes, where they find abundant safe retreats until old enough to venture out in pursuit of game under the leadership of their parents. At Parkin, a little way up the Cannonball River, in June, the writer found a family of nearly half-grown pups living in the brushy gulches on the side of one of the big buttes just east of town. While exploring the sides of the butte for chipmunks, the writer suspected the presence of young when one of the old coyotes began barking and howling in plain view at midday in the open valley. He soon found the tracks of the half-grown pups in one of the rocky gulches and saw where they had wallowed down the grass under the brush near the den. The anxious parents followed and would appear on first one side and then the other, at every turn doing their best to attract attention and lead away from the family.

During the latter part of summer and the fall, coyotes usually hunt in family parties, but by the beginning of winter they have mainly scattered out singly or in pairs. Unlike the wolves, they seem to begin breeding when 1 year old, and, late in January, when the mating season begins, they are usually found in pairs.

Economic status.—During the past coyotes have not reduced the number of injurious rodents sufficiently to protect the crops, and it has become necessary to resort to artificial means instead of depending upon coyotes as a natural aid. Hence their value in this respect may be overestimated. On the other hand, their destruction of livestock and game is in many localities so great as to make the raising of small herds of sheep impracticable, except where protected by wolf-proof fences, while the loss of other stock, poultry, and game which they destroy over the State, is very serious. In States like Montana, Wyoming, Colorado, and New Mexico, where stock raising is one of the most important industries, the annual loss from coyotes is estimated at hundreds of thousands of dollars each year. The bounty system has long ago proved worse than ineffective, but the present system of cooperation between the State and the Federal authorities in employing expert trappers promises satisfactory results. The full cooperation of residents throughout the coyote-infested regions is of the utmost importance in keeping down the numbers of the pests. The dens should be located and the young captured whenever possible. It is not probable that coyotes will ever be exterminated over the whole country, but their control over extensive areas can certainly be predicted.

Vulpes fulva regalis Merriam

Yellow-red Fox

(Pl. 17, fig. 1)

Ehchokuschi of the Hidatsas (Maximilian); *Hirütt-sa* of the Mandans (Maximilian); *Hirutse* (Will).

Vulpes regalis Merriam, Proc. Washington Acad. Sci., vol. 2, p. 672, 1900.

Type locality.—Elk River, Sherburne County, Minn.

General characters.—Slightly larger than the eastern red fox; slender and light, with erect, sharp ears, slender muzzle, and long tail. Winter fur, very long, full, and soft; tail, very large and fluffy; summer fur, short and

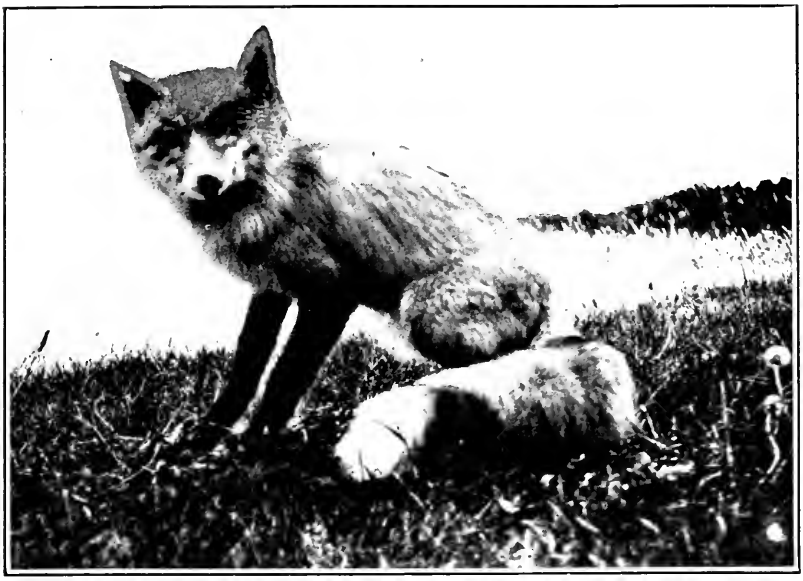


FIG. 1.—YELLOW-RED FOX (VULPES FULVA REGALIS)

Mounted in Agricultural College collection. Much reduced

FIG. 2.—BLACK-FOOTED FERRET (MUSTELA NIGRIPES)

Mounted specimen from Fort Rice. Much reduced

FIG. 3.—VARYING HARE, OR SNOWSHOE RABBIT (LEPUS AMERICANUS AMERICANUS)

Mounted specimen in winter coat. Much reduced

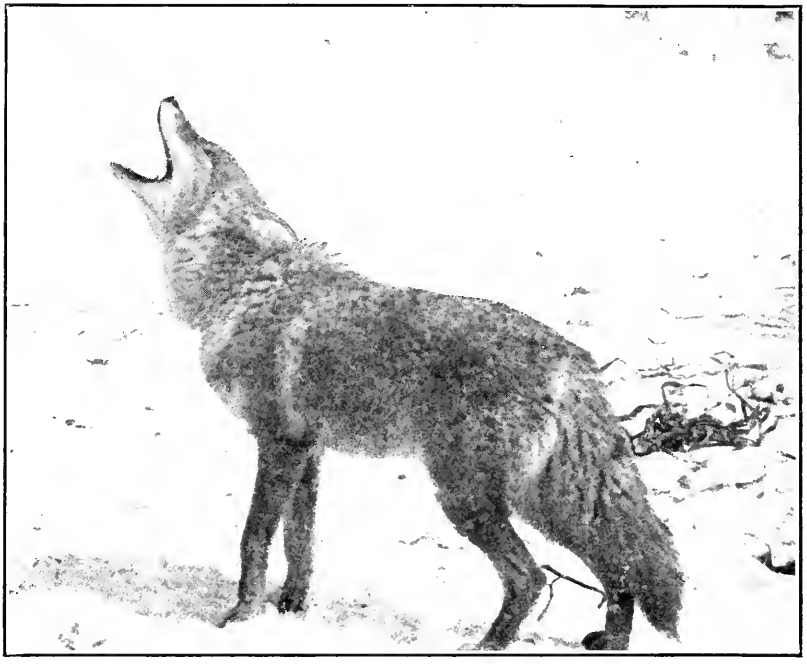


FIG. 1.—PLAINS COYOTE (CANIS LATRANS NEBRACENSIS)

A captive at Mandan

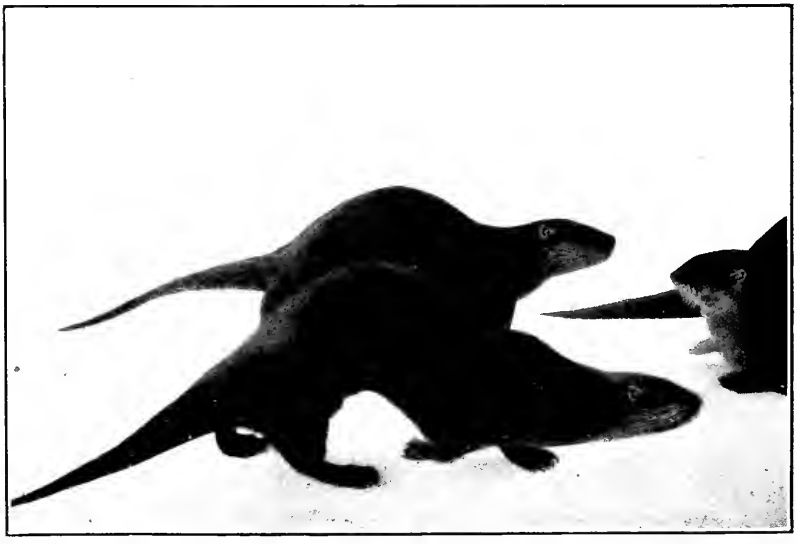


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FIG. 2.—OTTERS (LUTRA CANADENSIS CANADENSIS)

Captives in National Zoological Park, Washington, D. C.

thin; tail, slender. Color in winter, rich orange yellow, paler and more straw yellow over face, back, sides, and legs; underparts whitish, tip of tail always white, back of ears, feet, and ankles black. In summer coat darker, richer orange. Young blackish, soon fading to yellowish brown or yellowish gray, with tip of tail white. Measurements of type of species, adult male from Elk River, Minn.: Total length, 1,117 millimeters; tail, 420; hind foot, 170. Of adult female collected at Oakes, N. Dak.: Total length, 990 millimeters; tail, 381; hind foot, 165. Seton (1909, vol 2, p. 707) gives the weight of one taken at Carberry, Manitoba, as 10 pounds. The darker forms of this fox, called cross-fox, silver fox, and black fox, seem to be of rare occurrence in the prairie country, but they are merely different degrees of melanism occasionally found among red foxes, and are more common farther north and west.

Distribution and habitat.—The group of red foxes has not been sufficiently worked up to show the limits of range of the various forms, but all of the specimens available from North Dakota seem to be referable to the large yellow-red fox described from southern Minnesota, and apparently covering a great part of the northern Plains country. While probably never very numerous over the State, foxes were evidently much more so in the earlier trapping days than at present. In 1801 Alexander Henry (1897, pp. 184, 198, 221, 245, 259, 281, 422, 440) reported, among other furs taken in the Red River Valley, 82 red-fox skins from Reed River and 102 from Park River; in 1802, 20 from Grand Forks and 29 from the Hair Hills; 1803, 23 from Pembina River, 61 from Turtle River, and 78 from the Hair Hills; 1804, 8 from Grand Forks, 38 from Hair Hills, 4 from Park River, and 12 from Pembina River. In 1805 he reported 56 red, cross, and silver foxes from the Hair Hills, 91 from Salt River, and 31 from Pembina River; in 1806, 171 from Grand Forks, 256 from Pembina River; in 1807, 34 from Pembina River; in 1808, 2 from the Hair Hills, 6 from Grand Forks, and 28 from Pembina River. In 1833 Maximilian (Wied, 1839–1841, Bd. 1, pp. 431–432, 1839) stated that about 2,000 red-fox skins, 200 to 300 cross foxes, and 20 to 30 silver foxes were brought annually to the fur traders at Fort Union. On February 15, 1805, Lewis and Clark (1893, p. 235) mentioned a large red fox killed at their winter quarters among the Mandans at what is now Fort Clark.

Maximilian (Wied, 1839–1841, Bd. 2, pp. 86–87, 98, 1841), in 1833, while at Fort Clark, wrote in his journal: "The red fox (*Canis fulvus*) is very handsome and at the same time common, though by no means so numerous as the wolves." He compared many specimens and found them in general very similar, although "the fur dealers make a different species out of every slight variation." Generally they are lighter and brighter colored than the European fox and from their beautiful fur might well be called "goldfuchs." He further says: "The black or silver fox (*Canis argentatus*) is met with 60 or 70 miles farther north, but it is occasionally seen here, and its skin is highly prized, being sold for $60."

In 1856 F. V. Hayden (1875, p. 91) collected three skulls of these foxes from Fort Union, and reported the different varieties as cross, silver, and black, which he said were well known among the traders "and are much valued. A skin of the Silver variety . . selling for $100."

At Valley City John Hailand told Morris J. Kernall that red foxes were numerous when he came there in 1878. In 1887 the writer was told that they were common about Devils Lake and on

the prairie near Bottineau. In 1912 Eastgate collected an old female near Oakes, and nine young, about a month old, were found in the den. The same year the writer was told that there were a good many red foxes about Hankinson, where they were considered one of the standard fur animals. At Fargo there were said to be still a few in that part of the valley, and at Valley City they were reported as common, many being caught in winter. At Stump Lake there were said to be a few, and in the Turtle Mountains they were reported common, but mainly on the surrounding prairie. At Kenmare in 1913 they were said to be rather scarce, although a few were caught in winter. At Minot Mr. Booth, the taxidermist, said that they had been numerous in the early nineties, but that the great increase in coyotes since sheep were brought into the country had apparently resulted in a corresponding decrease among the foxes. At Crosby in 1913 the writer was told that a few were to be found in the glacial hills to the south, but that they were rather scarce. South of Medora, on the Little Missouri River, they were said to be scarce, and there seemed to be some doubt of their being there at that time. From Grafton on April 17, 1914, Williams sent the skin of a fox pup a day old from a litter of five born in captivity; again in 1917 he sent seven young, only 4 days old; in 1919 he reported red foxes fairly common and several killed every winter in the vicinity. In 1915 Kellogg found them fairly common at Wahpeton and reported a few skins taken each year by hunters. A litter of three was dug out on the farm of J. Brandt, 7 miles west of town, on May 23. At Larimore, Kellogg reported a few red foxes, and stated that a number of skins were taken each year at Manvel. At Drayton, in Pembina County, he reported a number trapped each year and two tame young ones kept in captivity. At Fort Totten he was told that red foxes had been common in that region 30 years before, but were then scarce. At Towner no records were obtained, nor at Lostwood, on the Missouri River. At Fairmount in 1915 Sheldon reported them as abundant at one time, but of late years rarely seen, although occasionally one was trapped or shot by some of the farmers. In 1916 there were said to be still a few in the country about Cannon Ball.

General habits.—The yellow foxes typify all that is sly, cunning, and crafty, with a peculiar combination of timidity and boldness. They are skilful hunters, but by farmers are often looked upon as cunning thieves, because of their excessive fondness for poultry. To the fur trapper they are the acme of all that is difficult and inspiring in his craft. In keen senses, alertness, and intelligence they are excelled by few wild animals. For most of the year they are hunters, depending for subsistence on mice, ground squirrels, pocket gophers, rabbits, and birds, which they are usually able to capture in abundance. At times they find grasshoppers and other insects acceptable, and in the blueberry season they almost live upon these delicious berries. They also eat a great variety of other berries and fruit. Although the animals are mainly nocturnal, their catlike eyes are well adapted to both night and day, and on rare occasions a fox may be seen prowling over the prairies or meadows watching for mice or small game in broad daylight. Generally, however, during the day they remain in their burrows or curl up on a knoll where

they can see on all sides, and at night range far and wide in search of food.

Breeding habits.—The young are generally from five to nine in number, and are brought forth in the breeding burrows prepared by the parents, or sometimes in hollow logs or trees. Near Oakes, Eastgate saw nine young about a month old that had been dug out of their den on June 5, 1912. Williams reported five and seven young in the litters of his tame foxes at Grafton. Alexander Henry reports five young caught by one of his men at Park River, October 18, 1800, but these may not have been the full litter, as at that season they would be large enough to be separated. The young when first born are dull black, with a conspicuous white tip of the tail extending up from a half to three-quarters of an inch. Their eyes are said to open in eight or nine days, and by that time the black has begun to fade and the yellow-gray is appearing over the head. About the time they begin to run about, when three or four weeks old, they are usually of a dirty gray color, unless destined to represent the darker cross, silver, or black forms, in which case they retain the dark black and shoulder stripes of the cross fox or the entirely dusky fur of the future silver or black. In all cases, however, the white tip of the tail and the black posterior surface of the ears distinguish them from young coyotes, dogs, or kit foxes. Both parents are very attentive to the young, the male taking its full share in hunting and guarding the den. Apparently the young do not follow their parents in the hunt, even when well grown, as more than one fox track is rarely seen at a place in any season. Their methods of still hunting are more likely to be successful singly than in groups.

Economic status.—The destruction by these foxes of game, poultry, and lambs is often discounted by the value of their skins and the interest they offer in hunting and trapping. They are known to be very destructive to lambs, however, in Michigan doing great damage among them. Apparently their fur value is sufficient to keep their numbers down to a minimum, or they might otherwise prove a pest and a serious check on the abundance of many species of small game. Their value in fur farming has not yet been fully determined, but the best grades of silver and black are among the most remunerative of fur animals to be raised under domestication. Many reports, and even books, have been published on the subject of fox farming, and experiments along this line indicate that in the future much of our choicest fur will be that produced under domestication.

Vulpes velox hebes Merriam

Kit Fox; Prairie Fox; Swift

Ihoichka of the Hidatsas (Gilmore); *Ohcha* of the Mandans (Maximilian); *So"gina* of the Dakotas (Gilmore); *Ciwaku* of the Arikaras (Gilmore).

Vulpes velox hebes Merriam, Proc. Biol. Soc. Washington, vol. 15, p. 73, 1902.

Type locality.—Calgary, Alberta, Canada.

General characters.—A very small fox with a rather short black-tipped tail, long, dense winter fur, and short, harsh summer hair. In winter the color is mainly dark buffy gray with orange sides, legs, and lower surface of tail, and light buffy belly. Tip of tail black and patches on sides of nose blackish.

In summer the upper parts are more reddish gray. The type, adult male, measures in the flesh, in total length, 844 millimeters; tail, 312; hind foot, 130. The weight, as given by Audubon (1851–1854, vol. 2, p. 14, 1851), is 8½ pounds. Seton (1909, vol. 2, p. 700) gives 4¼ pounds as the weight of an adult from Saskatchewan.

Distribution and habitat.—Apparently the kit foxes of the northern Plains at one time covered the whole of the prairies of North Dakota, but at present they are restricted to the western part of the State, and even there they have become very scarce. In 1800 they were one of the common fur animals of the Red River Valley. Alexander Henry (1897, pp. 184, 221, 245, 259), in his journal, recorded, among other skins taken by his trappers in the spring of 1801, 9 kit foxes from Reed River and 7 from the Park River; in 1803, 1 from the Turtle River and 23 from the Hair Hills; in 1804, 17 from the Hair Hills; and in 1805, 26 from Hair Hills and 31 from the Salt River. In "A Story of '53," which describes the fur-trading station at Walhalla, Charles Cavileer says 400 to 600 skins of kit foxes were obtained in a season, but none have been seen since the buffalo disappeared. In 1805, Lewis and Clark (1893, p. 271), on their journey up the Missouri River, spoke of the Assiniboine Indian camp, 25 miles above the mouth of the Little Missouri River, where the Indians were trading dried meat, grease, and skins of wolves and small foxes to British traders for liquor. In 1833, Maximilian (Wied, 1839–1841, Bd. 2, p. 51, 1841), while at Fort Clark, reported prairie foxes frequently seen. Just below the mouth of the White Earth River he speaks of finding traces of large bears and seeing the prairie fox come out of its burrow; and later he obtained specimens that were kept alive and furnished material for interesting study. Audubon (1851–1854, vol. 2, pp. 15–16, 1851) recorded them a little north of Fort Clark in 1843, and again at Fort Union, where specimens were obtained. He brought back a live one from Fort Clark to his home in New York. In 1862, F. V. Hayden (1862, p. 142) reported 50 to 100 caught every winter near each of the trading posts along the Missouri River.

There are a few specimens in the National Museum collection, taken by Culbertson in 1850 at Fort Union, and others taken by Coues in 1873 on the Souris River, where he reported them common. At Grafton, in 1915, Remington Kellogg was told that the last kit fox caught in that region had been taken by Olaf Dahal in 1876. At Minot, in 1909, the writer saw several skins at a taxidermist's shop, brought in to be mounted during the previous winter, and was told that there were still a few swifts in that region, but that they were so scarce that those caught were usually preserved as curiosities. A mounted specimen in the Williams collection at Grafton was taken near Williston, December 16, 1911. In 1913, a few mounted specimens and several skulls were examined in the collection of Mr. Allen, the taxidermist, at Mandan, who said that none had been brought in in recent years. At Sentinel Butte, Mr. Crawford said that kit foxes used to be common, but had become very scarce since the country had settled up. In 1915 Kellogg reported them as very scarce in the vicinity of Goodall in McKenzie County, where they had formerly been common. He said that they were very easily trapped, poisoned, or caught by dogs, so that they did not last long after the country became settled.

General habits.—At Fort Union (Buford), on October 16, 1833, Maximilian (Wied, 1839–1841, Bd. 2, p. 37, 1841) wrote in his journal:

> The little prairie fox is so hungry and therefore so tame that it often visits the environs of the fort, and we found these pretty little animals among the circles of turf which were left on the removal of the Indian tents. Here they remain in the daytime and at nightfall collect and look for the remains of provisions in the neighborhood of buildings. Our dogs frequently pursue them, but their extreme swiftness enables them to escape and to retreat to their burrows, where easily caught by setting snares.

On his return trip down the Missouri River to Fort Clark, in 1833, he (Wied, 1839–1841, Bd. 2, pp. 256–258, 1841) brought one of these little foxes with him as a pet and gave an interesting account of its habits. At one time, he says:

> During the night we were disturbed by great numbers of rats, and I placed my little tame prairie fox in the loft where the corn was kept and there he did excellent service. * * * This pretty and very tame little fox afforded us much amusement during the long winter evenings. He was nearly a year old but always glad to play with anyone. Would scratch or pat one on the clothing with his paw as he came quickly by and then make great bounds into the air as if he were pouncing upon a mouse or rat. He was very cunning and noticed everything and was delighted to be petted and stroked. He would often take some object in his mouth and shake and carry it about, dash away, hide it, look roguishly with head on one side, then come bounding back with all sorts of antics. We taught him to shake hands like a little dog, and he always offered his paw when he wished to be rubbed and petted. To rest he would roll up in a heap and cover his nose and face with his bushy tail. In cold weather he would get so close to the fire that he burned off much of his fur. He ate little, but drank often, though only a little at a time. He was very fond of rats and mice, and as with all such animals, caught them by the head. He usually chewed like a cat on one side of his mouth, using the sharp-edged molars, then licked his lips and usually one little paw. When no longer hungry he would bury the rest of his prey in the ground or in a corner, push it down with his nose, and cover it exactly as do others of the dog kind. His voice was a very loud bark, repeated three or four times in succession. It is very similar to that of the European fox, but louder and rougher. It has a wonderful ring to it, and one is astonished to hear such a loud voice from such a tiny animal.

Late in the fall (October 31) Maximilian (Wied, 1839–1841, Bd. 2, pp. 47–49, 1841) reported an abundance of buffaloberries, which after the frosts were very palatable. "With this fruit we refreshed our bears and my little fox, to which they offered an agreeable variety in their food." The wild grapes, however, he says were very poor and did not suit the taste of even the little fox.

In 1845, at Fort Union, Audubon (1897, pp. 116, 130), while riding over the prairie, saw a swift dart from a hole under the feet of Harris's horse. Harris gave chase and gained upon the beautiful animal with remarkable quickness, overtaking it and firing at it several times, but to no purpose as it doubled and cut about in such a manner that it escaped into a ravine. A few days later Harris succeeded in shooting one, which was saved for a specimen. At Fort Clark a captive kit fox was given to Audubon, (1851–1854, vol, 2, p. 16, 1851), who carried it back to his home near New York. It had been kept for some months in a loft without food other than the rats and mice which it caught there. In its new home it was fed on birds, squirrels, the flesh of other animals, and any kind of fresh meat, and grew fatter every day. This probably accounts for the weight of 8½ pounds, which seems much for this little

animal in its wild state. Seton's (1909, vol. 2, p. 700) weight of 4¼ pounds for an adult specimen from Saskatchewan seems nearer the probable average weight of wild individuals.

These dainty little foxes are among the most graceful and sprightly of native carnivores. They glide over the prairie as lightly and smoothly as passing shadows and are so quick in their motions as to have inspired fabulous stories of their speed. They are said to be tamed easily and to make interesting pets, but they are of relatively small value in the fur market.

Seton records several dens, in each of which a pair of kit foxes were found guarding five young. There is much to be learned in regard to their hunting, feeding, and breeding habits. As they are easily hunted, trapped, and poisoned, they are rapidly disappearing over a large part of their range and if doomed to extinction it is important that a closer study be made of their home life before it is too late.[23]

Family MUSTELIDAE: Weasels, Minks, Martens, Skunks, Badgers

Mustela longicauda longicauda Bonaparte

Long-tailed Weasel; Ermine

Ohsisa of the Hidatsas, and *Mahchpach-piraka* of the Mandans (Maximilian.)

Mustela longicauda Bonaparte, Charlesworth's Mag. Nat. Hist., vol. 2 (n. s.), p. 38, 1838.

Type locality.—Carlton House, Saskatchewan, Canada.

General characters.—One of the largest of our weasels, with slender body and long tail. In summer, upper parts, yellowish brown, darker on face, with tip of tail black; underparts and usually feet and toes, yellow, varying from rich buff to deep orange. In winter pure white, except for the black tip of tail and usually a light-yellowish wash or stain on the belly, hind legs, and tail. Measurements of an average-sized male from Crosby, N. Dak.: Total length, 445 millimeters; tail, 150; hind foot, 50; of an average female from Lostwood: 369, 121, and 40, respectively. A male from Treesbank, Manitoba, measured 457, 163, 49, and weighed 13 ounces.

The change from summer brown to winter white comes usually in November or with the first permanent snows. A male collected at Jamestown, November 1, and another at Castleton, November 3, 1892, are nearly white, with only a mixture of brown hairs over the back sufficient to produce a brownish gray. In the agricultural college collection at Fargo an adult male taken October 24, 1912, has the back, top of head, neck, and tail brown, and the sides and underparts, including the lower surface of tail, white, while an adult female taken November 2, 1912, is pure white, except for the black tip of the tail. A female taken at Valley City on November 13 is pure white with only a trace of sulphur yellow on the tail. Three specimens collected at Valley City, by Morris J. Kernall, on October 27, 1912, show three stages in the fall change; one has the back mostly brown, with sides, belly, and tail mostly white; another is mainly white, with a little brown on the back; and the third is in the full white winter coat. The spring change from white to brown comes approximately with the normal disappearance of the winter snow, but is not represented in the North Dakota series of specimens.

[23] Gray fox (*Urocyon cinereoargenteus*) (Schreber). There is only one record for the State and this seems doubtful. In 1835, at Fort Clark, Maximilian (Wied, 1839–1841, Bd. 2, p. 86, 1841) wrote: "The gray fox (*Canis cinereo argenteus*) and the cross fox (*Canis decussatus*) are likewise found here." This record seems very questionable, as no other report of their occurrence is to be found so far north in the prairie country. It seems probable that Maximilian confused the silver-gray fox of the genus *Vulpes* with this species, or merely applied the wrong name to the silver-gray. Perhaps the note refers to furs traded by the natives at Fort Clark, but really brought from points farther south. The northern edge of the Black Hills in South Dakota is the nearest point at which gray foxes are known to occur.

Distribution and habitat.—The long-tailed weasels cover the northern Plains country and are the most common of the weasels over practically all of North Dakota. They are common all over the prairie part of the State, and the forest of the Turtle Mountains region is sufficiently open to attract them. They are prairie dwellers, ranging over the wide open expanse of country and making their homes in the burrows of the numerous rodents on which they prey.

General habits.—These large weasels may often be seen over the prairie, running rapidly from one to another of the ground squirrels' burrows, and when alarmed taking refuge in the burrow nearest at hand. In 1833 Maximilian found their skins among those much prized by the chiefs of the Indian tribes along the upper Missouri River, but in those days they seemed not to have been included among the marketable furs of the white trappers. In 1887 the writer took specimens of this weasel at Devils Lake and Bottineau in traps set for pocket gophers and ground squirrels, and again while at Devils Lake in 1914 was surprised to see one thrust its head out from under a board sidewalk where crowds of people gather to take the electric car for the lake. In 1892 Loring collected specimens at Castleton, Valley City, Larimore, and Jamestown, taking most of them in traps set in the burrows of pocket gophers. In 1909, while riding over the prairie near Lemon, in the southwestern part of the State, the writer saw one running from one burrow to another of the 13-lined ground squirrels. The squirrels were greatly excited and were calling shrilly back and forth over the surrounding prairie, evidently passing along the word of great danger. At Buford, in 1910, Anthony reported the weasels quite common, some of them making themselves at home among the ranch buildings for several days. At Lisbon, in 1912, Eastgate reported them fairly common, but rarely seen. During the summer, living where the pocket gophers and ground squirrels are thickest, they destroy large numbers of these rodents, rarely entering poultry yards or killing chickens. Many are trapped during the winter. At Valley City, in 1912, one of these weasels came close to the writer in its pursuit of ground squirrels, running quickly from one burrow to another. On seeing him it stood erect, tall, and straight, as a snake will often raise its head to look over the top of the grass. It then ran into a badger hole, but, full of curiosity, soon reappeared and raised its head and neck in full view to watch. It was needed for a specimen, and the writer hoped to find out what it was eating, but its stomach was empty. At Crosby, in the northwestern corner of the State, while driving over the prairie, a large weasel was seen running from burrow to burrow, while the ground squirrels from far and near were uttering shrill whistles in a panic of fright. To obtain it for a specimen, it was only necessary to frighten it down a burrow and then wait a moment until it reappeared and raised its head and neck from the grass for inspection.

As usual, its stomach and intestines were entirely empty, in spite of the fact that it was evidently engaged in killing squirrels. In 1915, Sheldon collected a very large, dark-colored male near Oakes, in Dickey County, and reported the weasels fairly common throughout that part of the State. The same year Kellogg reported them

common all across the central part of the State, and down the Missouri River Valley from Goodall to Bismarck.

At Hankinson and Wahpeton it was said that a good many weasels were caught each winter for fur, and at Grand Forks Kellogg reported many brought in to the fur market, where they sold for $1.25 each. He also reported considerable numbers of them taken for fur at Drayton, Towner, and other points along his route across the State. In the Turtle Mountains the writer was told that weasels were considered by the trappers as one of the important fur animals. At Wade Bell reported them fairly common and was told that one trapper had caught 46 during the previous winter.

Breeding habits.—Of the breeding habits of these weasels there seems to be little definitely known. At Manvel, Grand Forks County, Kellogg was told of a litter of 11 young found by William Brown, but this seems a large number for any weasel to have at one time. Apparently they do not multiply very rapidly, as their abundance seems never to increase beyond a few scattered individuals found over the country.

Food habits.—The actual determination of the food of weasels is difficult, as examination of stomach contents rarely shows a trace of any food and generally the whole intestinal tract seems to be empty. The weasels when seen are usually chasing ground squirrels or putting their heads out of the burrows of squirrels or pocket gophers, which they enter freely, and where they find the occupants helpless against their attacks. From their well-known habit of killing many more animals than they can eat and the ease with which they can capture the ground squirrels and pocket gophers, it is evident that they are killing for the sheer lust of it as well as for a little blood, which they take from each individual and which is quickly digested.

In places where a weasel remains for some time, the ground squirrels and pocket gophers usually disappear, but generally the weasels are great wanderers, covering new hunting grounds every day.

In winter, when the burrows are filled with snow, the weasel tracks show that mice are the principal game sought. Open spaces under logs and brush or fallen grass are entered through the snow and often the tracks reappear on the surface a considerable distance away. In soft snow the weasels often force their way down to the surface of the ground and plow tunnels through the snow, evidently in pursuit of mice and small game.

If game is not to be found in sufficient abundance, they will feed on any frozen meat or old carcass that is available, and on rare occasions they find their way into henhouses and sometimes do serious mischief before they are discovered and checked. It is not improbable that they kill some wild birds and possibly eat the eggs, but there is little evidence of their doing so in a country where ground squirrels, pocket gophers, and mice are abundant.

Economic status.—Ordinarily many weasels are caught in traps set for other fur-bearing animals such as minks, martens, and foxes, but where these large weasels occur in considerable numbers and bring a good price, the trappers seem to devote their attention especially to catching them. This is easily done, as they are entirely unsuspicious and are easily attracted by bait of fur or feathers

scattered around or above the trap. It seems a great mistake, however, in a region of numerous rodent pests to destroy the greatest enemy of such animals. Even if it is possible to destroy by artificial means all of the ground squirrels and pocket gophers over a considerable extent of country, the mice and smaller rodents still remain in abundance, and if their increase goes unchecked serious losses of crops are sure to follow.

The occasional mischief done by weasels in the poultry yard can usually be prevented by a little care in making the buildings tight and secure by wire mesh. The value of weasel fur, which is sold as "ermine," is in most cases far less than the economic value of the animals as rodent destroyers.

Mustela cicognanii cicognanii Bonaparte

Bonaparte Weasel; Short-tailed Weasel

Mach-schipka of the Mandans (Maximilian).

M[ustela] cigognanii [sic] Bonaparte, Charlesworth's Mag. Nat. Hist., vol. 2 (n. s.), p. 37, Jan., 1838.

Type locality.—Northeastern North America.

General characters.—A medium-sized weasel with moderately short tail. In summer, upper parts light brown; underparts white, usually tinged on belly with sulphur yellow; winter coat, pure white or slightly tinged on belly, hind legs, and tail with sulphur yellow; tip of tail, always black for about an inch at end. Measurements of large adult male, from Walhalla: Total length, 338 millimeters; tail, 98, hind foot, 44. Weight, 6 ounces. Female much smaller, one from New York State measures 260, 72, and 31 millimeters, respectively.

Distribution and habitat.—A specimen of the Bonaparte, or short-tailed, weasel from North Dakota was collected by H. V. Williams at Stump Lake on May 6, 1913. Another specimen examined in the collection of the biological laboratory at Devils Lake in 1914 was taken near there by Eastgate. A specimen listed under *richardsoni* in the catalogue of the Field Museum from Minot is undoubtedly also this species (Elliot, 1907, p. 449). In 1833, Maximilian (Wied, 1839–1841, Folio, Tab. 13), at the Mandan villages, had a drawing made by his artist, Carl Bodmer, of one of the Mandan chiefs, Mato-Tope, dressed in full regalia and wearing many skins of both large and small species of white weasels with black-tipped tails. In December, 1912, Eastgate, on a trip from Bottineau to St. Johns, along the edge of the Turtle Mountains, reported both the large and small weasels very common and says: "I was never out of sight of their tracks in the soft snow and saw many skins of the larger kinds with the trappers' furs. The trappers did not bother to skin the small weasels."

General habits.—The writer's experience with these weasels has been mainly in Minnesota, where in the early eighties they were common and often came about the buildings in winter during the time of deep snow, and got into mink traps set along the streams and lake shores. Their tracks were found everywhere, but mostly in the woods or along fence rows and through thickets. On the meadows they would run from one haystack to another, or along the creek banks, where they would find or make openings to the surface of the ground under fallen grass or reeds. Here they were

always hunting mice and the small animals that remained active under the snow during the winter. In places where the weasels were most abundant the mice always became noticeably scarce before spring, and when the snow disappeared the mouse crop seemed always to be at its lowest ebb.

In the early pioneer days of log barns and rough buildings these weasels would occasionally make their homes in the barns and outbuildings for a time during the deep snows, and remain as long as there were rats and mice for them to feed upon. Occasionally they would get into the poultry houses and clean out the mice without doing any damage to the poultry, and when the mice were gone they would leave the building and go to the woods or find other hunting fields. There are, however, many authentic reports of their destroying large numbers of chickens and apparently killing them for sport as well as for food. Generally, however, the larger weasels are much more destructive to poultry where it is unprotected. The small size of these weasels, especially of the females, seems to limit their prey largely to mice and small rodents, and the number killed by one of these tireless, bloodthirsty little animals during the course of a year must be enormous.

Economic status.—The snowy white skins of these weasels in winter make some of the choicest ermine, but their small size fortunately limits their value, and many of those caught in traps set for minks, martens, and other animals are not even saved by the trappers. Their value as mice and rodent destroyers seems far to outweigh their fur value and greatly to overbalance the relatively small amount of damage done to poultry and game. In most parts of the country it would seem advisable to protect the weasels, although they are generally hardy animals, well able to protect themselves unless the price of their skins runs high enough to induce trappers to make special efforts to get them.

Mustela rixosa rixosa (Bangs)

Least Weasel

Hitu^{n}ka-sa^{n} (white mouse) of the Dakotas (Gilmore)

Putorius rixosus Bangs, Proc. Biol. Soc. Washington, vol. 10, p. 21, 1896.

Type locality.—Osler, Saskatchewan, Canada.

General characters.—Smallest of all native weasels, full-grown individuals measuring about 6 or 8 inches in length. The tail is very short, without black tip at any time. In summer the upper parts are dark brown, underparts, white; in winter the whole animal is pure white. An adult male from Grafton, N. Dak., measured in the flesh: Total length, 202 millimeters; tail, 39; hind foot, 25. A smaller male from Bowdon measured 155, 34, and 21 millimeters; and an adult female from Alaska, 165. 18, 21 millimeters, respectively.

Distribution and habitat.—The tiny least weasel occupies the Boreal Zones of much of the northern part of the continent. There is one specimen in the Biological Survey collection from North Dakota, taken by H. V. Williams at Grafton, October 24, 1913. Another specimen in the Williams collection was examined by Remington Kellogg in June, 1915. Kellogg also reported a specimen in the collection of the State university, taken at Fort Totten, July 21, 1913, and he was told that the species is trapped occasionally in the timber around Devils Lake. At Manvel, Grand Forks County,

he was told by trappers that a very small weasel was occasionally caught, but was not saved, as its fur had no value. At Fort Buford Anthony reported a small weasel that might be of this species. At Tolna, near Stump Lake, Eastgate reported the species as "said to occur." At Bowdon M. C. H. Murie took an adult male in brown summer fur July 27, 1918.

In 1833 Maximilian (Wied, 1839–1841, Bd. 2, p. 98, 1841) collected a specimen which was evidently of this species at Fort Clark, but unfortunately it was lost on the return journey. His measurements of 6½ inches for total length, 1¼ inches for tail, and 7½ lines for hind foot, and his statement that in winter it becomes "gänzlich weiss" seem to identify it beyond question. Apparently these little weasels are very scarce even in the midst of their range, and it is not surprising that so few have been taken in North Dakota on its extreme border.

General habits.—Apparently least weasels are strictly mouse hunters, and their small size enables them to follow the runways and underground burrows of almost any mouse. The specimens taken by collectors are usually caught in mouse traps. They are such inconspicuous animals, either in the dark-brown summer coat or pure-white winter coat, that it is not surprising that they pass unnoticed; but the fact that with all the trapping for the different small rodents few of these weasels have been found seems unquestionable evidence of their rarity. Occasionally fine tracks are seen in the snow that may have been made by this species, but these probably in many cases may be attributed to the very small females of the short-tailed weasel. In habits they do not differ from other weasels, except as limited by their diminutive size.

Economic status.—Although too small to do any serious harm to poultry or to be of any value for fur, these little animals certainly serve as a valuable check on the increase of mice. Studies in southern Manitoba by Stuart Criddle (1926) have demonstrated their effectiveness in controlling the colonies of *Microtus minor*, and they are undoubtedly equally beneficial in other parts of their range, and with other species of mice. If they could be domesticated, it seems probable that they might be of value in destroying mice around buildings, and that poultry and other animals would be safe from them. If a family of young could be obtained for breeding purposes, it might be well worth while to test their usefulness.

Mustela nigripes (Audubon and Bachman)
Black-footed ferret

(Pl. 17, fig. 2)

Etopta sapa of the Yankton Sioux; *Nazi* of the Mandans; *Tahu akukahak napish* of the Hidatsas (all, Gilmore).

Putorius nigripes Audubon and Bachman, Quadr. North Amer., vol. 2, p. 297, 1851.

Type locality.—Fort Laramie, Wyo.

General characters.—A large, heavy-bodied weasel with rather large ears, short tail, and short fur. Color, creamy yellow with a wash of brown over

middle of back and top of head; feet, legs, tip of tail, and mask across face and around eyes, blackish. An adult male measured by Osgood, total length, 529 millimeters; tail, 130; hind foot, 65; and adult female from Quinion, measured by Jewett, 510, 128, and 61, respectively.

Distribution and habitat.—The black-footed ferret, like the black-tailed prairie dog, has a wide range over the Plains country from Texas to Alberta. A few have been taken in western North Dakota, west and south of the Missouri River. In 1910, the late Howard Eaton told Cary of a ferret skin which he had bought at a Crow Indian fair, and said to have come from the Little Missouri River near Medora, where he has since reported them near his old ranch. In 1912 one was snared by some Indians near Fort Rice and given to H. C. Fish, curator of the Historical Society Museum, at Bismarck, and later was given to Bell for the agricultural college collection at Fargo. On June 20, 1913, Jewett collected a fine adult female near Quinion between the Killdeer Mountains and Medora. Describing the incident, he writes:

> While driving along the road through a large prairie-dog town about 2 o'clock in the afternoon, I saw a ferret's head disappear into a prairie dog's burrow only a few yards distant from the horses' feet. I jumped out of the wagon without stopping the team and almost immediately the head of the ferret reappeared and I shot it. It proved to be an adult female, evidently with young, as the mammae contained milk. I had been told by old settlers that there were no ferrets in this region, and when I showed the specimen to several no one knew what it was, so they are evidently quite rare in this part of the State.

In 1915, at Stanton, Kellogg saw a mounted specimen in a taxidermist's shop, which was said to have been killed near there.

General habits.—At his ranch on the Little Missouri River in the eighties, Roosevelt (1900c, pp. 85–86) writes of the ferret:

> It makes its home in burrows, and by preference goes abroad at dawn and dusk, but sometimes even at midday. It is as blood-thirsty as the mink itself, and its life is one long ramble for prey, gophers, prairie dogs, sage rabbits, jack rabbits, snakes, and every kind of ground bird furnishing its food. I have known one to fairly depopulate a prairie-dog town, it being the arch foe of these little rodents, because of its insatiable blood lust and its capacity to follow them into their burrows. Once I found the bloody body and broken legs of a poor prairie hen which a ferret had evidently surprised on her nest. Another time one of my men was eye-witness to a more remarkable instance of the little animal's blood-thirsty ferocity. He was riding the range, and being attracted by a slight commotion in a clump of grass, he turned his horse thither to look, and to his astonishment found an antelope fawn at the last gasp, but still feebly struggling, in the grasp of a ferret, which had throttled it and was sucking its blood with hideous greediness. He avenged the murdered innocent by a dexterous blow with the knotted end of his lariat.

Most of the records of the black-footed ferret throughout its range are from prairie-dog towns, where ferrets are almost invariably found running from burrow to burrow or taking refuge in the underground retreats. Evidently their principal prey consists of prairie dogs, although so far as is known they have never been seen actually catching and killing one. While apparently very useful in destroying prairie dogs, they are so rare that little impression is made upon the population of extensive prairie-dog towns. With the abundance of easily procured food it seems strange that they should remain so scarce. It is possible, however, that this very abundance has in some way pauperized the species until reproduction is restricted.

As in other weasels, the mammae are arranged in 3 pairs well back, 2 of these pairs close together in the inguinal region, and 1 pair a little farther out on the posterior part of the abdomen. Apparently nothing is known of the breeding habits or of the number of young at a birth.

Lutreola vison letifera (Hollister)

Mink

Dokshi"ca of the Dakotas (Riggs and Williamson); *Daktsuà* of the Hidatsas (Matthews), *Naksua* (Gilmore); *Monika suntike* of the Mandans (Will), *Mini-gasundek* (Gilmore); *Eruch* of the Arikaras (Gilmore).

Mustela vison letifera Hollister, Proc. U. S. Nat. Mus., vol. 44, p. 475, 1913.

Type locality.—Elk River, Minn.

General characters.—Size, medium, not so dark as the average of minks from farther north. In prime early-winter fur the color is a rich dark brown, darkening to blackish on the tail, with usually a white patch on chin, throat, or breast. Later in the winter and in spring the color fades out to a paler brown and in summer the short, harsh fur is yellowish brown. Measurements of large adult male from Lake Irwin, North Dakota: Total length, 697 millimeters; tail, 280; hind foot, 81. Of adult female from same place, 561, 178, and 67. Weights of the two, 3 pounds 12 ounces, and 2 pounds 5 ounces, respectively.

Distribution and habitat.—Until the minks have been thoroughly revised the limits of range of the different forms will necessarily remain somewhat in doubt. There are so few specimens from North Dakota that it is not possible to say whether more than one form is represented in the State, nor to determine the extent of the range of *letifera*. It is quite probable that specimens from the northern part of the State could be referred to the larger, darker *lacustris* described by Preble from Manitoba, Canada. In the Biological Survey collection there is a female collected at Stanton, on October 6, 1915, and an immature male from Fargo, taken December 27, 1918. In the National Museum collection are four skulls taken by Coues on the Souris River in 1873, and there is a specimen in the agricultural college collection at Fargo, taken on Apple Creek, near Bismarck, in 1914.

Although never numerous, minks seem to have been fairly common along most of the streams in the State. In 1801, Alexander Henry (1897, pp. 184, 198, 221, 245, 259, 281, 422, 440) reported 68 skins from Reed River and 29 from Park River; in 1802, 6 skins taken at Grand Forks; in 1803, 39 taken on the Pembina River, 3 on the Turtle River and 8 in the Hair Hills; 1804, 13 at Grand Forks, 2 in the Hair Hills, and 2 on Pembina River; 1805, 14 in the Hair Hills, 5 on Salt River, and 44 on Pembina River; 1806, 35 at Grand Forks, and 141 on Pembina River; 1807, 21 on Pembina River; and in 1808, 7 in the Hair Hills, 18 at Grand Forks, and 63 on Pembina River. At Fort Union, in 1833, Maximilian (Wied, 1839–41, Bd. 1, pp. 431, 432, 1839) reported a few thousand mink skins brought in by the trappers each year. In 1873 Coues (1877, p. 175) reported many minks taken on the Mouse River. In 1887 they were reported

common at Harwood, Grand Forks, Pembina, Devils Lake, and in the Turtle Mountains.

In 1912 the writer was told that a good many were caught around the lakes in the vicinity of Hankinson each winter and that in the Turtle Mountains they were considered the most important fur animal of the region. At Stump Lake and along the Sheyenne River, Eastgate reported them as occurring in limited numbers, and at Kathryn, in Barnes County, he reported six caught by one trapper during the winter of 1912. At Lisbon, Ransom County, he reported them as rather rare, but found on every river and creek, and on many of the deeper sloughs and lakes. At Fairmount, in 1915, Sheldon reported them as becoming rare, although a few were trapped each winter along the Bois de Sioux River. At Wahpeton a few were said to be caught along the river each year. At Larimore and Manvel, in Grand Forks County, Kellogg reported quite a number trapped each year. At Grafton he reported them fairly common along Park River, where many were trapped in winter, and at Drayton, in Pembina County, a good many trapped by the half-breeds in winter. At Devils Lake he says they were not very common, but a few were taken each year, and at Towner he saw the tracks of one on the banks of Mouse River and learned that a few were trapped in winter. At Goodall he reported them quite common along the creeks and river, and near Elbowoods an Indian had caught six on Shell Creek during the preceding winter. At Stanton he took one specimen on Knife River and along the river near Sather and Wogansport he saw a few tracks, but considered the animals rather scarce. At Bismarck, in 1914, the writer caught one in a beaver trap set on Apple Creek, and at Wade, on the Cannonball River, in 1913, Bell reported them as fairly common. In 1919, Murie reported them in fair numbers along the Red River near Fargo and a few on the James River and near Bowdon, and the writer found tracks along the Heart River near Mandan, in the Pembina Hills, and along the Red River near Grand Forks. Wherever there are streams or extensive lakes, minks seem to be holding their own fairly well over the State and will probably never be entirely exterminated even by persistent trapping and a rather high value on their skins. The days of the professional trapper seem nearly at an end, and if the minks have been able to withstand his skill for more than a hundred years they will doubtless persist for a long time with only local trappers to contend with.

General habits.—Minks are semiaquatic animals, usually found near streams, where they do much of their hunting for small game, both in the water and on the banks. They are great hunters, with some of the bloodthirsty ferocity of the weasel, always eager to kill whatever they claim as game. Eastgate reports digging out a mink den at Sweetwater Lake, where he found 9 full-grown muskrats, 4 ducks, 5 coots, several smaller birds, some mice, and one small jack rabbit, that had been killed and brought in for food. This was undoubtedly a breeding den, as it is only during the breeding season that the mink remains in one locality long enough to bring in such stores of food. For most of the year minks are wanderers over somewhat extended hunting grounds. In winter, when their habits can best be observed by watching their tracks, the same mink usually

makes its round every few days with the varying regularity of a free lance. An abundance of safe retreats are found in the hollow banks of streams and lakes, often in muskrat burrows or houses, the owners of which have been killed or driven out in terror of their lives. A hollow tree or log is often used as a refuge or resting place.

Minks climb trees readily when hard pressed by dogs and on several occasions while hunting raccoons the writer has shaken a mink out of the topmost branches of a tree for the waiting dogs below. Even then the dogs are not sure of their game, as the mink is weasel-like in its quickness at dodging and avoiding enemies. But if cornered, minks never refuse a fight with anything that comes their way and often terrify a dog by their savage screams as with lightninglike motions they fasten their keen teeth into his nose or lips. Their pungent odor, from an amber-colored liquid carried like that of the skunk in two glandular sacs surrounding the anus, is used as a method of defense, and though quite different from that of the skunk it is equally offensive to man or beast.

Breeding habits.—The five or six young are usually born in May and zealously cared for in the den by the mother mink until old enough to follow her on her hunting trips. Before the trapping season begins in early winter they are practically full grown. The male has no part in the family affairs after the brief mating season, and as soon as the young are large enough to capture their prey the family disperses, and each is thereafter a solitary hunter.

Food habits.—The natural food of minks consists mainly of rodents, birds, fish, and crustaceans. Among the rodents the muskrat is one of the favorites, and empty muskrat houses with a small round hole in one side usually indicate a family that has been destroyed by a mink. Sometimes a small pond will be entirely depopulated of muskrats before the mink leaves the vicinity, but in larger bodies of water the muskrats appear to escape to other houses or burrows and do not return until the mink has departed. Meadow mice apparently furnish considerable food for minks. Rats and rabbits are also captured for food, and wild ducks and other waterfowl, small birds, game, and poultry are equally acceptable. In places small fish furnish a large part of the food of minks, which often capture fish as large or larger than themselves. Crawfish and other crustaceans are greatly sought wherever they can be found and in many places form the principal food, as shown by the scattered droppings along the trails or about the dens. Frogs are eaten, but are evidently not a favorite food. At times dead animals, and especially frozen carcasses, are eaten when other food is not available, but live game that they can kill for themselves seems always to be preferred to all else. In captivity they will eat bread or cereals soaked in milk and many table scraps, but only when fresh meat and blood are not to be had.

Economic status.—Locally the minks have been known to do considerable damage to poultry. At Willows, N. Dak., in December, 1886, David H. Herman wrote to the Biological Survey that a mink killed all of his hens one night and the next night spent its time trying to climb up the sides of the house to get at those hung up from the previous night's kill; the third night it came back and killed the rooster, the only remaining bird of the flock, and was

found breakfasting on it in the morning. One of Mr. Herman's neighbors also lost 51 fowls in one night, the mink being killed with a stick in the henhouse the following morning. In 1912 Eastgate reported minks at Lisbon as doing some damage to poultry during fall and winter. So serious is this occasional damage that near streams or lakes it is generally necessary to protect poultry houses with some kind of mink-proof structure.

The destruction of game, and especially waterfowl, is probably far more serious than is generally supposed, but the guilt is not easily divided between minks, weasels, skunks, and foxes. On the other hand, considerable credit is due the minks for destruction of rats, mice, and other troublesome rodents. Their fur value usually assures them protection during the season when fur is not prime. In the absence of statistics of annual fur values it seems safe to assume that minks alone contribute many thousands of dollars a year to the local trappers over the State. Although minks are easier to trap than foxes, the boy who can catch his half dozen in a season without devoting undue time to his trap line can take considerable satisfaction in his skill.

Sufficient information has not been obtained to determine the practicability of domesticating minks, but with proper handling they have in some instances proved successful on a small scale. Considerable has been written on their management in captivity, but further tests are necessary to show that they can be produced economically.

Martes americana americana (Turton)

Marten; Pine Marten; American Sable

[*Mustela*] *americanus* Turton, Linnaeus, Syst. Nat., vol. 1, p. 60, 1806.

Type locality.—Eastern North America.

General characters.—About the same size as the mink, with longer legs, larger ears, longer and softer fur, and more bushy tail. Color usually lighter, more yellowish brown than the mink, varying from dull orange to dark chestnut; throat usually light yellow to deep orange. Measurements of adult male from Montana: Total length, 615 millimeters; tail, 200, hind foot, 93; of adult female, 565, 180, and 83, respectively.

Distribution and habitat.—At present there are probably no martens in North Dakota, but in 1801 Alexander Henry (1897, pp. 184, 198, 245, 259, 281, 422, 440) recorded among others taken, 26 marten skins from Reed River and 36 from Park River; in 1802 he reported 13 from the Hair Hills; 1803, 9 from Pembina River, 26 from the Turtle River, and 47 from the Hair Hills; 1804, 21 from Grand Forks, 3 from the Hair Hills, 1 from Park River, and 5 from the Pembina River; 1805, 6 from the Hair Hills and 3 from the Pembina River; 1806, 4 from Grand Forks and 271 from Pembina River; 1807, 75 from Pembina River; 1808, 2 from the Hair Hills, 6 from Grand Forks, and 69 from Pembina River. In his "Story of '53" regarding the fur trade at Walhalla, Charles Cavileer says 700 martens were taken one winter.

In 1833 Maximilian (Wied, 1839–1841, Bd. 1, pp. 431–432, 1839) gave a list of the approximate number of furs bought at Fort Union during the year, and among these, marten skins numbered 500 or 600. These, however, were undoubtedly brought down the river from wooded country farther north and west. Apparently martens

were originally fairly common in the timbered sections of northeastern North Dakota, but the beauty and value of their fur caused the early destruction of the species in that part of the State.

General habits.—Martens are timber-loving animals and are rarely found away from forests or the vicinity of trees. They are not only Boreal in range, but largely arboreal in habits, seeking much of their prey under cover of brush and trees and pursuing squirrels and chipmunks up tree trunks and among the branches. They are rarely found along streams, but range at large through the woods, where their winter tracks may be distinguished from those of the mink by larger feet and longer reach. There is nothing recorded of their food habits in this region, but in other parts of the country their natural food consists largely of mice, squirrels, rabbits, and birds; they are also known to eat berries, insects, and a variety of animal and vegetable foods.

Economic status.—It is not probable that martens, even with careful protection, would ever return to restock the limited forest areas of North Dakota, but in captivity they give some promise of becoming of practical value for fur farming. In the northern part of the State, especially the forest area of the Turtle Mountains and Pembina Hills, their fur should become dense and fine, as the Boreal climate represents their original habitat. If the experiments being carried on in raising martens prove successful, North Dakota should be found well adapted to the industry.

Martes pennanti pennanti (Erxleben)

Fisher; Pekan; Black Cat

[*Mustela*] *pennanti* Erxleben, Syst. Regni Anim., p. 470, 1777.

Type locality.—Eastern Canada.

General characters.—About twice the size of the marten, with relatively long legs, long tail, and coarse fur. Colors, blackish with a grizzled cape over top of head, neck, and shoulders. A large male measured in total length 1,020 millimeters; tail, 400; hind foot, 143; a female, 835, 343, and 115, respectively.

Distribution and habitat.—Fishers belong to the Boreal Zone forests of the northern part of the continent, and in the early trapping days reached into northeastern North Dakota. On September 26, 1800, Alexander Henry (1897, pp. 103, 122, 184, 198, 221, 245, 259, 281, 422, 440) reported one seen at the mouth of the Park River, and on October 19 wrote in his journal at the same locality that some fishers were brought in daily by the trappers. In the spring of 1801 he recorded 108 fisher skins from the Reed River and 70 from the Park River; in 1802, 23 from Grand Forks and 57 from the Hair Hills; 1803, 69 from the Pembina River, 98 from the Turtle River, and 111 from the Hair Hills; 1804, 36 from Grand Forks, 30 from the Hair Hills, 16 from the Park River, and 21 from the Pembina River; 1805, 74 from the Hair Hills, 14 from the Salt River, and 25 from the Pembina River; 1806, 59 from Grand Forks and 140 from the Pembina River; 1807, 78 from the Pembina River; 1808, 46 from the Hair Hills, 14 from Grand Forks, and 29 from the Pembina River. Apparently the animals were not uncommon then, as the number of skins usually ran higher than that of mink and marten and many of the other fur bearers that were being

taken. In 1853 Charles Cavileer, at Walhalla, reported 400 fisher skins a year as not an unusual number obtained by the fur company of which he was agent, but many of them doubtless came from beyond the borders of the State.

In 1833 Maximilian (Wied, 1839–1841, Bd. 1, pp. 431–432, 1839), in listing the approximate number of skins annually brought in to Fort Union (now Buford), gives the fisher as 500 to 600. Some of these may have come from the Turtle Mountains, Souris, and the Mouse River country, but probably more of them were brought down the Missouri and Yellowstone from farther west. At the present time there are certainly no fishers within the State and there seem to be no authentic records of their occurrence since the early trapping days.

General habits.—Fishers, like martens, are mainly forest-dwelling animals, seeking their prey of small mammals, rabbits, squirrels, and birds among the trees and brush and wandering at large over the woodland areas. They are expert climbers and pursue and capture squirrels in the treetops. The common name applied to them is an evident misnomer, as they are not known to catch fish or to frequent streams or bodies of water. The names "black cat" and "pekan" are also used for them, but less commonly than that of "fisher."

Economic status.—The fur of the fisher, although hidden by long, coarse hairs, is full, soft, and durable, and the general effect of prime skins made into wearing apparel is very pleasing. They are counted among the more valuable furs, and have always brought a high price in the fur market. For this reason the animals have disappeared or become scarce over much of their original range, but are still taken in some numbers in northwestern United States, Alaska, and Canada.

Gulo luscus (Linnaeus)

Wolverene; Glutton; "Indian Devil"

Eh-tupah of the Hidatsas, *Mató-ka* of the Mandans (Maximilian).

[*Ursus*] *luscus* Linnaeus, Syst. Nat., ed. 12, t. 1, p. 71, 1766.

Type locality.—Hudson Bay.

General characters.—A heavily built little animal with short ears, short legs, and short, bushy tail. Fur soft and light, covered with long coarse overhairs. Color dark brown, or blackish, with a yellow gray band along sides and across rump, and more or less gray over top of head and shoulders; throat, breast, and sometimes belly usually with irregular white spots. A very large male from Alaska, collected by Charles Sheldon, measured in total length, 1,070 millimeters; tail, 218; hind foot, 190; and weighed 36 pounds; an adult female from northern Mackenzie, measured by Preble, 920, 200, and 175 millimeters, respectively.

Distribution and habitat.—The wolverenes are Boreal animals extending across the northern part of the country and southward into the high mountain region. In North Dakota they apparently occupied at least the northeastern part of the State in the early trapping days and possibly the northweastern part. In 1801 Alexander Henry (1897, pp. 184, 198, 221, 245, 259, 281) reported, among other skins taken by his trappers, 2 wolverenes from the Reed River and 3 from the Park River; in 1802, he reported 3 from the Hair Hills; 1803,

4 from the Pembina River; 1804, 3 from Grand Forks, 1 from the Park River, and 2 from the Pembina River; in 1805, 1 from the Hair Hills and 5 from the Pembina River; in 1806, 1 from Grand Forks and 10 from the Pembina River. They were not mentioned by Maximilian among the skins brought in at Fort Buford in 1833, but in 1842 Harris included them in his list of mammals of the upper Missouri territory from Fort Leavenworth to Fort Union. A specimen brought from Fort Union by Mr. Culbertson in 1850, for the National Museum collection, probably, as Baird (1857, p. 182) says, was brought to Fort Union from some of the posts toward the Rocky Mountains. The fact that both the Minnetaree and Mandan Indians have names for this animal is suggestive of its occasional occurrence in the upper Missouri region of North Dakota. Howard Eaton wrote, under date of June 19, 1919, that while he never saw one during his residence in the Little Missouri country in the seventies, a hunter named Henry Bennett told him of poisoning one at the mouth of Cherry Creek, near the Killdeer Mountains. Apparently there are no recent records of occurrence in the State.

General habits.—Wolverenes are found mainly within timbered sections of the country, but are great wanderers and at times may strike out over open country in search of new hunting grounds. They are omnivorous hunters and scavengers and have the reputation of being gorging gluttons, a fact which has given them one of their common names. Although valuable as fur animals, they are in bad repute with the trappers from their habit of robbing traps and breaking into caches of food and supplies.

They are said to have from two to four young, and like most of the family they have three pairs of mammae arranged close together on the posterior part of the abdomen. Their underfur is soft and lax, of a gray-brown color, mainly obscured by the long, glossy outer hairs, which in prime skins have a well-spaced and pleasing effect aside from the beautiful and striking pattern of coloration. Prime skins usually bring a high price in the fur market, partly no doubt from their rarity, but mainly from their intrinsic beauty and durable quality.

Lutra canadensis canadensis (Schreber)

Otter

(Pl. 18, fig. 2)

Pta[a] of the Dakotas (Riggs and Williamson); *Pehtakè* of the Mandans (Will); *Midapóka* of the Hidatsas (Matthews); *Citapat* of the Arikaras (Gilmore).

Mustela lutra canadensis Schreber, Säugthiere, pl. 126b [1778].

Type locality.—Eastern Canada.

General characters.—Body, long and slender; tail, tapering and muscular; legs, short; feet, webbed; ears, small; fur, dense and glossy. General color, rich dark brown slightly lighter below and with grayish brown on throat and cheeks. Measurements of adult male from Canada: Total length, 1,220 millimeters; tail, 482; hind foot, not given (Audubon, 1851–1854, vol. 2, p. 4, 1851); in inches, 48, 19, respectively; of female, 1,150, 463, and 137 millimeters, respectively. Judging from a medium-sized female from Idaho which weighed 19 pounds, the weight of a large male may be estimated at 25 pounds.

Distribution and habitat.—A few otters are still found along all the principal streams in North Dakota and around some of the larger lakes. Although never very abundant, they were evidently much more so in the early trapping days than at present. Owing to their peculiar habits and disposition they hold their own better than many of the more common fur bearers and will undoubtedly remain for generations a part of the North Dakota fauna. In 1801–1808 Alexander Henry (1897, pp. 184, 198, 221, 245, 259, 281, 422, 440) reported 60 otter skins from Reed River, 49 from Park River, 117 from Grand Forks, 24 from the Hair Hills, 322 from Pembina River, 34 from Turtle River, and 12 from Salt River. In 1833 Maximilian (Wied, 1839–1841, Bd. 1, pp. 431–432, 1839) reported 200 to 300 skins brought in annually at Fort Union, and he frequently speaks of the use of otter skins or otter tails for decorations among the Indians. Henry (1897, p. 85) speaks of shooting four otters from the canoes in one day near the mouth of Park River on his way up the Red River, and evidently they were in considerable abundance in the Red River Valley at that time. Lewis and Clark (1893, pp. 175, 272), on October 21, 1804, obtained an otter near the mouth of Heart River, and another was seen and shot at about 30 miles above the mouth of the Little Missouri River on April 14, 1805.

A skull from Fort Berthold in the United States National Museum collection was mentioned by Doctors Allen and Coues, but seems to be no longer in the museum. Audubon (1851–1854, vol. 2, p. 11, 1851), on his trip up the Missouri River in 1843, says: "We did not capture any otters during our journey up the Missouri to the Yellow Stone River, but observed traces of them in the small water courses in that direction." In 1913 John Hailand told Morris J. Kernall that there were still a good many otters at Valley City when he settled there in 1878. In 1887 the writer found otter tracks along the northern shore of Devils Lake, and in the Turtle Mountains was told that the animals were still fairly common. In 1912 he could get only indefinite reports of their occurrence in the Turtle Mountains, but a more ideal country for them could hardly be imagined than this region of numerous lakes and streams well stocked with fish. In 1910 Anthony reported a few otters still caught along the Missouri River near Buford, and in 1912 Eastgate reported them from the Sheyenne River, 3 miles south of Tolna. In 1915 Kellogg reported one seen at the mouth of Antelope Creek near Goodall by Jess Widsome two years previously, and at Elbowoods a pair recently seen on a lake at the headwaters of Shell Creek, where they had been common a few years before.

General habits.—Otters are largely aquatic in habits, traveling with great ease and speed on or underneath the surface of the water, where much of their food is captured. On land they are slow and awkward except when they "toboggan" over the country on soft snow with considerable speed and evident pleasure. On dry land they are rarely found away from the shores of streams or lakes, but on deep melting snow they often make long journeys from one stream or lake to another, progressing rapidly in short jumps and long slides on their glossy bellies. They are powerful animals and savage fighters. Few dogs can handle one on land and they will quickly dispose of any dog that they can get into the water. They are

intelligent and, unlike the weasel tribe, have pleasant dispositions and are said to make affectionate and interesting pets. They have few enemies except man, and as more than ordinary trapping skill is required to catch them, they are able to maintain themselves and remain scattered throughout the settled parts of the country in spite of a high price on their beautiful fur.

Breeding habits.—The young are usually two to four in number and while small are kept in burrows along the banks. Later they follow the mother on hunting trips until nearly full grown, when they scatter out and each one becomes thereafter a solitary hunter.

Food habits.—Apparently the greater part of the food of otters consists of fish, which they pursue and catch in the water. They are rarely found along streams and lakes where fish are not plentiful, but evidently a great part of the fish taken are of the smaller and slower species or the sick or crippled individuals, which fall an easy prey. Crawfish and frogs are also eaten, and it is probable that many waterfowl are captured under favorable conditions. In winter otters travel long distances under the ice, through which they cut holes to the surface when they wish to come out. They are usually in good condition and often covered with a layer of fat like a white blanket under the skin, which serves to protect them from the cold and renders them very difficult to skin for fur.

Economic status.—Otter is one of the more valuable and most beautiful of our native furs. It is very durable, especially in the unplucked form, with the glossy overhairs protecting the dense, silky underfur. Although the price is relatively low for actual value, usually ranging from $10 to $25 for prime skins, it is sufficient to tempt the fur farmer to experiment with raising otters in captivity. As the habits of the animals are becoming better known it is found to be possible to breed them in captivity, and several broods of young have been raised in zoological parks. Further experiments and intensive study will be necessary before otters can be recommended for the production of fur in captivity.

Mephitis hudsonica Richardson

Northern Skunk

Maⁿka of the Dakotas (Williamson); *Suⁿkte* of the Mandans (Will); *Choka* of the Hidatsas (Matthews); *Hohga* (Gilmore); *Nichwit* of the Arikaras (Gilmore).

Mephitis americana var. *hudsonica* Richardson, Fauna Boreali-Americana, pt. 1, p. 55, 1829.

Type locality.—Plains of the Saskatchewan.

General characters.—Low, heavy-bodied, bushy-tailed animals with plantigrade feet, naked soles, and long digging claws. The most striking peculiarity consists of the pair of anal scent glands, which secrete a yellow fluid with a powerful odor. This northernmost and largest form of the genus *Mephitis* has a very long and bushy tail; the color is glossy black with a white stripe between the eyes and a white triangle on the back of the neck connecting across the shoulders with two broad white stripes along the sides of the back and tail; upper base, lower surface, and tip of tail usually black or washed with black over the surface. The relative amount of black and white varies greatly in different individuals. An adult male from Cannon Ball measures in total length, 710 millimeters; tail, 300; hind foot, 80; a female from Towner measures 780, 273, and 91, respectively. Weight of a large adult from the Yellowstone Park, 8½ pounds. (Seton, 1909, vol. 2, p. 968.)

Distribution and hatitat.—The large northern skunks range over most of the northern Plains country and extend south in the mountains to New Mexico. They are found over practically all of North Dakota, ranging alike over the prairie and into the open forest, but are most abundant along the brushy borders of streams and lakes and in the thickets of the gulches. They are much trapped and their abundance varies constantly, but they quickly increase where trapping is relaxed for a short time. So unsuspicious and easily caught are they that by persistent effort any amateur can get most of them in his vicinity. None were reported by the fur trappers of the early pioneer days, evidently because skunk fur was not then considered marketable. Hence no companion can be made of their past or present abundance. In 1878, when John Hailand came to Valley City, skunks were numerous. In 1887, the writer found them common at Pembina, Devils Lake, in the Turtle Mountains, and at Fort Buford. In 1909 D. D. Streeter reported them at Medora, and in 1910 Anthony reported a few at Fort Buford. In 1912 Eastgate reported them at Stump Lake, Valley City, Lisbon, Kathryn, and Bottineau. One trapper near Bottineau had 77 skins and another at Lisbon claimed to have taken 178 during the previous winter. The same year the writer found skunks fairly common in the country about Fargo, Stump Lake, Valley City, and in the Turtle Mountains, where they were said to be one of the principal fur-bearing animals caught in both fall and spring. In 1913 he was told there were a few about Kenmare and along the Mouse River farther west. At Fort Clark, Jewett reported them rather scarce, although a few tracks were seen on the river bottoms near there. In the Badlands, 25 miles south of Medora, a few tracks were found. In 1915 Sheldon reported them as common about Fairmount, Oakes, Dawson, and Cannon Ball across the southern part of the State, and Kellogg reported them common at Wahpeton, Larimore, Manvel, Grafton, Drayton, south of Devils Lake, Towner, Grinnell, and along the Missouri River at Lostwood, Elbowoods, Goodall, Stanton, and Sather. At many of these localities they were regarded as the principal fur-bearing animals taken by the trappers, and at Drayton, in Pembina County, Kellogg says that with the mink and muskrat they form the means of support for a large number of persons during the winter months.

General habits.—Owing to their confidence in their peculiar defensive powers, skunks appear fearless and independent. As a matter of fact they have no other recourse, as their short legs bar escape and their rather weak bodies are unfitted for combat. When met in the path or in the bushes or grass they usually stand their ground, stamp their feet, and with erect and bristling tail make themselves as conspicuous as possible, on the assumption that they will be given plenty of room. Generally their right of way is undisputed, but if closely pressed they about face or throw the body forward and with a quick contraction of the muscular bands surrounding the scent gland force the amber-colored fluid through one or both of the nipplelike ducts to a distance of 10 to 15 feet. The spray is often so fine as to be unnoticed, except by the powerful odor, which at once fills the air and almost stifles one in close proximity. So far as possible, the animals avoid getting the fluid on themselves, and

when undisturbed they usually have little, if any, trace of the odor. Even when caught in traps they rarely discharge their scent unless approached or clumsily handled when killed. If shot so as to break the spinal column or if struck a sharp blow with a club just back of the shoulders, the posterior muscles are paralyzed so that the scent will not be discharged and the animals may be skinned with no unpleasantness.

Skunks generally make their homes in burrows, which they dig in banks or brush patches, or even occasionally in the open. They are mainly nocturnal, but usually leave their dens early in the evening and are often seen abroad before dark and after daylight. They are great hunters, and notwithstanding their short legs often travel long distances in search of food. In fall they become very fat, and usually with the first snows enter the burrows that have been prepared for winter use and curl up for the winter's sleep of four or five months. Generally they are out before the last snows are gone in March, and often their tracks are found in the soft, wet snow in spring. Much of the winter's fat is carried over and is needed for the spring mating season or until the supply of insects and other summer food becomes available.

Breeding habits.—A female taken by Sheldon on May 11, 1915, at Fairmount, contained 4 well-developed embryos showing perfectly the characteristic white stripes. This was evidently the first litter of a young breeding animal, as usually the number of young is 6 to 10. Nine skunks which Kellogg reported dug out of one burrow, near Wahpeton, in the winter of 1915, probably represented a family that had not been broken up—the mother skunk and 8 young. The mammae in breeding females are usually arranged in 7 pairs, 2 pairs of inguinal, three of abdominal, and 2 of pectoral, or in 2 long rows of 7 each, rather evenly spaced along each side of the ventral region.

Food habits.—Apparently the largest part of the food of skunks consists of grasshoppers, beetles, crickets, and other insects and insect larvae, which they catch in the grass or dig up from underground or under decayed vegetation or rotten logs. Their stomachs are large and are usually found well filled with material that is easily identifiable. They eat some mice, especially the young of mice and other rodents which they dig out of the nests. To what extent they feed on young and old ground squirrels in North Dakota has not been well determined, but undoubtedly they get some of these among other rodents. They are fond of eggs and the stomach of one taken by Sheldon at Fairmount on May 11 contained egg-shells of prairie chickens, as well as remains of five young meadow mice. Eastgate says they are destructive to young chickens during early summer, and to prairie chickens, sharp-tailed grouse, and wild ducks during the breeding season. Along the borders of the Sweetwater Lakes in June, 1916, skunks were found unusually numerous and in the evenings they were often met galloping along the trails at the edge of the lake or climbing about through the reeds and tules where the ducks were nesting, evidently searching for nests containing eggs or young birds. The fact that many of the old ducks had small broods of young and others none may have been attributable to these nest robbers, although minks and other animals may have been in part

responsible. The regular breeding grounds of ducks and other water birds should be protected from skunks and such animals by very thorough trapping during the fur season and, if necessary, during the breeding season of the birds.

Economic status.—Skunks are one of the most valuable, because one of the most abundant, of the fur-bearing animals in North Dakota. There are no statistics as to the number taken in the State, but the total number of skunk skins sold in London in 1911 was more than 2,000,000. The average price at that time was $2 each. In 1921, 824,599 skunk skins were dressed by one association, which handles about 90 per cent of the fur dressed in America. The recent average price of raw skins in New York City was $3. This gives only an incomplete record of the skunk fur crop, of which North Dakota furnishes her full share.

In many sections, however, the fur of skunks is not their greatest value, as their insect and rodent-destroying habits render them extremely useful adjuncts to agriculture. An overabundance of skunks would not be advantageous in most localities, and in certain areas their numbers should be restricted as much as possible. Their abundance should be well controlled by suitable trapping laws with provision for local modifications. Many of the States have a close season protecting skunks, except when the fur is prime, during late fall, winter, and early spring. There is little danger of their extermination even locally, but their numbers could often be so controlled as greatly to increase their value for fur and other purposes.

For fur farming, skunks have been thoroughly tested and in many cases successfully raised in confinement, but the low value of their fur prevents any large returns from the industry. Farmers' Bulletin 587, of the United States Department of Agriculture (Lantz, 1914), gives much practical information on the breeding of skunks for fur.

Taxidea taxus taxus (Schreber)

Badger

(Pl. 15, fig. 2)

Choka of the Dakotas (Riggs and Williamson); *Maté* of the Mandans (Will); *Amaka* of the Hidatsas (Matthews), *Awagá* (Gilmore); *Sunuh-katuh* (flat porcupine) of the Arikaras (Gilmore).

Ursus taxus Schreber, Säugthiere, Theil. 3, p. 520, 1778.

Type locality.—"Labrador and Hudson Bay" (probably really from Manitoba or Saskatchewan).

General characters.—A heavy-bodied, low, wide, powerfully built animal of the weasel family, with short, muscular neck, short ears, short legs, and short tail; fur, long and light, especially on the sides, which heightens the effect of the wide body. Color of upper parts buffy or brownish gray, top of head and nose blackish with white stripe from nose to back of neck, white markings on cheeks connected with white or creamy throat; underparts, plain buff or soiled whitish; feet and legs, black. Measurements of adult male from Oakes: Total length, 788 millimeters; tail 133; hind foot 120. Of female from Lidgerwood, 730, 150, and 114, respectively. Weight of male from Wisconsin, 23 pounds 6 ounces. (Jackson, 1908, p. 28.)

Distribution and habitat.—Badgers range over most of the western United States and from southern Mexico to Saskatchewan, and several well-marked forms are recognized. Those ranging over the whole of North Dakota may undoubtedly be referred to the original species. Apparently there is no considerable area in North Dakota where they are not occasionally found. Although most abundant over the prairies, they penetrate into open forested country and even in the Turtle Mountains are found occasionally throughout the more or less scattered timber. Over the prairie country their greatest abundance usually coincides with the abundance of ground squirrels, which form their principal prey. In the more thickly settled parts of the State they are disappearing, as they are practically defenseless and easily destroyed by man unless they can escape into convenient underground burrows. As the time will doubtless come when these useful animals will be very scarce, it seems worth while to give detailed record of their present distribution.

In 1887 the writer found them common at Harwood, Grand Forks, Pembina, Devils Lake, Bottineau, Rugby Junction, and Fort Buford. In 1892 Loring reported them common about Sherbrooke and Jamestown. In 1909, they were found fairly common both in and around the Turtle Mountains. In 1910 Anthony reported a few burrows around Fort Buford, but the badgers were more abundant on the other side of the Missouri River. In 1912 they were more or less common at Hankinson, Fargo, Valley City, and Stump Lake, and a few in the Turtle Mountains; and Eastgate reported them about Stump Lake, Kathryn, and Lisbon. In 1913 the writer found them common at Kenmare, Crosby, and on the Dakota National Forest, south of Medora. Jewett reported a few along the Little Missouri River from Medora to Quinion and many of their burrows in the country about Sentinel Butte. In 1915 Sheldon found them fairly common across the southern part of the State at Fairmount, Lidgerwood, and Oakes. In the same year it was said that there were still a few near Wahpeton, and Kellogg saw the remains of one in the road near Larimore. At Manvel, in Grand Forks County, he reported a number of burrows found in almost any field where the badgers had been digging out ground squirrels. Near Grafton he reported one killed on the Munson farm. At Drayton, in Pembina County, he found where one had been working on the farm where he staid, but it had recently disappeared. Along the south side of Devils Lake he found a number of places where the badgers had been working, but saw none of the animals. At Towner he collected a specimen and reported the animals quite numerous and doing some damage to the roads as well as killing a great many ground squirrels. In one place he counted 18 burrows within a radius of 20 feet. At Grinnell, on the Missouri River, he reported two badgers seen and at Lostwood he considered them fairly numerous, judging by the number of burrows. At Elbowoods, farther down the river, he was told that they were plentiful, and at Goodall quite a few were found. At Stanton he reported them as fairly plentiful over the prairie and one occasionally found on the river bottoms. From Washburn to Bismarck he was told that they were occasionally found. At the Sweetwater Lakes in 1916, Mrs. Bailey saw three alive and one that had been killed.

General habits.—Badgers are preeminently burrowing animals, and they depend on their claws not only for unearthing a large part of their game, but also for the construction of both their summer and winter homes. They seem to prefer open country, where they can see to considerable distances and either escape the approaching enemy by retreating to some near-by burrow or, if necessary, by quickly digging a hole in the ground deep enough to protect all but their vicious jaws, which few animals care to approach. Within a few minutes they will sink their burrows until they are out of sight and then pack the earth behind them as they continue to tunnel through the ground to greater depths. A person on foot can easily overtake one as it lopes away on its short legs, but if unarmed or without even a stick or stone, the tables are quickly turned, and he has to run his best to escape having his legs severely bitten. With a camera one can usually obtain good pictures by chasing a badger until it turns and then backing about over the prairie as it comes on in animated pursuit. Occasionally one is seen lying in the sun on the mound in front of the burrow from which it has unearthed a ground squirrel, or loping across the road in its short, floppy gait. Dogs usually pursue, but keep well out of reach of the savage jaws of the badger, and there are very few dogs that do not get the worst of an encounter with one of these strong-jawed, thick-hided animals. In summer the badgers spend most of their time and energy in digging out the various rodents on which they feed, and even after the ground squirrels have denned up for winter continue to unearth and feed upon them for a month or six weeks, until the ground begins to freeze, when they seek their own winter quarters and, well ensconced in deep burrows, curl up for a long sleep. At this time of year they are always fat and covered with a heavy coat of long fur. From the middle of October to the middle of March they are rarely seen above ground, but with the melting of snow they appear and, still fat and with a still heavier coat of fur, start out on their hunting and mating expeditions.

Breeding habits.—Surprisingly little is known of the breeding habits of badgers. The young are apparently brought forth and kept within the burrows until well grown, as few persons have seen a badger outside less than half grown. The mammae are usually in 4 pairs, 2 pairs of inguinal and 2 of abdominal, and the young are usually four in number. Near Stump Lake, on July 23, 1912, a family of four not fully grown young were found in the prairie grass. They were followed to the nearest burrow, where the last of the four was struggling to get inside. It was caught by the tail and then by both hind legs and given a wide swing over the prairie grass to a considerable distance from the burrow. With the camera the writer followed around, teasing and keeping it engaged while taking as many photographs as were wished before it was allowed to return to the burrow where its brothers and sisters had disappeared.

Food habits.—In North Dakota the favorite food of the badger seems to be the Richardson ground squirrel, and where the squirrels are most abundant so also are the badgers. Other ground squirrels are dug out and eaten wherever found, as also are pocket gophers, prairie dogs, mice, and other burrowing rodents. Occasionally

badgers will feed on some old carcass, and usually they will take any kind of meat with which traps are baited. On rare occasions one will dig under a chicken coop and kill some of the poultry, but this happens so rarely and is so easily prevented as to be of little economic importance.

Economic status.—In North Dakota, as in other parts of the country, badgers are generally killed on sight by the residents on the pretext that they catch poultry, kill lambs, and are a danger to horses, which sometimes step in their burrows and, if running, possibly break their legs or injure their riders; or that they make burrows in roads, causing serious bumps to passing automobiles. All of these claims have some foundation in fact, but they are generally over-emphasized to warrant the wanton destruction of a conspicuous and rather ferocious little carnivore that is not swift or skilful enough to protect itself.

On the other hand, the badger spends almost all of its time digging out and devouring the most injurious rodent pests of the region, thus saving a large quantity of grain and other crops from destruction. It is unquestionably one of the least harmful and most completely beneficial of the native mammals in the State, and even when the ground squirrels are poisoned and under good control there will still be ample employment for the badgers in digging out pocket gophers, mice, and other small rodents which must be held in check to prevent serious loss to crops.

Only recently have badger skins come into general use as fur. While very durable, warm, and when in prime condition, rather attractive, they are certainly worth more to the State when worn by the badger than when made into robes, coats, or muffs. In some States the value of the badger is recognized and the animal is protected by law, but a protection through popular sentiment based on a full knowledge of its useful habits would be much more effective than a legal statute not well enforced.

Family PROCYONIDAE: Raccoons

Procyon lotor lotor (Linnaeus)

Raccoon; "Coon"

Wica of the Dakotas (Williamson); *Mikâ* of the Omahas (Gilmore); *Isat* of the Arikaras (Gilmore); *Shunte-pusa* of the Mandans (Gilmore); *Sida-buzhe* of the Hidatsas (Gilmore); *Asebun* of the Ojibways (Wilson).

[*Ursus*] *lotor* Linnaeus, Syst. Nat., ed. 10, t. 1, p. 48, 1758.

Type locality.—Eastern United States.

General characters.—A thick-set, furry little animal with pointed nose, prominent ears, round, furry tail, long naked soles, and strong curved claws. Color, yellowish or silvery gray, with light gray ears, face, and feet; gray more or less darkened with black-tipped hairs over the back; a black mask across face, black spots back of ears, and five black rings around tail; long woolly underfur light brown. Measurements of a large male taken near

Fargo, by Murie: Total length, 880 millimeters; tail, 265; hind foot, 125. Weight, 24 pounds. A large and very fat male at Elk River, Minn., weighed 30½ pounds.

Distribution and habitat.—In the early trapping days raccoons were abundant in the Red River Valley and apparently scarce in the western part of the State. On September 16, 1800, Alexander Henry (1897, pp. 88, 90, 112, 122, 136, 155, 171) on a canoe trip along Red River, tells us in his journal that his "people saw many raccoons in the course of the day, and shot four." On October 5, at the mouth of the Park River, his party caught 5, and on October 6, 3, and on October 18, 20. After that he records some brought in daily by the trappers; many of them were very fat, and when stripped of the fat and roasted made excellent eating. On November 7, he wrote: "My men took great numbers of fat raccoons in their traps;" and on November 18, no more taken, as they had all denned up for the winter. At Park River, on November 30, he reports seven raccoons taken from one hollow tree where they were evidently hibernating. On March 5, 1801, he says: "The snow is gone and raccoons begin to come out in the daytime." During the trapping seasons from 1800 to 1809, he (Henry, 1897, pp. 184, 198, 221, 245, 259, 281, 440) reported among others, 37 raccoon skins taken at Red River, 163 at Park River, 144 at Grand Forks, 57 in the Hair Hills, 158 on the Pembina River, 63 on the Turtle River, and 15 on the Salt River. Apparently they were one of the commonest fur-bearing animals of that region.

In 1887 the writer found them common near Fargo and at Devils Lake, and in 1895 Loring reported them common at Portland, where he saw skins of some that had been taken in that vicinity. In 1912, in the Turtle Mountains, a resident trapper said that he knew of only three instances of raccoons having been taken in the hills and he considered them decidedly rare. The same year Eastgate reported three killed just north of Dion Lake on November 27. Eastgate also reported a few on the Sheyenne River, south of Stump Lake, and was told that they were formerly common at Lisbon, but that of late years they had become very rare, only three or four skins being brought in each winter. In 1913, a few coons were reported along the Mouse River, east of Kenmare; and at Minot, Mr. Booth, the taxidermist, said that there were still a few at that time, but that they used to be very common when he first came there in the early eighties. On the Missouri River no mention is made of raccoons by Lewis and Clark, Maximilian, or Audubon, while Hayden (1875, p. 92) in his report on the upper Missouri region for 1855, 1856, and 1857, reports them abundant at Council Bluffs; but the highest point on the Missouri River at which he observed them was about the mouth of the Niobrara River. The fact that Maximilian found a name for them among the Minnetaree Indians on the Upper Missouri would indicate that they were not entirely absent from the region at that time. At Fort Clark in 1913 Jewett reported fresh tracks in muddy places along the Missouri River. In 1914 the writer found tracks along Apple Creek, just east of Bismarck, where the animals had been feeding on crawfish and mussels along the creek.

In 1915, raccoons were found common along the river at Wahpeton, where many of the old hollow trees were well scratched up by their claws, and where there were great numbers of frogs in the marshes and an abundance of acorns, all of which offered a feast for them. In the same year Kellogg reported them at Grafton, where he saw three very large dark skins in the Williams collection. At Drayton, in Pembina County, he reported one occasionally captured, and around Devils Lake he found them common in the woods. At Grinnell, on the Missouri River, he reported a few caught, and at Goodall, he saw tracks along the river and was told that two had been taken by trappers two years before. At Elbowoods he saw a few tracks along the river, and near Sather he followed their tracks from the river to a cornfield, where they had been eating the corn and had destroyed entirely two rows. On his way from Washburn down the river to Bismarck he reported a few in the wooded sections of the river bottoms and was told of two trappers who had sold 75 skins taken around Chanta Peta Creek, south of Bismarck. In 1919, Mr. Allen, a taxidermist at Mandan, said that there had always been a few raccoons along the rivers there and one was brought in to be mounted the year before. No records were obtained from the Little Missouri country and the areas west of the immediate Missouri valley.

General habits.—In general habits, as well as to a slight extent in appearance, the raccoons resemble the bears. They are very intelligent and resourceful animals, adapting themselves to almost any environment where food is abundant and the climate not too severe. They are excellent climbers and usually make their homes in hollow trees or logs, but in the absence of such protection they often occupy caves and hollow spaces in banks or cliffs, where they find dark retreats for the daytime and safe dens for their long winter sleep. They are mostly nocturnal in habits, but on rare occasions will come out in the daytime when disturbed or move from one place to another in search of mates in the breeding seasons.

Although not very swift runners, they can usually outdistance a man, but are quickly overtaken by dogs, which are often used in hunting them at night. When pursued, if no hollow tree or rocky retreats are within range, they usually seek protection by climbing up the nearest tree. They are savage fighters and will generally get the best of a dog of approximately their own size.

In fall they become very fat, and soon after the first snows fall enter their dens for hibernation and remain until the early spring thaws rouse them to renewed activity.

Breeding habits.—Audubon (1851–1854, vol. 2, p. 77, 1851) gives a number of young of the raccoon as four to six, generally brought forth in May. The mammae are usually arranged in two pairs of abdominal and two pairs of pectoral. The young are kept well secreted in hollow trees or caverns and are rarely seen until about half grown, when they begin to follow their mother in search of food. In fall they are still in family parties and if so fortunate as to escape the dogs and trappers until November, they enter hibernation together, the mother evidently selecting a suitable hollow for

their winter's sleep. In spring the males are out with the first few warm days, making long journeys from tree to tree in search of mates. Occasionally in early spring a male and female are found together in a hollow tree or hollow log, but for the rest of the year the animals are mainly solitary, except for the mother and young.

Food habits.—In tastes raccoons are highly omnivorous, accepting almost any food in the way of fish, flesh, or fowl, fruit, nuts, or corn. In this northern country they feed in summer very largely on crawfish, mussels, frogs, and fish, and on such birds, eggs, or small mammals as they can find or catch. They are especially fond of ripe blueberries, serviceberries, and any kind of sweet fruit. In fall they usually fatten on acorns where these are obtainable, and the northern limits of their range are almost coincident with the northern limits of oaks. Often at this season their large stomachs contain nothing but the finely masticated pulp of acorn meats and a few shells, and the fattening properties of these rich nuts seem not to be lessened by their bitter and astringent flavor. They are also very fond of unripe corn, and at night will make long trips to cornfields, where they pull down the ears and strip them of their milky kernels. Once started on the green corn, they usually continue to feast on it from the early milky stages until it has become fully ripe.

Economic status.—On rare occasions raccoons find their way into poultry yards or houses at night and kill some of the fowls or rob the nests of eggs. It is probable also that they destroy eggs and young of game and other birds occasionally, but there is little mischief that can be proved against them. Their raids on cornfields are often of considerable extent, but usually the animals are discovered and captured by a night hunt with dogs before they have done serious damage.

On the other hand, their value as one of the standard fur-bearing animals is usually sufficient far to outweigh the losses from their occasional depredations. Their fur is thick, warm, and light, and the skins, while light, are very strong and durable and specially well adapted for overcoats, robes, caps, and driving gloves. The fur is also used for women's capes and muffs, and when plucked is a fair imitation of plucked beaver fur, although longer and less dense. It is usually one of the rather low-priced furs, but gives good value in warmth and wear.

Many people are very fond of the flesh of raccoons, and when fattened on acorns or beechnuts in the north the meat is of good flavor and wholesome. The fat makes a thin oil that is much prized for use on leather. In the pioneer days it was the principal oil for domestic purposes and even for machinery in the frontier settlements. Generally the raccoon is considered a valuable fur and game animal and its depredations are easily overlooked. Many of the skins are of little value because taken early in the fall before they have become heavily furred and prime. The young do not get their full growth before entering hibernation in fall, and only a very short season should be allowed for trapping before they den up for the winter. In North Dakota an open season from November 15 to March 15 would probably insure prime fur.

Family URSIDAE: Bears

Ursus americanus americanus Pallas

Black Bear; Cinnamon Bear

Wasabè of the Omahas (Gilmore); *Wachank-shica* of the Dakotas (Williamson); *Konach-katit* of the Arikara (Gilmore), *Watú*—tame bear; *Haschida* of the Hidatsas (Maximilian); *Ischídda* of the Mandans (Maximilian).

Ursus americanus Pallas, Spicilegia Zool., fasc. 14. p. 5. 1780.

Type locality.—Eastern North America.

General characters.—A heavily built, powerfully muscled animal, not half so clumsy as it looks when fat and in long fur. Eyes, small and not very keen sighted, but the ears prominent and as sensitive to sound as the nose is keen to scent. Tail, short; feet, rather large and plantigrade with naked soles; front and hind claws, short, curved, and sharp for climbing. Color, mainly black, with usually a yellow-brown muzzle and occasionally a white spot on the breast or throat. Occasionally these bears are entirely brown, normally of a cinnamon color, but varying from yellow-brown to dark brown. Measurements of adult male, from Montana: Total length 1,680 millimeters; tail, 105; hind foot, 275; in feet and inches, 5.5 feet, 4.1 inches, 10.8 inches, respectively. In Minnesota, where probably the same form occurs, the weight is estimated usually at about 300 pounds for a fully adult male. One killed by A. H. Wilcox (1907, p. 100), at Detroit, Minn., weighed 299 pounds. Seton (1909, vol. 2, p. 1052) gives the weight of a large male killed near Winnipeg, Manitoba, as 265 pounds.

Distribution and habitat.—In the early days black bears evidently ranged over practically all of North Dakota, but were most abundant along the Red River Valley, in the Turtle Mountains, Pembina Hills, and on the wooded streams of the eastern part of the State. There are a few records of them for the Missouri Valley, but apparently they were never common over the open prairie country or in the Badlands farther west. Their greatest abundance seems to have been in the Red River Valley, where from 1800 to 1808 Alexander Henry (1897, pp. 184–440) records them in such numbers as have rarely been known in any part of the country. In September, 1800, near the mouth of Park River, he reported 4 bears killed on the 14th, 6 on the 15th, 1 on the 16th, 2 on the 20th, 3 on the 24th, 1 on the 25th, and 1 on the 26th of the month, and 40 skins taken by one party of trappers. For the next eight years he reported, among the fur bearers taken in the Red River Valley, 52 black and 20 brown bears on the Reed River, 148 black and 25 brown on the Park River, 64 black and 3 brown at Grand Forks, 131 black and 26 brown from the Hair Hills, 302 black and 75 brown on the Pembina River, 28 black and 12 brown on the Turtle River, and 18 black and 2 brown on the Salt River, making in all 906 bears from this region. At the mouth of the Park River, on September 22, 1800, Henry (1897, p. 101–102) says in his journal:

> Bears make prodigious ravages in the brush and willows; the plum trees are torn to pieces, and every tree that bears fruit has shared the same fate; the tops of the oaks are also very roughly handled, broken, and torn down, to get the acorns. The havoc they commit is astonishing; their dung lies about in the woods as plentiful as that of the buffalo in the meadow.

Over the rest of the State the records are few and scattered. Along the Missouri River bears were not mentioned by most of the

early explorers, although Audubon (1897, p. 133), in 1843, reported the killing of a black bear on the White Earth River, about 60 miles from its mouth, where he says a few are occasionally shot. In 1878, McChesney (1878, p. 202), from Fort Sisseton, S. Dak., just below the southeastern corner of North Dakota, reported them as once very common, but not seen of late years within 50 or 60 miles of the post. At Valley City, J. S. Weiser gave Morris J. Kernall a record of a black bear found near there in 1878. In 1887, there were said to be still a few black bears in the Devils Lake timbered areas, and in the Turtle Mountains they were said to be common. A few were also said to occur in the country about Fort Buford, but not on authority that seems very reliable. At Wade, on the Cannonball River in 1913, W. B. Bell reported black bears seen by Mr. Wade, who had lived there for 41 years. At the mouth of the Cannonball, in 1916, the writer was told that a few black bears had been found along the river bottoms up to comparatively recent times. Beede, who had lived among the Sioux Indians there, said that the Indians did not hunt them unless in dire need of food, as the bears were to them semisacred. When one was killed, he says, a bit of its skin was left on a bush or tree as an offering to the spirit world.

At the present time there are a few black bears in the Turtle Mountains and Pembina Hills, where one is occasionally killed, and in the Red River Valley one may sometimes wander in from the heavy woods of northern Minnesota. At Grafton, Kellogg reported two killed by Andrew Monsebroten, five miles west of the town, in 1884; two young bears killed by Arthur Blomquist, in 1910, about six miles north of Drayton on the Minnesota side of the river; and another killed in Pembina County, in 1894, by Jim Spanglo, "the latest record I could get for the county." At Devils Lake, in 1916, Mr. Palmer told of a small brown bear killed near the lake only two years previously. It had been seen in several localities and evidently had wandered from the Turtle Mountains.

General habits.—The black bears are timber-loving species, depending largely on the cover of thickets, swamps, and dense forests for protection, and to some extent also upon the trees for food and winter quarters. They are great wanderers, however, and do not hesitate to strike across wide stretches of open country when in search of a new supply of food, or when driven out of their regular haunts by hunters. Usually, however, their wanderings are along the lines of streams and wooded or brushy patches, where both food and cover are to be found.

Food habits.—Few animals are more nearly omnivorous than the black bears, and as they are hearty eaters a great quantity of food is required to satisfy them, especially in fall, when they are preparing for their long winter sleep. Acorns, berries, and fruit form a great part of their food in this northern country, but they readily accept any meat or carcass that can be found, such insects as can be procured from ant hills, rotten logs, or overturned stones, and many plants and roots and much succulent vegetation. In summer they gorge themselves on blueberries and serviceberries, the abundant sweet fruit of which seems to appeal strongly to their appetites. In fall, wherever oaks are to be found, bears search for the acorns and gather them, first from the treetops by draw-

ing in and breaking the branches until every acorn can be reached, often making the top of the tree look like an eagle's nest before they have finished with it. Later, as the ripe acorns fall to the ground, they gather them up and eat them to the exclusion of almost every other food. These puckery but rich little nuts rapidly supply the heavy coating of fat necessary for carrying the bears comfortably through the long, cold winter hibernation.

Hibernation.—In 1800, Alexander Henry (1897, pp. 157, 252–253, 87, 135, 136, 117) wrote in his journals that "bears den in hollow trees along the Red River, but in the Hair Hills on higher ground in holes in the banks. They are hunted by the Indians in the trees." On November 13, 1804, at Pembina, he writes, "My tame bear is making a hole to take up his winter quarters in." On September 6, 1800, he says, "one bear killed up a tree." In another place he records one bear killed November 5 and 10 skins brought in from the Hair Hills, November 6; and on May 1 following, he records 37 bear skins brought in from Grand Forks (p. 177). These dates, however, do not indicate reliable records of the beginning and end of hibernation, as apparently the Indians were in the habit of killing the bears in their winter dens. Usually the bears in northern Minnesota den up with the first heavy fall of snow and cold weather early in November, reappearing with the first warm days late in March or early in April. Their fur is not prime until about the time of hibernation and usually is in the best condition when they come out of their dens in spring. A large number of the skins taken are in almost worthless condition because the bears were killed too early in fall or too late in spring.

Economic status.—Over much of the country black bears are now considered one of the valuable game animals and given protection as such in the game laws. In a forested area like the Turtle Mountains it would seem well worth while to protect them until past danger of extinction. With the abundance of wild land, forest, and lakes, and ample food in the berries and acorns, there is little probability of their doing any serious mischief to crops or livestock in that region.

Ursus horribilis horribilis Ord

Grizzly Bear; Big Plains Grizzly; Silvertip

Mato or *Mato-chota* of the Dakotas (Gilmore); *Mato* of the Mandans (Maximilian); *Mato unknapininde* of the Mandans (Will); *Lachpitzi* of the Hidatsas (Maximilian); *Kúnuch* of the Arikaras (Maximilian), *Konuch-tarawis* (Gilmore).

Ursus horribilis Ord, Guthrie's Geogr., 2d Amer. ed., vol. 2, pp. 291, 300, 1815. (Reprint by S. N. Rhoads, 1894.)

Type locality.—Missouri River above the mouth of Poplar River, northeastern Montana.

General characters.—Size, very large; skull, long and massive with very heavy molar and canine teeth; front claws, long and only moderately curved. Fur, long and loose with well-marked mane or crest over "hump" of shoulder. Color, variable from light yellow to dark brown, the lightest individuals even called white by Lewis and Clark and other writers familiar with them. Audubon (1851–1854, vol. 3, p. 149, 1854) says: "We have skins in our pos-

session collected on the Upper Missouri, some of which are nearly white, while others are nearly of a rufous tint, and one that was killed by our party, of which we also have the skin, was a dark brown one."[24] Maximilian (Wied, 1839–1841, Bd. 1, pp. 490, 493, 1839) writes: An old bear and two cubs were killed. The mother was "a pale yellowish color; one of the cubs, which was brought on board alive, was whitish about the head and neck and brownish gray on body; the other was dark brown." Another killed on July 18 was reported as dark brown, with new hair of light gray with yellow tips already appearing; another killed farther up the river on July 21, 1833, was at first supposed to be a black bear, but when shot proved to be dark brown, and as Maximilian suggests, may have been another species of grizzly.

Measurements of a small male collected by Maximilian (Wied., 1839–1841, Bd. 1, p. 488, 1839) and supposed to be about 3 years old were: Tip of nose to tip of tail, 6 feet 2 inches 2 lines. A large one measured by Lewis and Clark (1893, p. 298) in northeastern Montana, apparently the type of the species, measured from tip of nose to extremity of hind foot, 8 feet 7½ inches, length of front claws, 4⅜ inches. A still larger one killed by the party was said to measure 9 feet from tip of nose to tip of tail, with front claws 6¼ inches in length. Skull of large male: Basal length, 351 millimeters; zygomatic breadth, 247; in inches 13.8 and 9.6, respectively. (Merriam, 1918, p. 19.) There seem to be no reliable weights for the adults of this Plains grizzly available, but Lewis and Clark (1893, p. 298) estimated the weight of a large one as 500 or 600 pounds.[25]

Distribution, habitat, and general habits.—At the coming of the white man these large grizzlies were apparently common over practically all of North Dakota. In 1800 Alexander Henry (1897, pp. 121, 145, 184, 245, 259, 231, 440), while in the Red River Valley, wrote in his journal:

> Grizzly bears are not numerous along Red River, but more abundant in the Hair Hills. At Lac du Diable [Devils Lake], which is about 30 leagues W., they are very common—I am told as common as the black bear [*Ursus americanus*] is here, and very malicious. Near that lake runs a principal branch of Schian [Sheyenne River], which is partially wooded. On the banks of this river I am informed they are also very numerous, and seldom molested by the hunters, it being the frontier of the Sioux, where none can hunt in safety; so there they breed and multiply in security.

Again, in speaking of the Sheyenne River, he says: "Grizzly bears are to be seen in droves." On his return from a trip to the Sheyenne River to his winter quarters at the mouth of the Park River, near where Grafton now stands, he records:

> During my absence the hunter had killed a large grizzly bear [*Ursus horribilis*] about a mile from the fort. He had seen two males and a female, but the latter escaped. My people having cooked and eaten some of the flesh were taken very ill, and most of them threw it up. This bear had been wounded in the fore leg some time before by an arrow, the iron head of which stuck fast in the bone, and was beginning to rust.

During the first trapping season 1800–1801, his men obtained four grizzly-bear skins at the Reed River and two at the Park River. In 1804 he reports one grizzly bear from the Park River and in 1805, four from the Hair Hills, four from the Salt River, and two from the Pembina River, and in 1806, three from the Pembina River. Meanwhile of the 113 skins of brown bears recorded, it is very prob-

[24] Possibly two species.

[25] The type specimen of *Ursus horribilis* collected by Lewis and Clark is lost, but a fine old male skull from near the type locality in eastern Montana, gives reliable characters of the species. There is still one skull of a 3-year-old male from Fort Buford in the National Museum collection, taken by J. P. Kimball, in 1868. This is the only specimen representing the species from North Dakota and we can only assume that the grizzlies extending across the State were all the same. Old skulls from any part of the State would be of great interest and value as contributions to the National Museum collection.

able that some were of the grizzly group. Henry (1897, pp. 422, 221) also reported one grizzly-bear skin in the catch from the Sandhill River, Minn., in 1807, and one from Portage la Prairie, Manitoba.

On their way up the Missouri River in 1804, Lewis and Clark (1893, pp. 157, 174, 251, 274, 288–289, 298) often referred to the white, yellow, and gray bears. On Fox Island, S. Dak., they saw the tracks of a "large white [grizzly] bear." On October 20, while camped on the river bottom just below where Bismarck now stands, they say: "We also wounded a white bear, and saw some fresh tracks of those animals, which are twice as large as the track of a man." From Mandan they sent back, among other skins, those of the "yellow bear." The following spring, on the way up the river after wintering at the Mandan villages, they saw one black and two white bears about 30 miles above the Little Missouri, and observed tracks along the river at other places. Near the junction of the Yellowstone with the Missouri River, on April 29, 1805, Captain Lewis, who was on shore with one of the hunters about 8 o'clock, met two white bears. He writes:

> Of the strength and ferocity of this animal the Indians had given us dreadful accounts. They never attack him but in parties of six or eight persons, and even then are often defeated with a loss of one or more of their party. Having no weapons but bows and arrows, and the bad guns with which the traders supply them, they are obliged to approach very near to the bear; as no wound except through the head or heart is mortal, they frequently fall a sacrifice if they miss their aim. He rather attacks than avoids a man, and such is the terror which he has inspired, that the Indians who go in quest of him paint themselves and perform all the superstitious rites customary when they make war on a neighboring nation. Hitherto those bears we had seen did not appear desirous of encountering us; but although to a skillful rifleman the danger is very much diminished, yet the white bear is still a terrible animal. On approaching these two, both Captain Lewis and the hunter fired, and each wounded a bear. One of them made his escape; the other turned upon Captain Lewis and pursued him 70 or 80 yards, but being badly wounded the bear could not run so fast as to prevent him from reloading his piece, which he again aimed at him, and a third shot from the hunter brought him to the ground. He was a male, not quite full grown, and weighed about 300 pounds. The legs are somewhat longer than those of the black bear, and the talons and tusks much larger and longer. . . . Its color is a yellowish-brown; the eyes are small, black, and piercing; the front of the fore legs near the feet is usually black, and the fur is finer, thicker, and deeper than that of the black bear. Added to which, it is a more furious animal, and very remarkable for the wounds which it will bear without dying."

A few days later, May 5, Captain Clark and one of the hunters killed a large grizzly, said to weigh 500 or 600 pounds, and to measure 8 feet 7½ inches, from the tip of the nose to the extremity of the hind foot. His front claws measured 4⅜ inches, and his color was of a reddish or bay brown. This specimen, with measurements and description, formed the principal basis of Ord's later description and name of the species; neither skin nor skull can now be found.

In 1833, Maximilian (Wied, 1839–1841, Bd. 1, pp. 419–420, 1839) notes in his journal on June 22: Near the great bend of the Missouri (just above the mouth of the Little Missouri River), a large grizzly seen on the prairie on the north bank of the river, and "soon after two others were seen, one whitish, the other of a dark color." From this place on, in their journey up the river, the gray bears become

more and more common. Above the mouth of the Knife River at the village of the Minnetarees, many of the Indians wore the large, valuable necklaces made of long bears' claws, and their handsomely painted buffalo robes were fastened around the waist by a girdle. A few days later Maximilian met a chief of the Assiniboines wearing a necklace of bears' claws, blue glass beads in his ears, and a red flannel shirt. At Fort Union he (Wied, 1839–1841, Bd. 2, pp. 39, 302, 213, 215, 1841) mentions several distinguished men of the Assiniboines who arrived at the post on October 20, among whom was one Mantó-Uitkatt (The Mad Bear). At the village of the Minnetaree Indians, about 30 miles above Fort Clark, he found an old chief, Lachpitzi-Sihrisch (The Yellow Bear), of whom he has much to say later. At the Knife River he gives the name of another Minnetaree chief as Lachpitzi-Wáh-Kikihrisch (The Bear Hunter). Mato-Tope (Four Bears) was one of the most famous of the Mandan chiefs and a staunch friend of Maximilian. His son was named Mato Berocka (Male Bear). In the folio of plates accompanying Maximilian's Reise in das Innere Nord-America, many of the Indians shown are chiefs or famous hunters wearing grizzly-claw necklaces, among them Sioux, Mandan, Minnetaree, and Crow, who had won the right to wear these trophies of the hunt. In Plate 36 of the folio, Maximilian (Wied, 1839–1841, Folio, pl. 36) shows his hunters attacking two grizzly bears as described in the text of his journal. On July 18 he (Wied, 1839–1841, Bd. 1, pp. 487–489, 1839) says:

> The hunters had seen several bears and on the 18th they saw two bears running about on a sand bar in the river. One of these was shot and when mortally wounded rolled over, uttering fearful cries. It was a male about 3 years old and not of the largest size, but was 6 feet 2 inches and 2 lines from tip of nose to tip of tail, and from tail to tip of hairs, 8 inches. His color was dark brown with the points of the hair of a rusty color, but new hair already appearing which was lighter gray with yellow tips. This bear is known to be a very dangerous beast of prey and is willingly avoided by the hunters. . . . It is certain that many white men and Indians have been torn to pieces by these dangerous animals, especially in former times, when they were very numerous and lived to a great age.

At Fort Clark, where he spent the winter with the Mandan Indians, he (Wied, 1839–1841, Bd. 2, p. 85, 1841) says:

> The grizzly bear approaches to within 4 miles of the fort because the Indians, who do not like to hunt them, leave them undisturbed. They are, however, very fond of the flesh of the young bear and the claws are much valued by them for the manufacture of their necklaces.

On returning down the river in October, Maximilian (Wied, 1839–1841, Bd. 2, pp. 47–49, 1841) brought with him, among other live animals, some young bears in cages. Near the mouth of the Muddy River, on October 31, he found along the shores an abundance of buffaloberries, which were fed to the caged bears and proved an agreeable variety in their food. Since no game had been killed for several days, the live animals, which would not eat salt pork, were half famished, and the bears especially made an incessant growling, which was in every respect highly disagreeable. The next day an elk was shot and he says: "The lamentations of my hungry animals were put a stop to." Generally, however, the bears were found feeding on buffalo carcasses, which were often plentifully distributed in the quicksand or along the river banks by floods and breaking ice.

Apparently the Missouri River Valley with its great abundance and variety of large game, wild fruit, and berries, bulbs, tubers, roots, and underground beans, was a paradise for those bears before the days of the rifle.

In regard to the breeding habits of the grizzlies, Maximilian (Wied, 1839–1841, Bd. 1, p. 510, 1839) says that only 2 or 3 young are generally raised, but 2 to 4 were sometimes recorded and some of the Indians even claimed that one group of 8 young had been found, but this he considered an exaggeration.

In 1843, Audubon (1897, pp. 155–156, 41, 51, 64, 75, 86, 117, 122, 146) on his trip up the river to Fort Union, found the grizzly bears apparently as common as had Maximilian and Lewis and Clark over the same ground 10 and 39 years earlier. Just above Bismarck he found many of their tracks, and near the mouth of the Little Missouri, on August 22, he and his companions killed one and saved it for a specimen. They had seen many tracks the previous day and on the following day saw another bear. In the vicinity of Fort Union he found many tracks around the three conical hills called the Mammalles. On June 19 a grizzly bear was seen just across the river, on June 22 another near there, and others were seen on June 27, July 5, 13, 27, and 30, and August 12, which gives some idea of their abundance at that time. Audubon describes a man at Fort Union who had been attacked by a grizzly in the Black Hills; his face was badly mutilated, one eye had been torn out, and his arm and side were literally torn to pieces, but he lived for years afterward. There are many accounts of bears attacking both Indians and whites, and often without provocation. Audubon (1851–1854, vol. 3, pp. 145–146, 1854) records an attempt to kill an old bear and capture her two young, discovered near the shore from one of the steamers of the American Fur Co. The old bear was wounded and charged the hunters with such fury that they dropped their guns, jumped into the river, and hurriedly made their way back to the steamer. He relates another incident of an attendant at Fort Union picking peas in the garden when he suddenly discovered a large grizzly gathering peas at the other end of the row. He dropped his bucket and fled, and when the hunters arrived they found the bear eating peas out of the bucket. He paid no attention to them as they approached and was shot dead.

In 1856, F. V. Hayden collected specimens of the grizzly bear near Fort Clark and a skeleton at Fort Union.

At Devils Lake, in 1916, Frank Palmer, who had lived in North Dakota since 1867, told the writer that he had never known of any grizzly bears east of the Missouri River Valley. He said that the Sioux in their own language called some hills near old Fort Ransom, in Ransom County, where the Sheyenne River turns north, "The Bears' Den." Some of the Indians from near Devils Lake used to go down there and hunt buffalo and Mr. Palmer was with them on one of these trips when he learned the name of these hills. In 1867, he says there were many grizzly bears on the river bottoms about Fort Buford, and also above and below there, and farther west in Montana. While carrying mail from Fort Buford west he often saw them along the Missouri River bottoms, and they would not always get out of his way.

In the Killdeer Mountains, in 1913, Jewett was told by the old settlers that grizzly bears were formerly common over all the country east and north of the Little Missouri River. Frank Donoyer, a veteran buffalo hunter, told of killing several of these bears in the Killdeer Mountains between 1864 and 1870. Dave Warren, assisted by a boy, killed two grizzlies in a gulch near Oakdale in the fall of 1897.

From his ranch on the Little Missouri, Roosevelt (1900, pp. 55–56) writes:

> In the spring and early summer of 1888, the bears killed no cattle near my ranch; but in the late summer and early fall of that year a big bear, which we well knew by its tracks, suddenly took to cattle-killing. This was a brute which had its headquarters on some very large brush bottoms a dozen miles below my ranch house, and which ranged to and fro across the broken country flanking the river on each side. It began just before berry time, but continued its career of destruction long after the wild plums and even buffalo berries had ripened.

Again, he tells of bears attacking his cattle, killing white-tailed deer, attacking one of his cowboys, and killing an Indian near his ranch, and of numerous instances of bears killed under thrilling circumstances during his ranching days on the Little Missouri.

In 1887, when the writer visited Fort Buford, there were still a few grizzly bears in the river bottoms in that vicinity, but they were growing scarce. In a letter dated March 30, 1914, Clarence H. Packer, of Minot, states that his father trapped along the river bottoms, 25 miles south of Williston, in 1887, and at that time there were some grizzly or silvertip bears there.

In 1889 William B. Mershon (1923, 1925), on a hunting trip along the Little Missouri, reported bear tracks everywhere, the sand bars literally tracked up by them, some of enormous size. He measured one track that was 8 by 14 inches.

At the present time there is certainly not a grizzly bear left in the State of North Dakota, and it is doubtful if there is anywhere a living representative of this original species of the grizzly group that was first given a scientific name and status in literature. Its destruction, however, was more inevitable than was that of the buffalo or the other large game animals of the Plains, because, aside from its commercial value and its appeal to the most vigorous sportsmen as a worthy antagonist among large game, its presence in an agricultural and stock-raising region could not be tolerated. Like some of the savage tribes with which it was associated, it has in passing left behind a thrilling record of savage bravery of surpassing interest to red-blooded Americans.

Ursus absarokus Merriam

Absaroka Grizzly

Ursus absarokus Merriam, Proc. Biol. Soc. Washington, vol. 27, p. 181, 1914.

Type locality.—Near head of Little Bighorn River, northern end of Bighorn Mountains, Mont.

General characters.—Large, but smaller than *Ursus horribilis*, with much smaller molar teeth. Color from skin of head and neck only, "Muzzle pale brown, changing to grizzled dark brown on head and face; a large patch of dark brown free from grizzling on side of face extending from eye to angle of jaw; chin and gular region dark brown (except anterior part of

chin, which has not yet molted the pale old coat); top and sides of neck and doubtless body also, strongly grizzled." (Merriam, 1918, p. 93.) Measurements of skull of adult male: Basal length, 322 millimeters; zygomatic breadth, 218; in inches, 12.7 and 8.6, respectively.

Distribution and habitat.—Doctor Merriam (1918, p. 93) gives the range of this grizzly as "Laramie and Bighorn Mountains, eastern Wyoming, Black Hills region, South Dakota, and northward along Little Missouri to Missouri and Yellowstone Rivers." He says it appears to be a mountain species, while *horribilis* apparently was a Plains species.

The only North Dakota specimen consists of a skull with accompanying skin of head and neck presented to Doctor Merriam for the National Museum collection by Howard Eaton, of Wolf, Wyo. This bear was killed by Mr. Eaton on October 27, 1880, at the mouth of Bear Creek, which empties into the Little Missouri River from the east, opposite Bullion Butte. Apparently its range overlapped that of the Plains grizzly to some extent, which may account for the supposed discrepancy in color of that species. Evidently this was a darker, browner bear than *Ursus horribilis*.

Order INSECTIVORA: Insect-eating Mammals

Family TALPIDAE: Moles

Scalopus aquaticus (machrinoides?) Jackson

Missouri Valley Mole

(Pl. 19, fig. 1)

Scalopus aquaticus machrinoides Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, 1914.

Type locality.—Manhattan, Kans.

General characters.—Rather large for the common mole; a compact little animal with beaklike naked nose, no functional eyes, minute ears, large spadelike front feet with five rigid claws, small hind feet, short, nearly naked tail, and dense plushlike fur of a brassy brown color. Measurements of average adults: Total length, 172 millimeters; tail, 30; hind foot, 22.2.

Distribution and habitat.—The northernmost form of the common mole of the eastern United States ranges from Arkansas up through Missouri, Iowa, and Minnesota to Elk River, and has been reported from Ottertail County, near Fergus Falls, and from Crookston. There is no definite record for North Dakota, but at Hankinson, in the southeastern corner of the State, some of the residents reported that mole ridges had been seen on the sandy soil in that region. Doctor Bell and the writer were unable to find any trace of moles or ridges, however, and but for their close proximity along the eastern border of the State, little weight should be given to the report. Until specimens are actually obtained from the State this must be considered as a hypothetical species and the identity of the form occurring there doubtful. The characteristic ridges along the surface of the ground, pushed up by these moles in extending their tunnels, are so unmistakable and so well known to those who have lived where they are abundant, that the presence of moles is easily recognized. It is often difficult to obtain specimens, as the moles are not easily trapped. Once discovered in the act of pushing

up their ridges, however, they are easily caught by simply pressing down the earth back of them and then quickly scraping them out with hands, feet, or shovel. It is hoped that if the species does occur in North Dakota, specimens may be obtained to add this interesting and very useful little animal definitely to the list of the mammals of the State.

Condylura cristata (Linnaeus)

Star-nosed Mole

(Pl. 19, fig. 2)

[*Sorex*] *cristatus* Linnaeus Syst. Nat., ed. 10, t. 1, p. 53, 1758.

Type locality.—Eastern Pennsylvania.

General characters.—Starlike disk of sensitive filaments on tip of nose, and no visible eyes or external ears; front feet wide, flat, and spadelike, but not so large as those of the common mole; hind feet, slender; tail, large and slightly hairy, usually swollen toward the base. Color, black or dusky, nearly uniform all over. Measurements of average specimens: Total length, 202 millimeters; tail, 78; hind foot, 28.

Distribution and habitat.—The star-nosed moles are wide-ranging, Canadian and Transition Zone animals of eastern Canada and the northeastern United States, reaching their previously known western limit of range in central Minnesota and southeastern Manitoba. Seton (1909, vol. 2, p. 1137) records them from the vicinity of Winnipeg, on the authority of W. R. Hine, who assured him "that specimens have been brought to his taxidermist shop in Winnipeg; unfortunately, they were not kept." This record from Winnipeg on the north and report of occurrence at Fort Ripley, central Minnesota, mark a close approach to the State line on the east. The animals undoubtedly occur in the Red River Valley and Turtle Mountain country. At Towner, in 1915, Kellogg was told by James Lymburner of an animal answering the description of the star-nosed mole, which had on several occasions been found in his meadow. One was taken to the house and kept in a glass jar for a while as a curiosity, but no specimens were saved. Mr. Lymburner described it as having a long, pointed nose with a ring of soft, fleshy, finger-like projections. Its body was 2 or 3 inches long and its color a bluish black, which would indicate an immature animal. Kellogg says that several other persons described the same animal, but although traps were placed all over the meadow where the moles had been seen, none were caught. This seems to be the only available record for the State of this very useful little insectivorous animal, and while it adds the species tentatively to the State list, it only increases the importance of procuring specimens to substantiate the report.

Family SORICIDAE: Shrews

Sorex cinereus haydeni Baird

Hayden Masked Shrew

(Pl. 20)

Sorex haydeni Baird, Mamm. North Amer., p. 29, 1857.

Type locality.—Fort Union (now Buford), N. Dak.

General characters.—A tiny shrew with slender pointed nose, minute eyes, concealed ears, and slender tail about half as long as its body and three

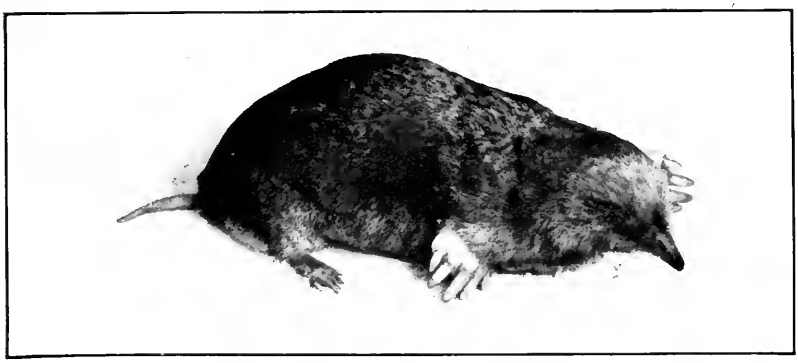

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FIG. 1.—COMMON MOLE (SCALOPUS AQUATICUS MACHRINOIDES)

Photograph of fresh specimen. Half natural size

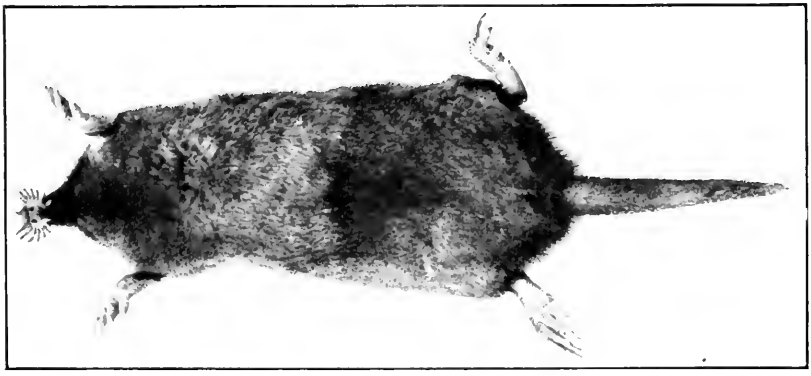

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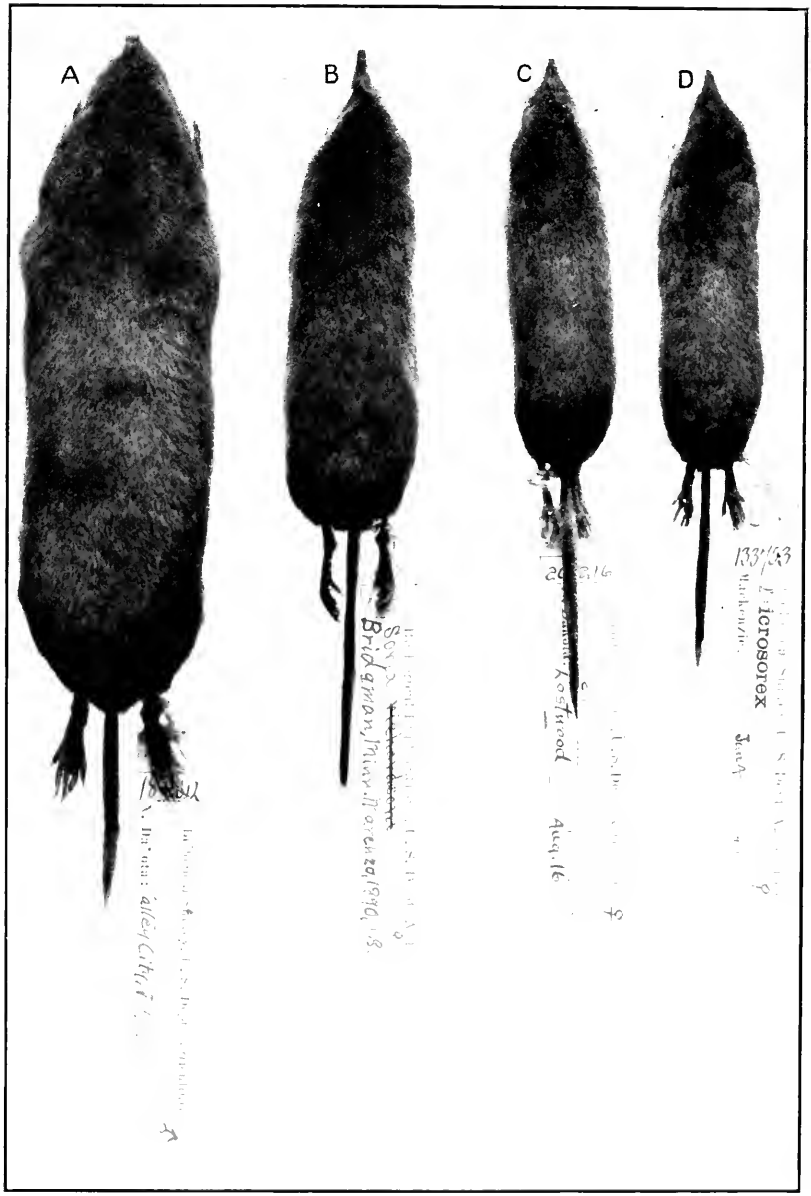
FIG. 2.—STAR-NOSED MOLE (CONDYLURA CRISTATA)

Photograph of fresh specimen. Half natural size



B1330

SKINS OF FOUR SHREWS

(A) Short-tailed shrew (*Blarina brevicauda brevicauda*); (B) Richardson shrew (*Sorex arcticus*); (C) Hayden shrew (*Sorex cinereus haydeni*); (D) Pigmy shrew (*Microsorex hoyi*). About natural size

times as long as its hind foot. Fur, soft and fine; color of upper parts, sepia brown, underparts, ashy gray. Measurements of an average adult, from Kenmare: Total length, 95 millimeters; tail, 33; hind foot, 11. An adult female at Walhalla measured 98, 38, and 12 millimeters, respectively, and weighed 3.6 grams; two others each weighed 3.3 grams.

Distribution and habitat.—The Hayden masked shrew is a barely recognizable prairie form of the wide-ranging species *cinereus* (formerly known as *personatus*) which with its various subspecies covers most of the northern part of the continent. The subspecies *haydeni* covers North and South Dakota and the prairie country of most of the surrounding States and Provinces. In North Dakota there are specimens from Buford, from near Williston and Lostwood, and from Kenmare, Bottineau, Birchwood, Walhalla, Grand Forks, Portland, Fairmount, Blackmer, Oakes, Steele, Cannon Ball, and Selfridge, all in the National Museum collection. There is one from Minot in the Field Museum collection, and specimens from Fargo and Grafton in the agricultural college collection, at Fargo. Although rarely seen, they occupy practically every meadow, brush patch, and grove, and are found under rich vegetation almost anywhere on the prairie.

General habits.—These little masked shrews live on or under the surface of the ground, mainly under the cover of old leaves, grass, and fallen vegetation, where they make endless runways and tiny tunnels over and through the surface of the mellow soil, keeping almost as completely hidden from view as do moles and pocket gophers. Their long, flexible, sensitive noses apparently take the place of eyes in their dark tunnels and burrows, for their eyes have become mere specks, with apparently very limited range of vision. On rare occasions a shrew is uncovered in turning over a board or log or in loading hay that has stood long on the meadows. More often one is found dead in some trail where killed by a cat, weasel, or little owl, and found too musky for food.

On soft snow in winter their tiny double lines of tracks are frequently seen, and often little ridges the size of one's finger show where they have plowed tunnels close under the surface of the snow for passageways from place to place. When caught alive in the hands they struggle and fight with surprising strength and vigor, although their tiny teeth can do no harm and their vain struggles are like those of some vigorous insect.

The little that is known of their habits comes mainly from trapping them either in their own little runways or burrows or catching them in traps set for meadow mice, whose larger runways they habitually follow. They are usually caught in small traps baited with fresh meat, bacon, or fat pork, and set under logs and in open places scooped out under the leaves and grass. Traps set for meadow mice and baited with rolled oats also catch them, either because they accidentally run against the trigger or in some cases apparently because they stop to feed on the bait.

Food habits.—The principal part of their food, as shown by the stomach contents consists of insects, earthworms, and the small animal life found over the surface of the ground. They ravenously devour any kind of fresh meat, whether it be a meadow mouse or woods mouse, or one of their own kind, found in a trap, or a bit of bird meat or beef placed on the trap trigger to attract them,

and in winter they will gather in numbers if a piece of frozen meat, lard, or tallow is left under a log for them to gnaw. They undoubtedly catch many of the small rodents, and especially the young, for food, as they are capable of killing animals larger than themselves. They apparently never accumulate any fat and are active throughout the year, evidently finding an abundance of frozen insects and other food along their tunnels on or below the surface of the ground.

Breeding habits.—Very little is known of the breeding habits of shrews, but Stuart Criddle, of Treesbank, Manitoba, sent to the Biological Survey for identification eight half-grown young of this shrew taken on October 14, 1924. They were found dead in a grass nest under a sheaf of brome grass, and near them the head of a partly eaten shrew, probably their mother. So little is known of the habits of shrews that such scraps of information are important.

Economic status.—Fortunately these bloodthirsty little animals are not large enough to do any damage to game or domestic poultry. In camps, cabins, and cellars in the wilderness they often gather in winter and become as numerous as some of the wild mice, and in some cases do slight damage by gnawing and soiling meat left within their reach. Any damage along this line, however, is so insignificant as to be negligible, while their constant destruction of insects and probably also their destruction of many small rodents, mark them as beneficial animals. There is still much to be learned of their habits and of the actual species of animals which furnish the bulk of their food.

Sorex merriami Dobson

Merriam Shrew

Sorex merriami Dobson, Monogr. Insectivora, pt. 3, fasc. 1, pl. 23, fig. 6, 1890.

Type locality.—Little Bighorn River, about 1½ miles above Fort Custer, Mont.

General characters.—About the same size as *haydeni*, but readily distinguished by buffy-gray upper parts and white underparts, feet, and lower half of tail. The skull characters show that it belongs to a very distinct group, but external characters are sufficient for easy recognition. Measurements of type specimen, preserved in alcohol: Total length, 90 millimeters; tail, 36; hind foot, 11.

Distribution and habitat.—The Merriam shrew is known only from the type specimen collected near Fort Custer, Mont., in 1884, by Major Bendire, and an imperfect specimen picked up by Jewett near Medora, on June 30, 1913. The latter was found on top of a dry Badlands butte, where evidently it had been caught by a hawk or a weasel and the head eaten off. Fortunately the skin was saved and the white underparts and the sharply bicolor tail served to identify it as this species. Apparently it is closely associated with the Badlands country and additional specimen will undoubtedly be taken in this semiarid region when more naturalists are on the lookout for rare species. Although a great deal of collecting of small mammals has been done in that general region, the scarcity of these shrews may be only apparent and due to some peculiarity of habits not yet learned by naturalists. Specimens should not only be saved, but any clue to their habits recorded, so that some light as to whether they are really scarce or merely escape observation may be obtained.

Sorex arcticus Kerr

Richardson Shrew; Black-backed Shrew; Saddle-backed Shrew

(Pl. 20)

Sorex arcticus Kerr, Animal Kingdom, p. 206, 1792.

Type locality.—Severn Settlement, mouth of Severn River, Ontario, Canada.
General characters.—Size, rather large; tail, of medium length; nose, long and pointed; eyes, minute; ears, concealed. In winter, whole back dark brown or black sharply contrasted with buffy brown sides and gray-brown belly. In summer back dull brown but still strongly contrasted with lighter sides and underparts. Measurements of average specimens: Total length, 112 millimeters; tail, 40; hind foot, 14.

Distribution and habitat.—A specimen of the black-backed shrew, now in the National Museum collection, was taken at Pembina by Charles Cavileer in 1855, and another by Robert Kennicott in 1861. One was taken at Fort Sisseton, just below the southeastern corner of the State, in 1877, by C. E. McChesney. Eastgate took one at Stump Lake in 1912, the writer took one at Kenmare in 1913, and Kellogg one at Fort Totten and another at Lostwood in 1915. There is one specimen in the Morris J. Kernall collection, taken at Valley City in 1912, and Kellogg reports one in the H. V. Williams collection taken at Grafton in 1915. This carries the range of the species diagonally over the northeastern half of the State.

It is a wide-ranging species, extending from the Mackenzie, through the Canadian Zone forests, to northern Michigan, Wisconsin, and Minnesota. In North Dakota the records are mainly from forested valleys, marshes, or lake shores. At Grafton, Williams reported catching these shrews on the edge of a marsh near town. Near the east end of Stump Lake Eastgate took one in some cold spring marshes, and at Kenmare the writer caught one in a trap set for meadow mice in a runway under the grass at the lower end of the Upper Riviere des Lacs, not far from cold gulches occupied by aspens and snowshoe rabbits. Usually there is a trace of Canadian Zone conditions where they are found.

General habits.—Like most of the shrews, these more conspicuous saddle-backs are known mainly from specimens taken in traps set for small rodents under fallen grass in the meadows or under leaves and dense vegetation or old logs in the woods. Cold, damp places seem to be their favorite haunts in the southern part of their range, where the conditions of Boreal habitat are most nearly approached. These shrews are readily caught in traps baited with meat and set across the runways which they follow, but the few specimens taken indicate that they are by no means a common animal in this region. In food, habits, and habitat they seem not to differ from most of the other small shrews.

Neosorex palustris (Richardson)

Water Shrew; Marsh Shrew

Sorex palustris Richardson, Zool. Journ., vol. 3, p. 517, 1828.

Type locality.—Marshy places from Hudson Bay to the Rocky Mountains.
General characters.—Largest of the long-tailed shrews in the region, with tail about as long as body, hind feet, large and fringed for swimming; nose, long and pointed; eyes, minute, and ears hidden in the fur. Upper parts, vel-

vety black, with sometimes a trace of brownish or gray; underparts, silvery white, often clouded with gray or smoky. Measurements: Total length, 160 millimeters; tail, 70; hind foot, 20.

Distribution and habitat.—Specimens of water shrews collected at Fort Sisseton, just below the southeastern corner of North Dakota, and from Winnipeg, would imply that this species has a general distribution along the Red River Valley and in eastern North Dakota, although no specimens are at present available from the State. They belong to a wide-ranging group of species occupying the Canadian Zone practically across the continent from Nova Scotia to Alaska, but generally associated with the marshes of the forest region. The Fort Sisseton record is apparently the only outlying prairie locality for the species.

General habits.—Although named for the marshes where they are usually found, these shrews are more than palustrine in habits. As their structure indicates, they are expert swimmers and apparently spend much of their time and obtain much of their food in the water. At Elk River, Minn., where the writer collected them from 1884 to 1887, they were generally taken along the banks of the creek which flowed through the meadow. Traps set at little burrows under fallen grass on the creek banks, just above the edge of the water, would occasionally contain one of these shrews, and in winter a few were taken under the ice when the water had fallen and left an air space between two layers of ice. In no locality has the writer ever found them common, or in numbers sufficient to yield more than an occasional specimen among the many other shrews and meadow mice taken in the trap line. In the spring of 1886 a neighbor brought one that he had caught while it was swimming about in a small pond of snow water. He said it darted about through the water like a fish and when under the surface seemed coated with silver and even more fishlike. The stomachs and intestines of those taken are usually found to contain particles of insects and small animals so well masticated that the species are not easily recognized. Of the breeding and other habits little is known.

Microsorex hoyi hoyi (Baird)

Pigmy Shrew

(Pl. 20)

Sorex hoyi Baird, Mamm. North Amer., p. 32, 1857.

Type locality.—Racine, Wis.

General characters.—Smallest of all North Dakota shrews and until a slightly smaller and closely related species was discovered and described by Preble in 1910, from near Washington, D. C., it was credited with being the smallest mammal in North America. In general proportions it approaches *merriami* and *haydeni*, but averages a little smaller than either. Upper parts, sepia brown; underparts, ash gray; tail, somewhat bicolor, brown above, whitish below. Measurements of specimens from Elk River, Minn.: Total length, 81.7 millimeters; tail, 30.7; hind foot, 10.7; weight, 2.9 grams.

Distribution and habitat.—The pigmy shrew, with its several recognized forms, apparently fills the Canadian Zone across the northern part of the continent, but specimens are few and from widely scattered localities. The one record for North Dakota is based on a specimen found dead in a road on the north side of Devils

Lake in 1887. Unfortunately it was in such condition that only the skull could be saved; but it proves to be *Microsorex* instead of *Sorex personatus*, as given in the writer's report for 1887. With all the collecting since done in the State, it seems remarkable that no others have been taken. The nearest localities outside of the State from which specimens are recorded are the Red River Settlement (Winnipeg), Manitoba; and Elk River, Minn.

General habits.—Of the habits of these little shrews practically nothing is known except that they are caught in traps with other species in woods, clearings, or meadows. In Ontario, Miller (1897, p. 37) recorded them as invariably found in dry clearings and gardens.

Blarina brevicauda brevicauda (Say)

Short-tailed Shrew; Mole Shrew

(Pl. 20)

Sorex brevicaudus Say, Long's Exped. Rocky Mountains, vol. 1, p. 164, 1823.

Type locality.—West bank of the Missouri River, near Blair, Nebr.

General characters.—A large heavy-bodied shrew with the usual small eyes, sharp nose, concealed ears, and short tail. The fur is short, soft, and velvety, varying in color from glossy plumbeous to almost black, with underparts but slightly paler than the upper parts. The color is unmarked and almost uniform over the body. Measurements of adult male, from Wahpeton: Total length, 137 millimeters; tail, 30; hind foot, 17; of a female from same place: Total length, 136; tail, 28; hind foot, 16; measurement of a large male from Walhalla: 127, 25, and 19 millimeters, respectively; weight, 23 grams.

Distribution and habitat.—There are specimens of the short-tailed shrew from Wahpeton, Fairmount, Oakes, Valley City, Portland, Fargo, Harwood, Grafton, Pembina, Walhalla, Turtle Mountains, Sweetwater Lakes, and Fort Berthold. From a wide range over the Transition and Upper Austral Zones of the northeastern United States and eastern Canada, these large shrews reach their northwestern limit of range in North Dakota, extending commonly as far west along the stream and lake valleys as the eastern timber reaches. Over the open prairie and the drier western part of the State they seem not to occur, although an alcoholic specimen in the National Museum is supposed to have been taken in 1856 by F. V. Hayden, at Fort Berthold, on the Missouri River. At Wahpeton they were very common and a number were caught in traps set in meadow-mouse runways along the river and slough banks. At Hankinson the writer caught one in a patch of dense grass under a fence, but it was so badly damaged that it was not saved for a specimen. At Fairmount, Sheldon found them common along the river banks, where a number of specimens were taken. At Oakes he reported them as fairly abundant along the James River, where they were found in the damp soil along the banks of the stream and also in patches of snowberry bushes. At Larimore, in Grand Forks County, Kellogg reported them, but did not collect specimens; at Manvel he also reported them as found about old strawstacks; at Drayton, in Pembina County, he was told by the farmers that during harvest they were often seen under shocks of grain. In the Turtle Mountains, near Fish Lake, in Roulette County, the writer caught two in the woods, one in a damp place on low ground and another under an old

log near the lake shore. At the Sweetwater Lakes two specimens were taken in a dry marsh in the woods back of the lake shore, where they were living in the meadow-mouse runways under heavy fallen grass. At Portland Loring caught seven under logs and stumps in the woods.

General habits.—Most of our specimens were taken in mouse traps baited with small pieces of meat or set in runways where bait was not necessary. The shrews eat many of the mice caught in traps and often leave only a piece of skin and a few bones to show what the trap had caught. In such cases they soon return and are almost certain to get into the trap when it has been reset. They are savage little brutes and very strong and muscular for their size. When caught in small box traps or cans sunk in the ground, they are usually found dead after a few hours, apparently because they are unable to live without an almost constant supply of food. They are caught as readily in the daytime as at night, and at Wahpeton Kellogg watched one digging a burrow in the ground about noon. Usually, however, they are not seen except as caught in traps or uncovered in moving logs or hay or grain that has been lying long on the ground. They burrow through the mellow soil and make runways between the fallen grass and leaves and the surface of the ground. Usually they are in moist, rich places where insect life is abundant, and where they have an ample supply of food while well concealed from enemies whose eyes are keener than theirs.

Breeding habits.—Little is known of the breeding habits of these shrews, but an interesting note was obtained by Sheldon at Fairmount, where on old female, which contained nine embryos, was taken May 28. Immature specimens are often caught in traps, but the very young have rarely been found and little is known of the nest or home conditions.

Food habits.—Their principal food consists of insects, earthworms, mollusks, and the various forms of animal life found on or near the surface of the ground, but these shrews are always eager for any kind of fresh meat. They devour many more desirable species of small mammals caught in traps where their runways are located. The number caught in traps set for meadow mice suggests that they deliberately follow the mouse runways for the purpose of capturing their prey. Even if not able to catch and overpower the full-grown meadow mice, which are nearly twice their size, they will certainly catch, kill, and eat many of the young and immature individuals. Their stomachs and intestines are usually well filled with food, but are never found distended, as are those of rodents, especially mice, after hearty feeding. They are never fat and are active throughout the year, in winter evidently getting their food on or under the surface of the ground, although occasionally coming to the surface of the snow and making long lines of their peculiar little double rows of tracks. They burrow in and out of the snow at will and in midwinter are easily lured to a food supply of frozen meat placed under logs, hay, or fallen vegetation on the surface of the ground. When once in the habit of coming to a food supply they are easily caught in considerable numbers.

Economic status.—There are no injurious habits of any consequence chargeable to these shrews, although they often come into

cellars and storage places on the farm, and if meat or milk is left within their reach will gnaw and soil the meat and eat the cream around the edges of the milk pans. Conditions where they can do such mischief are, however, rare and unnecessary. Their destruction of insects and great numbers of worms and other small animals inhabiting the richest soils goes on continuously throughout the year and their destruction of small, injurious rodents is undoubtedly of great benefit to agriculture. While many of our small mammals must be considered enemies and destroyed in every possible way, fortunately some, as the shrews, may be classed as wholly beneficial and their presence welcomed on the farm. Of all the small mammals, perhaps the shrews with their voracious and often cannibalistic natures are least lovable, but they can all be accepted as very useful allies.

Order CHIROPTERA: Winged Mammals

Family VESPERTILIONIDAE: Common Bats

Nycteris cinerea (Beauvois)

Hoary Bat; Great Gray Bat

(Pl. 21, fig. 1)

Vespertilio cinereus Beauvois, Catal. Peale's Mus. [Philadelphia], p. 15, 1796.

Type locality.—Philadelphia, Pa.

General characters.—Teeth, 32; size, large; spread of wings, about 16 inches; ears, short and rounded with black naked rims; top of feet and tail membranes, furry; fur, full and soft; color, yellowish brown, frosted with white above and below; throat and wing linings, buffy. Measurements of adult male, from North Dakota specimen: Total length, 130 millimeters; tail, 60; hind foot, 13; forearm, 51.

Distribution and habitat.—From a wide Boreal range across the northern part of the continent and southward in the mountains, and a winter migratory range to the southern border of the United States, the big hoary, or gray, bats cover at one time or another all of North Dakota. They are undoubtedly far more common than the few scattered records seem to imply, as their nocturnal habits conceal them from common observation. In 1833, at Fort Clark on the Missouri River, Maximilian (Wied, 1839–1841, Bd. 1, pp. 403–404, 1839) collected an adult female, which he described in much detail as to the color and measurements. About 1861, F. V. Hayden (1875, p. 95) collected a specimen at Fort Union (now Buford) and reported them as found "all over the United States east of the Rocky Mountains." In 1887 the writer recognized one of these bats on the wing at Pembina, August 3, and saw several about the woods on the north side of Devils Lake, August 6, but obtained no specimens. A specimen from Minot, N. Dak., was recorded in the catalogue of the Field Museum. (Elliot, 1907, p. 514.) A specimen collected June 20, 1913, was sent to the Biological Survey for identification by Daniel Freeman, of the agricultural college at Fargo, and in 1914, Bell and the writer shot four specimens in the little forest area between the lakes on the Hankinson farm near Hankinson. At Wahpeton, in 1915, the boys described a large gray bat which they had found hanging in the leaves of a tree, which was undoubtedly this species. At

Grafton, Kellogg found one dead in a cow path, but it had been so trampled by cattle as to be worthless for a specimen. At Towner he reported two seen one evening and perfectly identified by their large size, but before he could get his gun they had disappeared.

General habits.—These great gray bats are powerful and rapid fliers; they usually appear rather late in the dusk of evening and are rarely noticed except by bat hunters. During the day they hang head downward in clusters of leaves, usually at the ends of branches of trees. This habit restricts them to the forested areas or to country about ranches, where they can find sufficient foliage for roosting sites. At the Hankinson ranch, where the fine old elms, oaks, ashes, basswoods, and boxelders form heavy foliage and deep shade, they were found to be one of the common species. As they darted swiftly across the narrow spaces between the trees, the collectors had much trouble in shooting four specimens among the considerable number of smaller bats taken during the twilight. Their large size, however, made it possible to obtain all of those killed, while many of the smaller bats were lost in the grass and weeds. Some of these specimens were evidently young of the year, but practically full grown, and probably were born in this particular grove, although strong enough to have flown from a considerable distance. These bats are migratory, and as the cold weather approaches and insect life becomes scarce they move southward at least to the southern border of the United States and probably beyond for the winter season. Their breeding range has not been well worked out, but apparently they breed mainly in the cooler zones of the Northern States, Canada, and the high mountain areas.

Food habits.—Little is known of the food habits of the hoary bats except that they are insectivorous and capture their prey on the wing in swift zigzag flight, most baffling to the collector. At times they seem to be gleaning among the branches of the trees and at other times they circle high over the forest, apparently snapping up the insects that swarm far overhead.

Breeding habits.—The specimen collected at Fort Clark by Maximilian on June 12, 1833, was an adult female containing two large well-developed embryos, which he describes as quite naked, with wings folded over their noses. The specimen from the agricultural college was a female taken June 20, 1913, which contained two large embryos, now also preserved in alcohol. Other specimens have been recorded containing two embryos, and mother bats have been shot while flying about in the evening with two young clinging to their sides. There are two mammae close together on each side of the breast, located in a subaxillary position, and when the mother hangs head downward in the foliage they are just above the two fur-lined cradles formed by the hollows of her folded wings. Apparently the young cling to the body of the mother during her flight and are thus always with her until old enough to use their own wings. The young are surprisingly large at birth and it seems probable that they grow rapidly and do not long burden the parent. If born after June 20 and practically full grown by July 22, their growth and development must be very rapid.

Economic status.—Besides being in every way harmless and unobjectionable, these bats are, through their insectivorous habits, of un-

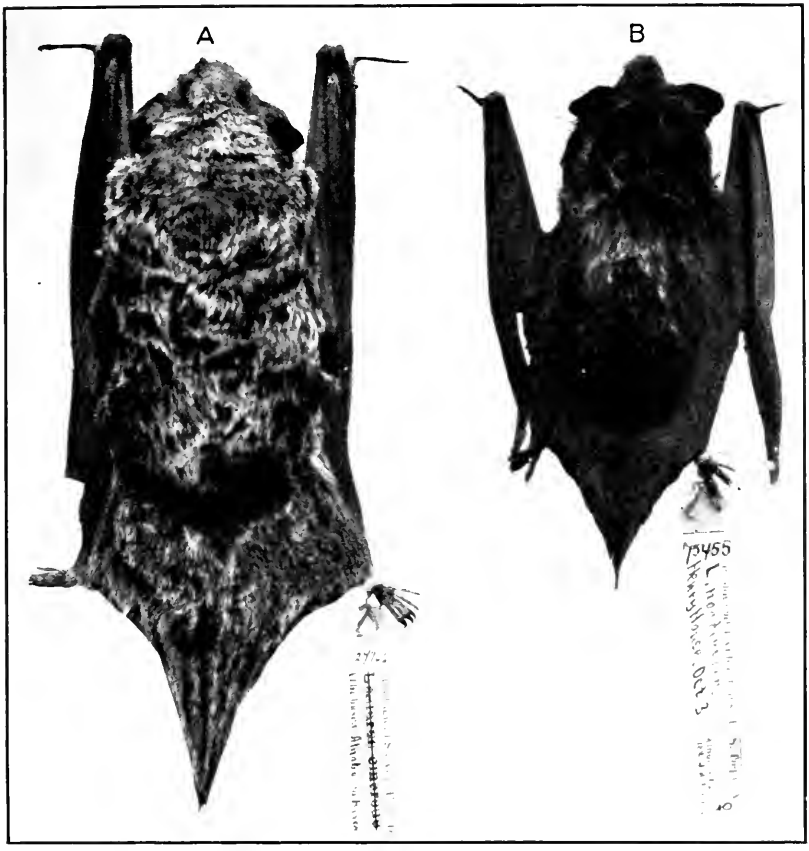


FIG. 1.—(A) HOARY BAT (NYCTERIS CINERIA); (B) SILVER-HAIRED BAT (LASIONYCTERIS NOCTIVAGANS)

About two-thirds natural size

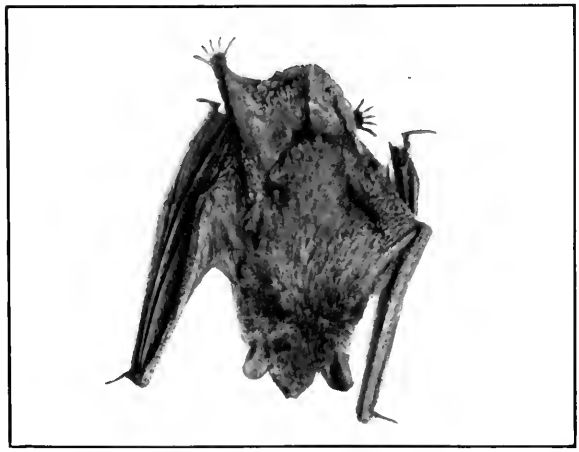


FIG. 2.—SAY BAT (MYOTIS SUBULATUS SUBULATUS)

About two-thirds natural size

questionable value to man. The extent of their destruction of nocturnal pests and their importance to the welfare of the forests and other products of the country will not be known until a thorough study of their food has been made.

Nycteris borealis borealis (Müller)

Red Bat; New York Bat

Vespertilio borealis Müller, Natursyst., Suppl., p. 20, 1776.

Type locality.—New York.

General characters.—Teeth, 32; size, medium; expanse of wings, about 12 inches; ears, short and rounded, mainly naked inside and on rims; top of tail membranes and feet well furred; color, bright rusty or pinkish yellow with slight frosting of white over back and breast. Measurements of large female, from Grinnell, N. Dak.: Expanse, 330 millimeters; length, 117; tail, 52; hind foot, 10; forearm, 41; a smaller female from the same place measures 298, 104, 45, and 9, millimeters.

Distribution and habitat.—There are specimens of the red bat from Devils Lake, Grinnell, the Yellowstone River (probably Buford), and "Chantee Hills." At Wahpeton some boys reported that they often found a very pretty red-colored bat hanging in the plum trees when they were gathering plums. Across the river from Fargo, Murie often found them hanging in plum trees in July and August, and Williams has one taken near Grafton on August 23, 1919. At Hankinson these yellowish-red bats were accurately described and were said to be often found hanging in the leaves. At Stump Lake, where the wind blew so incessantly that the writer was not able to get any bats, people said that two kinds were found, one red and the other dark brown. At Beaver Creek, 4 miles west of Grinnell, where the Missouri makes its first big bend to the southward, Kellogg reported red bats common in the woods and found two hanging in the leaves of branches. The "Chantee" or "Chartee" Hills the writer has not been able to locate; and another specimen collected by Hayden has no positive locality other than the Yellowstone River. The red bats are abundant over the eastern United States, mainly in the Austral Zone, and the few specimens from North Dakota may be wanderers after the breeding season or scattered individuals beyond their normal breeding range.

General habits.—At least in the northern part of their range these bats are migratory and with the beginning of cold weather move southward until suitable hibernation quarters or a comfortable climate and an ample food supply are found for the winter. In the daytime they hang head downward among the leaves of trees or bushes. In July, 1887, in a little grove on the north side of Devils Lake, the writer picked five specimens from the leaf clusters of box-elder trees, where they were hanging at about the height of the head above the ground. They were well concealed by the leaves, but after the first one was noticed there was no trouble in finding others. Their bright yellow color contrasted sharply with the dark green foliage.

In places where common these bats often come out of their diurnal roosts rather early in the dusk of evening and occasionally one is seen flying about on a cloudy day or even in bright sunlight, doubtless when it has been disturbed or the sunlight has penetrated to its

sleeping quarters. They have a quick and erratic flight and when darting back and forth among the trees in the dusk of evening are no easy target for the shotgun. As most of the specimens are obtained by evening shooting, it is not so remarkable that they are scarce in collections even where fairly common outside.

Food habits.—Little is known of the food habits of the red bat, except that it seems always busy catching insects while on the wing, and the stomachs of those collected for specimens are usually distended with a mass of finely masticated insects of great variety, mainly unidentifiable.

Eptesicus fuscus fuscus (Beauvois)

Large Brown Bat

Ágráphiga of the Mandans; *Ishwatáshia* of the Hidatsas; *Hupáhuwakí'kadakena* of the Dakotas (all, Gilmore).

Vespertilio [sic] *fuscus* Beauvois, Catal. Peale's Mus. [Philadelphia], p. 14, 1796.

Type locality.—Philadelphia, Pa.

General characters.—Teeth, 32; size, rather large; expanse of wings, about a foot; ears, prominent and pointed; membranes of ears, wings, and tail, naked; fur, long and lax; color, glossy light hair-brown, slightly paler below; ears and membranes, black or blackish. Measurements: Spread of wings, 324 millimeters; total length, 117; tail, 50; foot, 11; forearm, 44.

Distribution and habitat.—A series of five specimens of these large brown bats taken by Kellogg at Grinnell (where the Missouri River turns southward), August 29 and 30, 1915, and six taken by Sheldon at Cannon Ball, September 2, 1915, give, for the first time, a good representation of this species from the State. The old specimen collected by Hayden at "Fort Union, Nebr." (now Buford, N. Dak.), about 1861, was the only certain previous record on which to admit the species to the State list, although Maximilian in 1833 recorded what was probably this species under his *Vespertilio ursinus*. In 1912 Kellogg also reported two skins seen in the State university collection, taken at Stump Lake. At Grafton, Williams reports having killed a large brown bat a number of years ago, but no later records have been obtained. At Hankinson, in 1912, the writer saw several bats which he believed to be the species flying among the trees, but did not obtain a specimen. One was also recognized in the evening at the Sweetwater Lakes, but not procured. At Buford, in 1910, Anthony shot a large brown bat that he supposed to be of this species, but it fell in the brush on the river banks and could not be found. Having a transcontinental range extending north into the edge of the Boreal Zone, these bats undoubtedly cover the whole of North Dakota in considerable numbers. The specimens from Grinnell and Cannon Ball are decidedly pale and appear to be shading toward the western form, *Eptesicus fuscus pallidus* Young, but are not sufficiently marked to be referred to it.

General habits.—At Cannon Ball Sheldon found these brown bats between the walls of old buildings, and specimens taken 4 miles west of Grinnell by Kellogg were found around a house in the Badlands. Like many other species of bats, they spend the daylight hours hidden away in cracks and dark cavities in walls, roofs, or cornices

of buildings, in hollow trees, under bark, and less commonly in the clefts of rocks. In the rather late dusk of evening they come out and after quenching their thirst at the nearest pond or stream begin their nightly hunt for winged insects. Usually they are found flying rapidly about buildings and trees or through the open spaces in forests and groves. Their flight is swift and erratic as they snap up one flying insect after another, and it is only an occasional specimen that can be brought down with fine shot as they zigzag against the twilight sky. Where they are at all common, bat shooting may become very exciting, both from the effort and dexterity required to bring down specimens and also from the possibility of getting rare species. In some places only one species will be abundant, while others are rare or entirely absent, and in other localities several species and genera will be found equally abundant and hunting over the same ground.

Hibernation.—In fall these large brown bats become excessively fat, with a heavy layer of very oily tissue lying under the skin and filling the body cavities. Although probably in part migratory, they seem to hibernate throughout their range, disappearing with the first frosty nights, occasionally reappearing on warm evenings, but again entering their permanent hibernation before the real cold weather begins. They crawl away into the cracks and walls of buildings or any sufficiently sheltered place where they can spend the winter without too much exposure to cold. Occasionally during the most severe weather, when houses are overheated, some of these bats are roused from their winter sleep in the walls and appear inside the rooms, flying about in good condition, apparently under the misapprehension that summer has arrived. Such specimens are usually found to be exceedingly fat, but with empty stomachs. In spring they are one of the first bats to appear with the warm days, the time of beginning plant and insect activity.

Migration.—To what extent these bats migrate is not known, but like other species they probably make considerable flights to and from their favorite winter quarters. In the mountains, where they range high in the Canadian Zone late in summer, they undoubtedly return to lower milder levels to find winter quarters. It is doubtful whether an extensive north-and-south migration is common to the species.

Breeding.—The mating season is late in July or early in August, and the young are born in June of the following year. In June the males and females are usually found in separate localities or, if in the mountains, at different levels. By June 20, females are usually found carrying one or two large embryos, which at birth are very large for the size of the parent. The two mammae are located on the sides back of the wing bases, so that when the mother hangs head downward the suckling young are neatly cradled in the fold of the wing. As with other species of bats, the young are probably carried clinging to the mother's body until able to fly and catch their own food. Their development is evidently rapid, for by July 26 the young are flying, and immature specimens have been collected as early as July 24.

Food habits.—Not much is known of the species of insects on which the brown bats feed, but there seems always to be an abundant sup-

ply, and soon after the bats have begun flying their stomachs are found distended with a finely ground mass of insect remains. In some localities traces of various beetles are detected in the stomachs. Little is known of the species but it is certain that a vast number of insects are consumed by each bat.

Economic status.—The comparative value of different species of bats can not be determined until their food habits have been thoroughly studied and their choice of food and the species of insects consumed more fully determined. In general, however, their usefulness can be well compared with that of insectivorous birds, for many of the most destructive insects are active only at night and if by day they escape the birds, they are devoured in millions by these aerial guardians of the night.

Lasionycteris noctivagans (LeConte)

Silver-haired Bat; Silvery Bat; Black Bat

(Pl. 21, fig. 1)

V[*espertilio*] *noctivagans* LeConte, Cuv. Anim. Kingdom, McMurtrie ed., vol. 1, p. 431, 1831.

Type locality.—Eastern United States.

General characters.—Teeth, 36; size, medium; spread of wings, about a foot; ears, medium, nearly quadrate, about as broad as long, naked; upper base of tail membrane, hairy; fur, long and soft; color, dark brown, sooty, or black with white-tipped hairs over back and belly; ears, wings, and feet, sooty or black. Measurements of adult female, from Grafton: Spread of wings, 301 millimeters; total length, 105; tail, 42; hind foot, 9; forearm, 42.

Distribution and habitat.—With a breeding range apparently over the Transition and Canadian Zones across the continent, these bats cover at least all the forested parts of North Dakota during the breeding season and the months of greatest insect activity. There are specimens from Fort Union, Bottineau, Minot, Fargo, Grafton, and Stump Lake. A specimen in the National Museum, collected by F. V. Hayden at Fort Union, has no date but was entered in the catalogue in 1863. On August 23, 1887, the writer found two of these bats under a piece of loose bark on a dead tree in the edge of the Turtle Mountains near Bottineau. On May 12, 1913, Williams took an adult male at Stump Lake; and on July 22, 1915, he collected a less than half grown young at Grafton. It was brought to him alive, and flew about the room before it was killed. An adult female was taken by Kellogg in a pile of fence posts at Grafton on June 11, 1915, and one recorded in the Field Museum catalogue was taken by W. E. Snyder at Minot. A specimen sent to the Biological Survey for identification by Professor Freeman, of the agricultural college, was collected on September 12, 1914. At Wahpeton the writer was told that a black bat was found there. These meager records for the State do not so much indicate the rarity of the species as the difficulty of obtaining specimens and information regarding the habits of a strictly nocturnal species which can not be caught in traps. In reality, these bats are probably common at one season or another in every patch of woods over the State.

General habits.—More than most species the black bats are forest dwellers, apparently very largely depending on the cover of loose

bark and hollow trees for their diurnal roosts and keeping mainly among the trees in their nocturnal flight. They usually appear rather late in the evening and, after quenching their thirst at the nearest water, begin their rapid flight between and around the branches of trees. The lateness and swiftness of their flight render them especially difficult to shoot and apparently as many specimens are picked up in their hiding places as are obtained with the shotgun.

Food habits.—Like other bats, they are eager in their pursuit of night-flying insects, but the particular species chosen or rejected are not known. Their habit of hunting among the trees would indicate their especial value in forest protection.

Breeding habits.—The mammae in these bats are one pair, arranged on the sides just back of the wing base. The young, as indicated by embryos, are usually two, but sometimes only one. The female taken by Kellogg at Grafton on June 11 contained two embryos, and the young taken by Williams on July 22 was apparently not more than 2 or 3 weeks old. In his Mammals of the Adirondack Region, New York, Merriam (1884, p. 190) states that females killed during the latter part of June were heavy with young, and that up to July 1 not one had given birth to offspring, but that all killed after July 4 were then suckling their young. He also records the discovery of an old crow's nest which contained embedded in the sticks and litter 13 young bats, with their eyes not yet open. Although not positively identified, they were supposed to be the young of this species. Merriam also says that these bats begin to fly when 3 weeks old, those killed on the first evening weighing only about half as much as their parents.

Migration and hibernation.—The black bat is one of the species with a well-established record for migration, appearing in fall and winter far south of its summer range and possibly moving far enough south to avoid the necessity of hibernation. More probably, however, it is prepared to creep away under cover and become dormant for a period of cold weather and scant food supply even in the southern part of its winter range. As with the hoary bat, its migratory habits may well explain the uniformity of characters of the species over a wide range across the continent.

Myotis lucifugus lucifugus (LeConte)

Little Brown Bat

V[espertilio] lucifugus LeConte, Cuv. Anim. Kingdom, McMurtrie ed., vol. 1, p. 431, 1831.

Type locality.—Georgia; probably Riceboro.

General character.—Teeth, 38; size, very small with small, pointed, naked ears, which laid forward, do not reach to the tip of the nose; wing and tail membranes, naked and dark brown; fur, soft, glossy hazel brown, bright buffy below. Measurements by Doctor Mearns of specimen from Fort Snelling, Minn.: Expanse, 260 millimeters; total length, 94; tail, 41; hind foot, 9; forearm, 38; ear from notch at base, 13 millimeters. A very fat male at Elk River, Minn., measured as follows: Expanse, 260; total length, 96; tail, 37; and hind foot, 10 millimeters, and weighed 12.68 grams.

Distribution and habitat.—The little brown bats with their several subspecies cover all but the extreme northern part of North America, but the ranges of the different forms have not been determined and are somewhat indefinite. The type species, *lucifugus*,

covers the eastern United States and apparently reaches its western limit in eastern North Dakota, grading into *carissima* toward the western part of the State. The only specimens that seem to be typical of this little dark form are from Hankinson and Fargo, although specimens from Stump Lake, Devils Lake, and Esmond Lake are evidently intermediate in character and could be referred to either *lucifugus* or *carissima*. Those from the western part of the State at Towner, Goodall, Cannon Ball, and Bismarck are referred to *carissima*, although not fully typical of that paler western form. Apparently one form or the other is common all over the State wherever there are buildings, water, and mosquitoes, without much regard to timber.

General habits.—The little brown bats are mainly cave, cliff, or house dwellers, spending the daylight hours hung up in dark crevices, caverns, and rooms, where well protected from the daylight. From their dark retreats they come out at the dusk of evening and after visiting the nearest open water, where their thirst can be quenched as they skim over the surface, they begin hawking after insects, around and around the buildings, under and among the branches of the trees, or over the ponds and marshes wherever insect life is abundant. If the wind is blowing, the bats work in the shelter of buildings or trees or get inside of buildings where insects also take refuge from the wind. They are quick, crooked fliers and by no means an easy mark for the collector, unless they can be silhouetted against the western light for sufficient distance to allow time for a double shot. At Hankinson this seemed to be the most common of the small bats that flew in considerable numbers about the buildings on warm evenings, and the fact that few specimens were taken was due to the limited spaces between the buildings and the treetops. Near Fargo they were numerous over the surface of the river in the evenings, but were usually flying so low among the trees that no clear shots could be obtained against the light portions of the sky. After drinking, they usually left the river to circle about the buildings in town or on the farms, where shooting was not permitted. It is always a great exasperation to a field naturalist to see unknown species of bats circling about buildings and over the streets of towns where he can have no hope of obtaining specimens unless one strays into his room at night and can be captured with a towel. Occasional specimens are thus obtained, but in most cases our meager information of the distribution and habits of bats is very slowly accumulated.

Breeding habits.—In these bats the embryos are usually, and perhaps always, one, and the single pair of mammae are on each side back of the wing bases. Of the habits and care of the young so little is known that a most interesting field for close observation remains almost untouched.

Food habits.—About the buildings where these bats are usually most numerous the insect life often seems to consist largely of mosquitoes, flies, and nocturnal beetles and moths. The actual species eaten are not well known, but the bats are certainly industrious gleaners and in a few minutes after they have begun to fly their stomachs are found filled to capacity.

Myotis lucifugus carissima Thomas

Yellowstone Bat

Myotis (Leuconoe) carissima Thomas, Ann. and Mag. Nat. Hist., vol. 13 (ser. 7), p. 383, 1904.

Type locality.—Yellowstone Lake, Yellowstone National Park.

General characters.—Teeth, 38; about the size of typical *lucifugus;* ears, small and pointed; fur, glossy; colors, light hazel brown above, buffy below; ears and membranes, dark brown or blackish; tail membranes, edged with gray; young of the year, darker, without gray edges on tail membranes. Measurements of typical specimen, from Yellowstone Park: Expanse of wings, 260 millimeters; total length, 94; tail, 40; hind foot, 10; forearm, 38.

Distribution and habitat.—This northern Rocky Mountain form of *Myotis* ranges at least from western Montana to the Black Hills and over western North Dakota. Specimens from Towner, Goodall, Bismarck, and Cannon Ball, while not typical, are nearer this species than to the eastern little brown bat, while some of those from the Devils Lake country show intermediate characters. Apparently the intergradation between the two forms is gradual across the middle part of the State.

General habits.—On the Mouse River, 8 miles north of Towner, Kellogg collected 28 specimens of these bats on August 2, 1915. They were found behind a barn door and all of the 9 adults were females; of the 17 dark-colored but full-grown young of the year, 8 were males and 9 females. This was evidently a breeding colony from which the adult males were keeping a respectful distance. On September 4 Kellogg collected an adult male at Goodall, at the edge of the forest along Antelope Creek. At Fort Totten on July 15 he collected a male at the edge of the forest and on July 17 a female as it was flying around buildings in the evening. On November 19, 1919, Russell Reid found one dead hanging on the wall of a house in Bismarck. It evidently had been dead for some time, as the temperature had been 10° F. as early as October 26. At Cannon Ball, on August 20, Sheldon collected four adult females, part of them in the eaves of an old building, while others were shot in the evening as they flew about, after it had become so dark that it was hard to find them. In the Yellowstone Park, where the subspecies was first discovered, they occupy a large warm cave, called the Devil's Kitchen, in great numbers through the summer, but apparently leave for cooler caves in which to hibernate during the cold season. In the Bitterroot Valley, western Montana, a large breeding colony was found in a bridge over the Bitterroot River; they returned each spring from their winter quarters and many of the old and young were taken for specimens.

Breeding habits.—In a large number of specimens examined only one embryo was found in each. The mammae, as in other species of the genus, are two in number, one on each side back of the wing base. Little is known of the breeding habits other than that some females were shot while flying about with the young clinging to them, and others collected had evidently left the young at home while hunting for their food.

Migration and hibernation.—In fall these bats disappear with the first cold nights and consequent reduction in the abundance of insect life. Some may hibernate in buildings, but apparently most of them resort to caves, the location of which they seem to be

familiar with, and here they hang during the winter and remain dormant in the cool, but not freezing, air. In a level prairie country like North Dakota, it may be necessary for them to make long journeys in search of winter quarters, but their migration is as imperfectly known as their other habits.

Myotis subulatus subulatus (Say)

Say Bat

(Pl. 21, fig. 2)

V[espertilio] subulatus Say, Long's Exped. Rocky Mountains, vol. 2, p. 65, 1823.

Type locality.—Arkansas River, near La Junta, Colo.

General characters.—Teeth, 38; small and very similar in appearance to *lucifugus*, but readily distinguished by its longer ears, which reach, when laid forward, well beyond the tip of the nose. From the larger-eared *evotis* it is distinguished by darker color of fur and narrower, more pointed ears; ears and membranes, naked and dark brown; fur, soft and lax; color, yellowish-brown, slightly paler below. Measurements: Expanse of wings, 247 millimeters; total length, 95; tail, 41; hind foot, 9; forearm, 37; ear from notch at base, 16.

Distribution and habitat.—Miller gives the range of the Say bat as North America, east of the Rocky Mountains, but its distribution is irregular; and although abundant in many places, it is often locally scarce, or absent. Over a wide strip of prairie country from the Gulf of Mexico to Manitoba there are very few records of its occurrence, while to the eastward and westward in rough country where caves are more numerous, the map shows many records. The only specimens from North Dakota are a few collected long ago and labeled "Fort Union," "Fort Buford," or the "Upper Missouri." These few, collected by Hayden, Carpenter, and Rothhammer, are in the National Museum collection. Specimens have been taken south, west, and east of the State and may be found at any locality over it, but they are more likely to be found in the western Badlands country in close proximity to cliffs and caves. Their presence near Buford is probably accounted for by the many little caves or openings in the rocky cliffs bordering the Missouri Valley. Some of the many small bats seen along the Little Missouri at Medora, and others along the river south of Bullion Butte, may also have been in part of this species. They are known to roost and hibernate in caves, but of their specific habits our knowledge is very indefinite.

Breeding habits.—Examination of females taken for specimens indicates two as the usual number of young of this species, although the mammae are of the same number and position as in other species of the genus *Myotis*, one on each side back of the wing base.

Myotis evotis (H. Allen)

Little Long-eared Bat

Vespertilio evotis H. Allen, Monogr., Bats North Amer., p. 48, 1864.

Type locality.—Monterey, Calif.

General characters.—Teeth, 38; size rather small; ears, strikingly large, naked, black; wing and tail membranes, dusky or black; fur, soft and lax; color, glossy buffy yellowish above, buffy or whitish below. Measurements of an adult male taken near Grinnell by Kellogg: Expanse of wings, 292 millimeters; total length, 90; tail, 42; hind foot, 9; forearm, 39; ear from notch at base (measured dry), 18.

Distribution and habitat.—The little long-eared bat is found in western United States and Mexico, mainly in the Austral and Transition Zones. A single specimen from Beaver Creek, 4 miles west of Grinnell, is the only record of the species for North Dakota and this is a considerable extension of its known range eastward, Loveland, Colo., being its previously known easternmost locality. The specimen, an adult male, found by Kellogg in his room on August 26, 1915, was clinging to the side of a smooth plastered wall. It may represent a stray wanderer in this Badlands region of cliffs and caves, or it may have been within the regular range of the species. If the latter is the case, additional specimens should be obtained from other places.

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No. 27. A Biological Investigation of the Athabaska-Mackenzie Region. By Edward A. Preble. Pp. 574, pls. 25 (incl. 4 maps), figs. 16. 1908--*Price, $1.25*

No. 28. Revision of the Mice of the American Genus *Peromyscus*. By Wilfred H. Osgood. Pp. 285, pls. 8 (incl. 1 map), figs. 12 (maps). 1909-[*Out of print.*]

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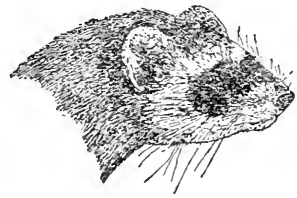

REVISION OF THE AMERICAN LEMMING MICE

(Genus SYNAPTOMYS)

BY

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REVISION OF THE AMERICAN LEMMING MICE

(GENUS SYNAPTOMYS)

By A. BRAZIER HOWELL

INTRODUCTION

The genus Synaptomys, comprising those rodents generally known as lemming mice, is confined to North America and is most closely related to the true lemmings, genus Lemmus of the section Lemmi, subfamily Microtinae. The present revision, based chiefly upon the material in the Biological Survey collection, was undertaken early in 1923. Care has been taken to present all available information that should prove of real help to students, without the inclusion of minute descriptions and unnecessary details.

GEOGRAPHIC DISTRIBUTION OF SYNAPTOMYS

The genus Synaptomys is locally distributed throughout most of the Hudsonian and Canadian Zones of Canada; it enters the United States in the extreme northwestern portion, and eastward is found sparingly throughout the Canadian and in the humid sections of the Transition and certain parts of the Upper Austral Zones, south into Arkansas, Tennessee, and North Carolina. (Fig. 1.)

HABITS

Synaptomys is not common in collections, but it is by no means certain that it is not more numerous in nature than is generally supposed. Except in a very few places, or in years of unusual abundance, lemming mice have proved exceedingly difficult to obtain in numbers. Because they are usually confined to bogs and tracts of swampy land, they are rarely if ever of economic importance.

The habits of lemming mice are almost unknown. The members of the genus Synaptomys belong at the present day definitely to a boreal fauna, and in the north, although usually found in moist situations, they also occur in dry patches of grass and other low cover, as well as in bogs. In the districts farther south, however, they have evidently been able to survive only because of the presence of occasional cold sphagnum bogs, to which they are almost entirely confined in the lower latitudes of the Eastern States. Near Lake Drummond, Va., however, and at Horseshoe Lake, Mo., in Indiana,

and at several other places the genus has been found in grassland, both moist and dry.

Observations on food habits have been confined practically to the recording of the presence of cut green grasses in the runways, but judging from the habits of related rodents, these animals may occasionally feed upon a variety of bulbs and even insects, as well as succulent herbage. Examination in the Biological Survey of 11 stomachs from Kansas and 1 from Minnesota also showed contents of finely ground grass and sedge leaves and a few insignificant traces of other green vegetation. Further observations on the food habits of Synaptomys are greatly needed.

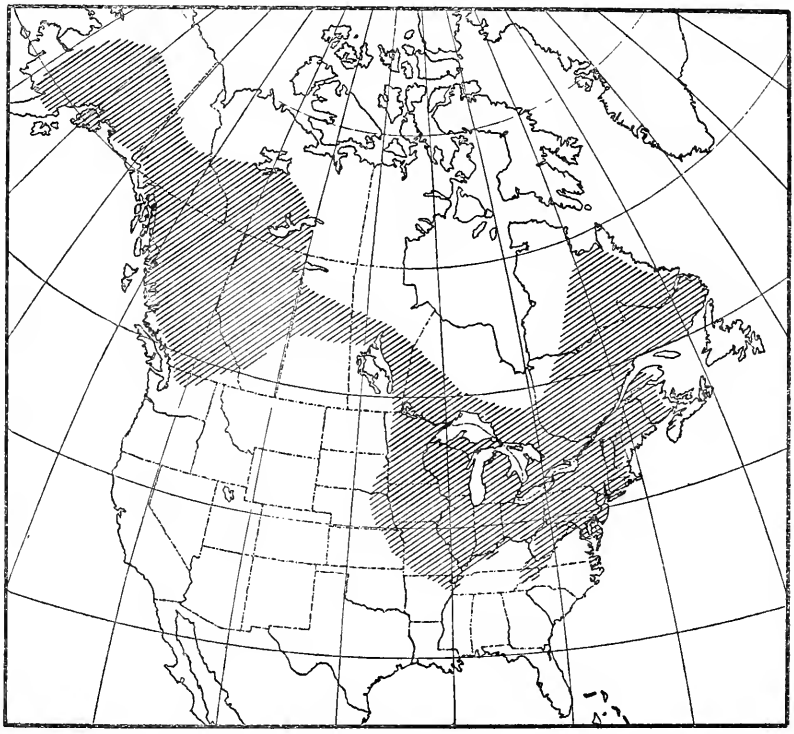

FIG. 1.—Approximate distribution of the genus Synaptomys

Well-defined runways are maintained, and burrows are constructed in the ground or through beds of sphagnum. Nests are occasionally placed in tussocks of grass or amid other surface cover, according to published reports (Hahn, 1909a, p. 570).[1]

Collectors, mostly those of the Bureau of Biological Survey, have trapped females containing from four to six embryos, from March 11 to October 7. This indicates that litters are only of moderate size. Probably several litters are borne each year, the period of greatest reproductive activity being largely confined to the warmer months.

[1] Literature citations in parentheses refer to the bibliography beginning on page 31.

MATERIAL EXAMINED AND DESIRED

The present revision is based on a study of 593 specimens, chiefly in the United States National Museum, in which are all the specimens listed for the various groups, unless otherwise stated.[2] In the case of most of the races here recognized, the material is adequate, but some of the type specimens present problems. Of the 15 forms that have been named, the types of 7 are markedly unsatisfactory, being skulls without skins or skins with fragmentary skulls, and the types of 3 others are immature. In addition, topotypes of several have never been collected.

Need for additional material.—Lemming mice are so rarely obtained that collectors are likely to seek them whenever possible. Further material from certain critical localities is badly needed, however, and it is hoped that field parties will make special efforts to procure such desiderata. Until more specimens are obtained further progress in the proper understanding of the relationships of several races can hardly be expected.

Specimens of the subgenus Synaptomys are most needed from the area immediately north and west of the Great Lakes, southwestern South Dakota, Arkansas, and all the New England States. In addition, more material illustrating various degrees of intergradation between *Synaptomys c. cooperi* and *S. c. stonei* is much to be desired.

Specimens of the subgenus Mictomys are greatly needed from the vicinity of Fort Chimo, Ungava, and the coast of southern Labrador, and nothing is known with certainty regarding the subgenus in the interior of eastern Canada as far west as Lake Winnipeg. Specimens from immediately south and west of Hudson Bay might prove exceedingly important.

Because of excessive cranial variation among the few adult topotypes of *Synaptomys b. borealis*, more material should be had from the vicinity of Fort Franklin, Mackenzie, as well as from one or two points between that place and the Yukon boundary. Topotypes of *S. b. dalli*, from Nulato, Alaska, and from the lower stretches of the Yukon River are greatly desired. Special search should be made for the genus in southwestern British Columbia and extreme northwestern Washington, and intensive trapping in the sphagnum bogs at the base of the Olympic Peninsula of the State of Washington is desirable.

EXPLANATIONS OF MEASUREMENTS AND COLOR TERMS

All measurements given are in millimeters. With the exception of the type of *Synaptomys b. innuitus*, all external measurements listed were taken by collectors in the field from specimens in the

[2] For unrestricted access to the collections under his charge, the writer is much indebted to G. S. Miller, jr., of the U. S. National Museum. For the loan of pertinent material thanks are tendered the Museum of Vertebrate Zoology (18 specimens), through Joseph Grinnell; the American Museum of Natural History (103 specimens), through H. E. Anthony; the Field Museum of Natural History (28 specimens), through W. H. Osgood; the Museum of Comparative Zoology (23 specimens), through G. M. Allen; the Royal Ontario Museum of Zoology (2 specimens), through John R. Dymond and L. L. Snyder; the National Museum of Canada (24 specimens), through R. M. Anderson; the Provincial Museum (1 specimen), through Francis Kermode; the Academy of Natural Sciences of Philadelphia (26 specimens), through Witmer Stone; Washington State College (12 specimens), through W. T. Shaw; G. L. Kirk, Rutland, Vt. (1 specimen); W. E. Saunders, London, Ontario (10 specimens); Charles F. Batchelder, Cambridge, Mass. (7 specimens); and Donald R. Dickey, Pasadena, Calif. (8 specimens).

flesh. For the reason that there is usually slight difference in external size (and such as is indicated by the figures is often not substantiated upon direct comparison of the specimens), the importance of field measurement is not stressed.

The following measurements of adult crania were taken by the writer with vernier calipers registering in tenths of a millimeter:

Condylobasilar length.—Distance from the posterior border of the condyle to the posterior edge of the alveolus of the incisor on the corresponding side of the skull.

Rostral length.—Distance measured from a line passing through the anteriormost portions of the zygomatic process of the maxillae to the anterior tip of the nasals.

Rostral breadth.—Greatest breadth of rostrum measured across anterior borders of the anteorbital foramina.

Interorbital breadth.—Shortest distance between the orbits.

Zygomatic breadth.—Distance across the zygomatic arches at their widest point.

Lambdoidal width.—Greatest width of posterior portion of cranium measured across the lambdoidal ridges.

Incisive foramina.—Greatest length of incisive foramina.

Height.—Height of skull measured from a plane passing from the inferior surface of the bullae to the crown of the third molar.

Color terms.—Because of the mixture of shades to be found in any one specimen of lemming mouse, such color names as are applied, including those of Ridgway,[3] must be considered only approximately correct. For the same reason minute color descriptions of the different races are not included in the present work.

Genus SYNAPTOMYS Baird

Synaptomys Baird, Mamm. North Amer., p. 558, 1857. Type, *Synaptomys cooperi* Baird.

HISTORY

The genus Synaptomys was described and named by Baird in 1857, but material accumulated very slowly, and for many years each instance of the discovery of the genus in a new locality was recorded over and over again. The first species of lemming mouse described was *borealis*, by Richardson in 1828, but it was referred by him to the genus Arvicola [=Microtus], and for a long time its proper relationship was a puzzle to systematists. In fact, it was not until 79 years after this specimen was named that the fragments of the skull were removed from the skin and the generic affinity definitely established.

When Baird named Synaptomys he also described the species *cooperi*, which he made the generic type, but unfortunately his single imperfect specimen was from an unknown locality. The race *gossii* was designated by Coues in 1877, but without a description, and only a list of measurements saved the name from becoming a nomen nudum. It was not until 19 years later that a description of this Kansas race was published, by Merriam, who selected a skull without skin as the type, none having been designated by Coues.

[3] RIDGWAY, R. COLOR STANDARDS AND COLOR NOMENCLATURE. 43 p., illus. Washington, D. C. 1912.

Rhoads described *stonei* from New Jersey in 1893; and in the following year True named *innuitus* from Fort Chimo, Ungava, the type being an alcoholic specimen. Merriam named *helaletes*, *dalli*, "*truei*," and *wrangeli* in 1896, only the first one of which was described from a first-class adult specimen; in the same year Bangs characterized "*fatuus*." *S. sphagnicola* Preble, from New Hampshire, appeared in 1899, and *medioximus* Bangs, from Labrador, a year later. Preble described "*bullatus*" from the Mackenzie region in 1902, but the determination of the generic identity of Richardson's type of *borealis*, confirmed by the capture of a series of specimens at the type locality by Preble in 1903, relegated this name to synonymy. Finally, "*andersoni*" and *chapmani*, both from British Columbia, were described by Allen in 1903.

True in 1894 proposed Mictomys as a full genus, but the degree to which it differs from Synaptomys is certainly not greater than subgeneric, judged by present standards. Two years later Merriam (1896) revised the genus, recognizing eight of the nine forms that had at that time been named, but, with few exceptions, his material was scanty and unsatisfactory. For other history of the subject perhaps mention need here be made only of Genera and Subgenera of Voles and Lemmings, by Miller (1896).

The last new race of this genus was proposed just 20 years before the present study was undertaken, and the material subsequently accumulated has not justified the naming of another. Of the 15 races thus far named—all but one of them as full species—11 are now recognized as valid under the two species, *S. borealis* and *S. cooperi*, the remaining four ("*truei*," "*fatuus*," "*bullatus*," and "*andersoni*") being placed in synonymy. The subgenus Synaptomys here comprises the races of *S. borealis* and the subgenus Mictomys the races of *S. cooperi*.

PROBABLE RELATIONSHIPS

No fossil remains of the genus Synaptomys have been found either in this country or abroad, as far as known, so it is of little use to speculate as to where it originated. As it is now confined to the New World, it is at least fairly certain that it is a product of North America, but all the evidence does not necessarily corroborate such a hypothesis. Late in Tertiary and possibly even early in Quartenary times the lemmings are believed not to have been so strictly confined to a boreal habitat as at present. In those days, before the appearance of many of the higher and more adaptable species of the Microtinae (at least in western Europe and possibly in America as well), they encountered milder competition, but at present they have mostly retired into habitats to which Microtus is not so partial.

That Synaptomys as a genus, but not necessarily as individuals, is adaptable in some respects is indicated by the considerable variety of habitats in which it occurs throughout its range. The evidence at hand, however, indicates that it has a marked intolerance for the immediate presence of other genera of Microtinae, although, of course, it can seldom or never procure for itself complete isolation in this respect. In the warmer parts of its range its presence may be expected only where there is an occasional cold sphagnum bog,

now small and dwindling, to which it may be confined throughout a considerable stretch of territory.

Externally Synaptomys is certainly much less specialized than either of the other two American genera of lemmings (Lemmus and Dicrostonyx), and in this respect the genus is more primitive. The hypsodont condition of the molars is an advanced modification, but its exact significance is difficult to interpret, for it is impossible now to be sure whether such tooth development in Synaptomys, and its lack in Phenacomys, constitutes a case of a single advanced character forging ahead of others in the first instance, or of a primitive character lagging behind in the second. The equal thickness of the enamel on the concave and the convex surfaces of the prisms is somewhat primitive, as has often been considered the presence of grooves on the upper incisors. The actual enamel pattern is considered most generalized in Lemmus, less so in the subgenus Synaptomys, and more specialized in Mictomys, because in the lower molars of the last named the buccal triangles, undoubtedly present in some ancestral form, have entirely disappeared. The crania of the less specialized forms of the genus Synaptomys are also more primitive in a number of respects than are those of the other two lemmings, which are of an incipient fossorial type, a development not shared by Synaptomys.

In summary, judging as well as possible without the aid of fossil material by which decision might be further influenced, the evidence seems to indicate that on the whole Synaptomys is the most primitive of the North American members of the supergeneric group Lemmi, and although the facts are susceptible of different interpretations, according to the relative importance accorded the several indices of evolutional modification, it is evidently more primitive in some ways than many of the lower Microti, such as Phenacomys, in spite of its having a type of molariform dentition of a higher order than occurs in the latter.

CHARACTERS

Generic diagnosis.—The characters whereby the genus Synaptomys may be most readily distinguished from all other Microtinae are its grooved upper incisors and the extreme shortness of the rostrum (about 25 per cent of the total length of the skull). The molars are rootless, with persistent pulp, as in Microtus, and the mandibular incisors have their roots on the lingual side of the molars. The reentrant angles are excessively deep on the buccal side of the maxillary molars, and on the lingual side of the mandibular ones, and the third upper molar consists of four simple, transverse loops, peculiarly arranged. The tail is slightly longer than the hind foot. The feet are not especially modified, but the nail on the first digit of the forefoot is flat and strap shaped. The hind foot has six tubercles on the sole.

External characters.—Externally there is little or nothing by which the genus may invariably be distinguished, but the shortness of the tail is sufficient to separate it from all but a very few species of American Microtus. In appearance its members are robust, with

massive heads, in this respect somewhat resembling the other lemmings, but in the main the superficial appearance is that of voles and meadow mice.

Old males may be distinguished from females and from other genera by the color of the hairs overlying the hip glands. These are apparently absent in females, but are well developed in fully mature males. In the latter, some of the hairs growing from the center of the glands are a dingy white, these usually, though not invariably, extending to the surface of the pelage. These white patches are better developed in the subgenus Mictomys than in Synaptomys.

The dorsal coloration does not serve to distinguish the present genus from Microtus, but in several races it averages somewhat richer and more chestnut than the usual meadow mouse, with coarser and somewhat longer coat. Sometimes the anterior portion of the body is slightly grayer than the posterior. The ventral surface is some shade of plumbeous, the exact tint depending upon the degree to which the lighter tips of the hairs have been abraded. In examples in new pelage, the underparts may have a faint suggestion of cream-colored overtone.

The feet are dark, the precise color being largely influenced by the quantity of grease present in the dried skin. The very short tail is indistinctly bicolor and for a microtine is moderately well haired.

Alcoholics available in such condition that the plantar tubercles can be clearly distinguished number 11 and consist of 5 specimens of *stonei*, 1 of *cooperi*, 1 of *innuitus*, and 4 of *gossii*. All have six well-developed tubercles, the three anterior ones of which—especially the outer—are unusually large.

There are said to be eight mammae in Mictomys and only six in true Synaptomys, but the full number are not always functional in young mothers with small litters.

The winter coat differs from the summer one only in that it is longer and denser, and newly acquired pelage is usually, but not always, rich in coloration. Wear is manifested by the abrasion or breaking off of the tips of the hairs, resulting in the proximal coloration showing through to a greater extent. The brighter or richer tips to the new hairs of the adults are largely lacking in very young animals, and hence the color of the young averages darker and more plumbeous.

Unfortunately, both winter and summer pelages from any single northern locality are not available, and it is difficult to gain an understanding of the precise changes and sequences of pelage. Molt is gradual over the whole animal, there never being any well-defined zones or divisions between the old and the new coats, but the old hairs are replaced uniformly over the whole surface. Specimens that seem to be in perfectly fresh coat are available, however, taken during every month of spring, summer, and fall. For this reason it is difficult to be sure whether there is one or two annual molts. The changes of pelage, however, are somewhat irregular, especially in younger animals, and depend fully as much upon the age of the individual as upon the precise march of the seasons. In other words, it seems that a young animal may shed its juvenile coat at some definite stage of development and that temperature has but a partial influence upon such change. In addition, it is not by any means

certain that the changes of coat are precisely the same for all races in different climates.

External size is remarkably uniform in Mictomys, but is slightly more variable in Synaptomys. The sexes do not differ in this respect.

Skull.—In this genus the skull varies from moderately light to exceedingly massive, but it is less robust than in other American lemmings. The rostrum is considerably depressed and is very short, comprising about 25 per cent of the total length of the skull, and the zygomatic processes of the maxillae are proportionately heavy, as in the other Lemmi, and very deep, but the arches are not widely flaring. The brain case is rather long, the postorbital border quite sharp, and its outline almost right-angled. The interparietal is narrow in relation to its height. There is practically no ridging upon the brain case, but the interorbital ridges are usually prominent in adults. The pterygoids are short and thickened, and the palate not greatly unlike that of Microtus.

Teeth.—The maxillary incisors of Synaptomys are grooved on their anterior surfaces, in young as well as in old individuals, and worn into deep pits on their posterior faces by the narrower lower incisors. The roots of the mandibular incisors terminate at a point slightly anterior to the posterior portion of the third molar and lie wholly on the lingual side of the molars.

The molars are rootless and hypsodont, growing throughout life from a persistent pulp. The enamel pattern is characterized by the extreme depth of the reentrant angles on the lingual side of the lower teeth and the buccal side of the upper ones, and are of a style essentially different from all other genera except Lemmus. The enamel is of equal thickness on the concave and convex edges of the prisms, and the reentrant angles contain a moderate quantity of cementum. The upper molars are practically the same in both subgenera. The outer reentrant angles extend to the opposite side of the molars, but the inner ones only halfway toward the buccal side. The first and second upper molars are not otherwise peculiar, the former consisting of five closed enamel spaces, and the latter of four. The third molar has three transverse loops directed outward, and in addition, a fourth situated posteriorly and directed inward, separated from the others by a deep inner reentrant angle. Its shape is distinctive, and its pattern possible of confusion only with Lemmus. The lower molars are described under the subgenera.

The question of whether the anterior molariform teeth of the Microtinae are true molars or premolars is not considered in the present study, but the more conservative terminology—first, second, and third molars—is used.

The molars, although hypsodont, never project so far beyond the alveoli as do those of most other genera of microtines with hypsodont dentition, and hence there is less provision made for rapid wear. Therefore, the teeth must be unusually resistant, or else the food is less abrasive than is that of most voles. Of these two theoretical explanations, the former is considered unlikely. The facts as known seem to justify the conclusion that the molars grow at a less rapid rate than in most other genera of the subfamily and hence are of a less pronounced order of hypsodontism.

VARIATION

The material now available indicates strongly that the genus Synaptomys contains only two species, one to each subgenus. These, in turn, are further divisible, with tendencies for variation as mentioned under the subgenera.

Key to the Subgenera of Synaptomys

Mandibular molars with triangles on outer side.....Synaptomys.
Mandibular molars without triangles on outer side.....Mictomys.

List of Species and Subspecies, with Their Type Localities

SUBGENUS SYNAPTOMYS

Synaptomys cooperi cooperi Baird	Type locality unknown.
cooperi stonei Rhoads	Mays Landing, N. J.
cooperi helaletes Merriam	Lake Drummond Dismal Swamp, Va.
cooperi gossii Coues	Neosho Falls, Kans.

SUBGENUS MICTOMYS

Synaptomys borealis borealis (Richardson)	Fort Franklin, Mackenzie, Canada.
borealis dalli Merriam	Nulato, Alaska.
borealis chapmani Allen	Glacier, British Columbia, Canada.
borealis wrangeli Merriam	Wrangell, Alaska.
borealis innuitus (True)	Fort Chimo, Ungava, Canada.
borealis medioximus Bangs	L'Anse au Loup, Labrador.
borealis sphagnicola Preble	Fabyans, N. H.

Subgenus SYNAPTOMYS Baird

Synaptomys Baird, Mamm. North Amer., p. 558, 1857. Type *Synaptomys cooperi* Baird.

Geographic distribution.—Canadian Zone in eastern Canada west probably through Ontario; thence south through the Upper Austral Zone along the eastern border of the Plains into Arkansas: on the Atlantic slope occurring southward into North Carolina. (Fig. 2.)

Essential characters.—Mandibular molars with closed triangles upon the outer sides, and outer reentrant angles well developed. Mandibular incisors relatively robust, not usually excessively pointed. Mammae, 6.

Subgeneric diagnosis.—Skull, especially rostrum, in all but one race, very heavy, with maxillary incisors correspondingly so, their outer edges never noticeably unworn nor prolonged into sharp splinters of enamel. Mandibular incisors rather short and relatively stout, their tips not being sharply and narrowly pointed. Mandibular molars with closed triangles and well-developed reentrant angles upon the buccal side. Palate (fig. 3) but little different from that of some species of Microtus. Foramen rotundum and foramen ovale practically always separate and distant. Mammae, 6. No hairs at base of ears appreciably brighter than remainder of pelage. White patch upon the hip glands of old males seldom showing conspicuously.

Skull.—The skull of the typical race (*cooperi*) is no larger (smaller than in some forms) nor is the rostrum heavier (although proportionately shorter) than in the case of Mictomys, contrary to the usual statement. The skulls of the remaining three subspecies of the present subgenus are larger, however, and the rostra and incisors decidedly heavier. The crown of the first upper molar is situated considerably above a plane passing from the inferior border of the bullae through the crown of the third molar. The interorbital sulcus is seldom obliterated in old age. The inferior surface of the cranium has very few characters of any value in diagnosis.

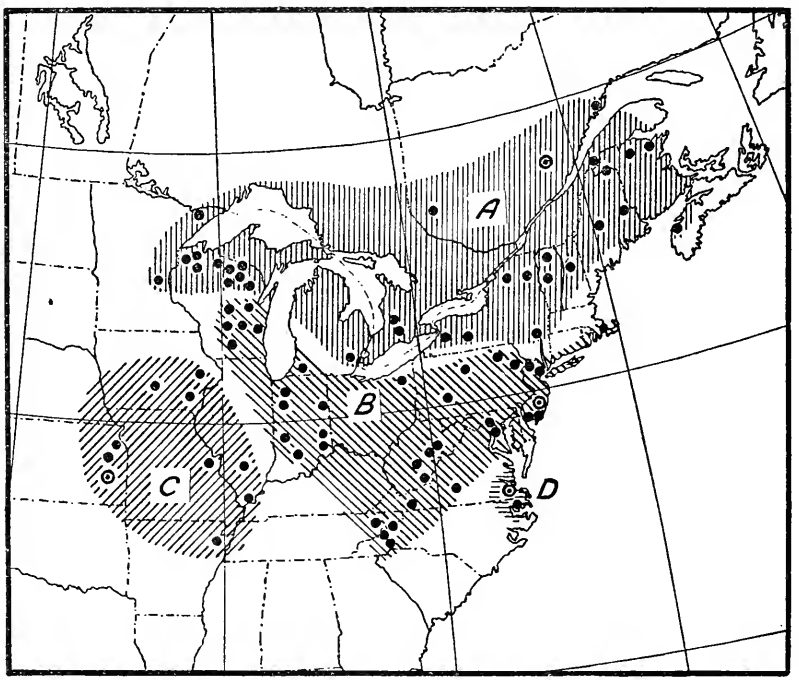

FIG. 2.—Distribution of the subgenus Synaptomys. Open circles indicate type localities; solid spots, other specimen records. A, *S. c. cooperi;* B, *S. c. stonei;* C, *S. c. gossii;* D, *S. c. helaletes*

Teeth.—Maxillary molars exactly as described under the genus. Of the mandibular teeth (fig. 4), the first molar consists of an anterior space, corresponding to the usual microtine trefoil, with an incipient triangle (widely open) upon its outer side. In addition, there are three inner loops and a median outer triangle. The second molar consists of two median loops, an irregular, narrower, enamel space anterior to these, and a median outer triangle. The third molar is composed of three triangular spaces—one of them upon the outer side—and a posterior loop. The outer reentrant angles of these molars are well developed, although not to so great an extent as the inner ones.

The incisors (fig. 5) are of a deep orange color. The upper ones have the grooves very close to the outer borders, and the

corners are usually noticeably worn. The mandibular incisors are short and heavy, with tips not excessively slender.

Remarks.—Taking the average of cranial characters, skulls of Synaptomys may be distinguished from those of Mictomys by their proportionately smaller bullae, shorter incisive foramina, more Microtus-like palates, relatively shorter rostra, less attenuate terminations of the ascending branches of the maxillae, the fact that the foramen rotundum and foramen ovale are always separated by a substantial osseous partition, by the greater or lesser tendency of the interorbital ridging to join, by the difference in tilt of the upper molar series, and by the mandibular enamel pattern.

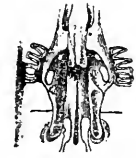

FIG. 3.—Palate of the subgenus Synaptomys—*S. cooperi helaletes* (Dismal Swamp, Va., No. 95876, U. S. Nat. Mus.). Enlarged

The subgenus Synaptomys as now understood contains but a single species, divided into four exceedingly well-marked geographical races. It is considered that further subdivision, based upon the material now available, would be entirely unjustified.

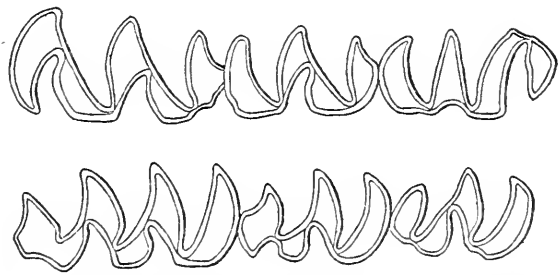

FIG. 4.—Enamel pattern of molars of the subgenus Synaptomys—*S. cooperi stonei* (Roan Mountain, N. C., No. 47821, U. S. Nat. Mus.). Enlarged, after Miller, 1896

There has been much uncertainty expressed by various authors regarding the identity of specimens from many localities, an uncertainty doubtless caused by the question of the proper status of the type of *cooperi* and by the fact that the existing material, sometimes scanty or in other ways unsatisfactory, was widely scattered.

The characters of most use in differentiating the subspecies of the subgenus Synaptomys comprise general size of the skull, shape of the brain case, the width and length of the rostrum, width of incisors, and, to a lesser extent, the shape of the incisive foramina and zygomatic arches. Although there may be some individual variation in these characters, they are usually reliable. There are no differences in tooth pattern, nor in the relative size of the bullae. Immaturity is indicated chiefly by lack of the normal amount of interorbital ridging, but there are also the other signs of youth usual in the Microtinae.

FIG. 5.—Front view of incisors of the subgenus Synaptomys—*S. cooperi helaletes* (Dismal Swamp, Va., No. 95876, U. S. Nat. Mus.). Enlarged

There are no external characters whereby the four races of this subgenus may surely be distinguished. As far as can be told by the dried study skins, the external differences are relatively trifling, often inappreciable, and not at all commensurate with the range of size and development exhibited by the crania.

The mammae are said to be six in number, inguinal, 1:1, pectoral 2:2, and this seems to be the maximum. Young females may have a smaller number than this actually functional.

The tooth pattern of this subgenus is less advanced in type than that of Mictomys, but the skull, in most forms, is much more specialized, though it is difficult to say for just what purposes. The northernmost race of the subgenus has the simplest skull, but those to the southward, inhabiting lower zones and living amid surroundings that may logically be assumed to be considerably different from what is normal for the genus, have developed very robust crania and massive dentition, most pronounced in the two southernmost subspecies.

Key to the Subspecies of Synaptomys cooperi (Subgenus Synaptomys)

(Based on adults)

a^1 Maxillary incisors very narrow (about 1.1 mm.); condylobasilar length averaging under 24; zygomatic breadth under 16 ..... *S. c. cooperi* (p. 12)

a^2 Maxillary incisors wider (over 1.5 mm.); condylobasilar length averaging over 24.5; zygomatic breadth over 16.5.

b^1 Incisive foramina short (averaging 4.7); condylobasilar length under 26.

c^1 Skull not broad for length; rostrum moderate (width under 6) ..... *S. c. stonei* (p. 14)

c^2 Skull very broad for length; rostrum stubby and massive (width over 6.1) ..... *S. c. helaletes* (p. 17)

b^2 Incisive foramina long (averaging 5.7); condylobasilar length about 27 ..... *S. c. gossii* (p. 18)

SYNAPTOMYS COOPERI COOPERI Baird

Cooper Lemming Mouse

(Plate 1, A)

Synaptomys cooperi Baird, Mamm. North Amer., p. 556, 1857.

Synaptomys fatuus Bangs, Proc. Biol. Soc. Washington 10:47, 1896. Type from Lake Edward, Quebec, Canada. Female adult; No. 3857, coll. E. A. and O. Bangs; collected by O. Bangs, September 28, 1895; original number 3.

Type.—Type locality, unknown; immature; No. $\frac{1367}{3230}$, U. S. Nat. Mus.; from Wm. Cooper.

Geographic distribution.—Canadian and upper part of Transition Zones in North American east of the Plains from Nova Scotia to Godbout, Quebec, and thence westward to the territory immediately north and west of Lake Superior; south to central Wisconsin and Michigan and in the Catskill Mountains to southern New York. (Fig. 2.)

General characters.—A small race with light rostrum, small incisors, weak brain case, and little or no interorbital ridging.

Color.—As in the subgenus, dorsally somewhat close to the cinnamon brown of Ridgway. Below, the skins with least worn pelage show a distinct tinge of cream, while the others are of the usual plumbeous.

Skull.—The cranium is the smallest of any race of the subgenus and may readily be distinguished by the small size of the incisors (width, 1.1 mm.) and by the narrowness of the rostrum, making the latter appear longer in comparison with the rest of the skull than in the other races. Interorbital and temporal ridges prac-

tically absent in characteristic specimens. Brain case weak and rather long for its width. Zygomatic arches weak and but slightly developed at the supero-inferior expansion of the jugals.

Measurements.—Average of collectors' measurements of five largest individuals from Quebec: Total length, 118; tail, 16.5; foot, 18. Average of four adult skulls from Quebec: Condylobasilar length, 23.1; rostral length, 6.1; rostral breadth, 5; interorbital breadth, 3; zygomatic breadth, 15.1; lambdoidal width, 11.9; incisive foramina, 4.3; height, 8.6.

Remarks.—In the original description of the species, Baird stated that the type is "probably from the New England States, or New York; possibly from Iowa or Minnesota." He must have had some reason for making such a statement instead of presuming, as have most of his successors, that the type came from near the Hoboken, N. J., home of Mr. Cooper, from whom it was obtained. The type is without the head and feet and is torn in many places, and the single paratype is in even worse condition. The posterior portion of the skull of the type is missing, only the rostral region, the right zygomatic arch and postorbital border remaining intact, but this is entirely adequate to show that the specimen is subadult, and that it certainly can not be identified with the material from the Central Atlantic States heretofore called *cooperi.* Among the lemming mice now available it can be exactly matched only by certain examples of the "*fatuus*" of authors from Ontario, Quebec, and New York State. Hence, *fatuus* must now be abandoned, as a pure synonym of *cooperi.* The type locality of the latter can probably never be fixed with exactitude, but it may well be considered as situated somewhere in the northern or western portion of the New England States, or in western New York, as Baird suggested. So far as the present material indicates, skulls from western New York are practically indistinguishable from those taken in Quebec, and the characters of the latter are now considered in greater detail for the reason that the material from this area is the most satisfactory of any available.

The chief characters whereby *cooperi* may be distinguished are the small size of the skull coupled with the narrowness of the rostrum and almost total lack of ridging, the two latter points being especially diagnostic. The increase in the width of the incisors as the range of *stonei* is approached is sometimes of great value in an understanding of the degree of intergradation existing in various areas. The measurements given indicate a shorter foot for *cooperi*, but comparison of skins fails to show an appreciable difference in this respect.

Along the southern border of its range this race approaches *stonei* in varying degree, especially where the Great Lakes do not impose a physical barrier between the two. Such variants are not always uniform as regards minor characters, but these differences are, as a rule, relatively minute. Specimens from northern Wisconsin and Ann Arbor, Mich., show a slight increase in the size of the brain case and a stronger indication of interorbital ridging than is usual in Canadian examples, and the same may be said of the specimens from Minnesota. The latter are unusually bright in coloration, but this may be due to the fact that they were taken

early in March, a season during which there are almost no specimens of this race available for comparison. It is considered best to allocate such with *cooperi*, even though some of them, with equal propriety, might be considered by others as referable to *stonei*.

Rather unexpectedly the single skull from the Catskill Mountains must be called *cooperi*, although it is not typical.

Two specimens from Vermont are intermediate in character and might as well be referred to *stonei* as to the present race. Those from Essex County, N. Y., vary to some degree, especially in the slightly larger incisors, toward *stonei*, but only one of these specimens is adult. The skull from Mount Mansfield, badly damaged, is especially questionable as to its identity because of the rostrum.

The skull accompanying one of the skins labeled Canoe River, British Columbia, proves to be a true Synaptomys, but this subgenus has never before been taken west of the prairies, and six other specimens taken at the same time are without skulls. If this example really came from the locality indicated it would almost certainly be perfectly distinct from anything now known, but in many ways it is close to *cooperi*, although undeniably larger. It was taken by a reliable collector, but because there has very likely been some sort of subsequent confusion in the case of this skull, as occasionally happens in spite of utmost care, it is no more than mentioned here.

Specimens examined.—Total number, 88, as follows:

Locality unknown: 2 (type and paratype).
Maine: Mount Madawaska, 2[4]; east branch Penobscot River, 1; Sebec Lake, 1.
Michigan: Ann Arbor, 12.
Minnesota: Burntside Lake, 2; Elk River, 4.
New Brunswick: Near Bathurst, 4[5]; Tobique Point, 1.[6]
New Hampshire: Mount Moosilauke, 1.[4]
New York: Alfred Center, 1; Catskill Mountains, 1; Keene Heights, Essex County, 4[4]; Wanakena, 1.
Nova Scotia: Digby, 5.[7]
Ontario: Bryanston, 2[8]; London, 8[9]; Macdiarmid, Lake Nipigon, 1.[10]
Quebec: Godbout, 3[11]; Lake Edward, 10 (including type of "fatuus")[12]; St. Rose, 5.
Vermont: Leicester, 1[13]; Mount Mansfield, 1.
Wisconsin: Conover, 3[14]; Lac Vieux Desert, 1[14]; Lakewood, 1; Lake St. Germain, 4; Long Lake, 2; Mercer, 1; St. Croix Falls, 1; Sayner, 1[14]; Solon Springs, 1.[14]

SYNAPTOMYS COOPERI STONEI Rhoads

Stone Lemming Mouse

(Plate 1, B)

Synaptomys stonei Rhoads, Amer. Nat. 27: 53, 1893.

Type.—Collected at Mays Landing (on Egg River), Atlantic County, N. J., by S. N. Rhoads, December 2, 1892. Female subadult;

[4] C. F. Batchelder coll.
[5] Nat. Mus. Canada.
[6] Amer. Mus. Nat. Hist.
[7] Mus. Comp. Zool.
[8] Nat. Mus. Canada, 1; W. E. Saunders coll., 1.
[9] W. E. Saunders coll.
[10] Royal Ontario Mus. Zool.
[11] U. S. Nat. Mus., 2; Royal Ontario Mus. Zool., 1.
[12] Mus. Comp. Zool., 7; Field Mus. Nat. Hist., 3.
[13] G. L. Kirk coll.
[14] Field Mus. Nat. Hist.

No. 7567, Acad. Nat. Sci. Philadelphia (formerly No. 567, coll. S. N. Rhoads).

Geographic distribution.—Lower portion of Transition and northern half of the Upper Austral Zones in the United States east of the Plains, from central Wisconsin and Illinois east to the Atlantic coast; occurs as far north as Massachusetts and south in the mountains into North Carolina. (Fig. 2.)

General characters.—A race with moderate-sized, well-ridged skull with well-developed zygomatic region. Rostrum somewhat intermediate in size between the extremes of development as exhibited by *cooperi*, on the one hand, and *helaletes*, on the other. Incisors wide (1.7 millimeters).

Color.—The coloration of New Jersey specimens is indistinguishable from that of animals from Quebec. Maryland skins average a shade brighter.

Skull.—Adult crania from southern New Jersey are of medium size with well-developed interorbital ridges, which meet in the case of animals of advanced age. Brain case rather long, its length being especially accentuated in thoroughly typical specimens by the narrowness of the interparietal. The rostrum is much heavier than in *cooperi*, as are the incisors, and the zygomatic arches flare strongly, with jugals quite deep supero-inferiorly. The incisive foramina are variable, but are usually relatively long.

Measurements.—Average of collectors' measurements of four largest specimens from southern New Jersey: Total length, 127; tail, 21; foot, 20. Average of four adult skulls from the same area: Condylobasilar length, 24.9; rostral length, 6.4; rostral breadth, 5.9; interorbital breadth, 3.1; zygomatic breadth, 16.7; lambdoidal width, 13; incisive foramina, 4.7; height, 9.9.

Remarks.—As the name *cooperi* is found to belong to the northernmost race of the subgenus, the form occurring in the Middle Atlantic States will have to take Rhoads's name *stonei*. The type specimen of this is not adult and the cranial points that may be considered most characteristic of the animals in the vicinity of the type locality are not so well developed as could be desired.

This race is in many ways intermediate between the light-skulled *cooperi*, on the one hand, and *helaletes* and *gossii*, with their heavy crania, on the other, yet being well defined and rather constant over a wide area, it can not be considered as an intergrade. This intermediateness in skull characters is entirely sufficient to distinguish it from the three other races. The larger skull and heavier rostrum, including incisors, in connection with the well-developed ridging, distinguish it from *cooperi*, and its smaller size and narrower or smaller rostrum, from the remaining two forms. Its foot seems to be a shade longer than that of *cooperi*, but not sufficiently so for this character to be of practical value in diagnosis.

In the northern portion of its range *stonei* approaches *cooperi* in varying degree, and there is some little geographic fluctuation of characters in several places, as may only be expected of an animal inhabiting bogs that must often be separated by considerable intervals of country unsuited to the needs of the genus. Such fluctuations, however, are usually slight and on the basis of the material now

available seem not to be sufficiently pronounced or constant to admit of further subspecific division.

Specimens from southern Maryland definitely vary toward *helaletes*, having the large brain case and stout zygomatic region of that race, but with the rostra more as in *stonei*, with which they should clearly be placed.

The individuals from Roan Mountain, N. C., have slightly weaker skulls, narrower zygomata and wider interparietals than typical, but these differences are not sufficiently pronounced to merit separation.

An old female from Wareham, Mass., is certainly closer to *stonei*, although with a rather weak rostrum, while the three other skulls from this locality are entirely intermediate between this race and *cooperi*.

The individual from Cassopolis, Mich., taken during January, is excessively gray, especially laterally.

There is a type of variant in central Wisconsin the skulls of which are no larger than those of *cooperi*, but fully as stout and ridged, proportionately, as are those of *stonei*. This is most accentuated in individuals from Elkhart Lake and Kilbourn, and these might possibly be considered worthy of subspecific separation if it were not for the fact that the animals from Kelly Lake, Wild Rose, and Rib Hill, all to the north of the two localities first mentioned, have skulls much larger and close to typical *stonei*. Such being the case, it seems wiser to consider them merely intermediate, to different degrees, between *stonei* and the *cooperi* type of lemming mouse occurring in the northern part of the State.

The Indiana animals have, at one time or another, been referred to *gossii*, but in view of the adequate series of the latter form now available, such a decision can not be sustained. Material from the southern half of the State is clearly *stonei*, while two skulls from Hebron and Roselawn, in the northwest section, although undeniably large and with stout rostra, are not sufficiently developed in these respects for inclusion with the Kansas race.

Specimens examined.—Total number, 160, as follows:

Indiana: Bascom, 8; Bicknell, 1; Brookville, 6; Hebron, 1; Mitchell, 4; Roselawn, 1; Salamonia, 5.[15]
Maryland: Hyattsville, 8; Prince George County, 6.
Massachusetts: Wareham, 4.[16]
Michigan: Cassopolis, 1.[16]
New Jersey: Bear Swamp, Sussex County, 1[17]; Greenwood Lake, 2[17]; Mays Landing, 4[18]; Port Norris, 3[17]; Tuckahoe, 1.[17]
North Carolina: Magnetic City, 1; Roan Mountain, 25[19]; Weaverville, 11.[20]
Ohio: Ravenna. 2.[21]
Pennsylvania: Bushkill Creek, near Cresco, 1[17]; Krings Station, 5[17]; Lake Lehigh, 1[17]; Round Island, 2.[17]
Tennessee: Rogersville, 1.
Virginia: Campbell County, 13[21]; Mount Rodgers, 5.[21]
West Virginia: Cranberry Glades, 1; Pocahontas County (head of Cranberry River), 5; Travellers Repose, 4; White Sulphur Springs, 3.[22]
Wisconsin: Camp Douglas, 1; Elkhart Lake, 2; Kelly Lake, 9; Kilbourn, 3; Rib Hill, 2; Wild Rose, 7.

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[15] Field Mus. Nat. Hist.
[16] Mus. Comp. Zool.
[17] Acad. Nat. Sci. Philadelphia.
[18] Acad. Nat. Sci. Philadelphia, 3 (including type); U. S. Nat. Mus., 1.
[19] U. S. Nat. Mus., 19; Acad. Nat. Sci. Philadelphia, 6.
[20] Amer. Mus. Nat. Hist., 10; Field Mus. Nat. Hist., 1.
[21] Amer. Mus. Nat. Hist.
[22] Field Mus. Nat. Hist., 1; Mus. Comp. Zool., 2.

SYNAPTOMYS COOPERI HELALETES Merriam

Dismal Swamp Lemming Mouse

(Plate 1, C)

Synaptomys helaletes Merriam, Proc. Biol. Soc. Washington 10: 59, 1896.

Type.—Collected at Lake Drummond, Dismal Swamp, Norfolk County, Va., by A. K. Fisher, October 14, 1895. Female adult; No. 75172, U. S. Nat. Mus. (Biol. Surv. coll.); original number 1818.

Geographic distribution.—Extreme southeastern Virginia and northeastern North Carolina. (Fig. 2.)

General characters.—A race with large, heavy skull and broad, stubby rostrum. Brain case wide and relatively short, and zygomatic arches much bowed. Incisors very broad (1.9 mm.) (Fig. 5), and incisive foramina rather short.

Color.—Evidently averaging a shade brighter and lighter (only winter and early spring specimens available) than the two preceding forms, but many individuals are indistinguishable from them.

Skull.—The rostrum of the present form is excessively broad without any compensating increase in length, and the zygomatic arches are strongly bowed. The interorbital ridging is moderate, with the sulcus almost, though not quite, obliterated in old age. The brain case is very broad and hence appears rather short, and the interparietal is moderately wide. The incisive foramina are usually short.

Measurements.—Average of nine adult topotypes: Total length, 129; tail, 21.4; foot, 20. Average of six skulls of adult topotypes: Condylobasilar length, 25.5; rostral length, 6.6; rostral breadth, 6.3; interorbital breadth, 3.3; zygomatic breadth, 17.2: lambdoidal width, 13.4; incisive foramina, 4.7; height, 10.1.

Remarks.—The present form may be most readily distinguished from typical *stonei* by the much broader, though no longer, rostrum, and correspondingly broader incisors. The zygomatic arches are more strongly bowed and the brain case is considerably wider. The incisive foramina are also, as a rule, shorter. In reality the ridging is less developed in *helaletes*, the skull gaining its appearance of ruggedness by its great breadth. The feet of this lemming mouse, although no longer, are apparently appreciably stouter than those of its neighbor.

As previously mentioned, specimens from southern Maryland, although referable to *stonei*, definitely vary in the direction of *helaletes*. At the present day, bogs suitable for the presence of this genus are undergoing shrinkage throughout the region in question, and there may now be a definite hiatus between the ranges of the two forms, but there are not sufficient grounds for considering the Dismal Swamp animals as being more than subspecifically distinct.

The two skins from Chapanoke are very light, but the single skull from this locality is entirely typical.

Specimens examined.—Total number, 24, as follows:

North Carolina: Chapanoke, 2.[23]
Virginia: Lake Drummond, 22 (including type).

[23] U. S. Nat. Mus., 1; Acad. Nat. Sci. Philadelphia, 1.

SYNAPTOMYS COOPERI GOSSII (COUES)

GOSS LEMMING MOUSE

(Plate 1, D)

Arvicola (*Synaptomys*) *gossii* Coues, Monogr. North Amer. Rodentia, p. 235, 1877.

Type.—Collected at Neosho Falls, Woodson County, Kans., by B. F. Goss, 1866. Male adult (skull only); No. 6915, U. S. Nat. Mus.

Geographic distribution.—The west-central Mississippi Valley country, mostly in the Upper Austral Zone, from northeastern Arkansas and southern Illinois into Iowa and extreme southeastern South Dakota (fig. 2).

General characters.—A large, rather bright-colored Synaptomys with long, heavy skull having a wide, though long, rostrum.

Color.—Dark examples are indistinguishable externally from the other races, but the majority of adults are of a somewhat brighter, richer shade, most noticeable in the case of the series from Rosiclare, Ill.

Skull.—Long and heavy in all parts, but its width hardly proportionate to the length. Rostrum heavy but long, with massive incisors (width, 2 mm.). Interorbital ridging moderately pronounced but never meeting entirely in old age. Temporal ridges well developed both anterior to the parietals, and in the interparietal-lambdoidal region. The zygomatic arches, although heavy, are relatively unexpanded, thus adding to the appearance of length of the cranium. The incisive foramina are narrow but very long.

Measurements.—Average of three adults from Kansas: Total length, 134; tail, 21; foot, 20. Average of four adult skulls from Kansas: Condylobasilar length, 27.1; rostral length, 6.3; rostral breadth, 6.1; interorbital breadth, 3.5; zygomatic breadth, 17.7; lambdoidal width, 13.3; incisive foramina, 5.6; height, 10.9.

Remarks.—In the original citation, Coues gives this name as above, observing that it had been written by Baird upon the labels of the Kansas specimens, and giving a list of these with their measurements. Such a citation may be considered a valid characterization, and hence Coues is sponsor for the name rather than Merriam (1896, p. 60). Coues, however, designated no type, and this was later selected by Merriam, as above.

The present race may be distinguished from *stonei* by its larger size and heavier ridging on the posterior portion of the brain case. The zygomatic arches are proportionately less flaring, and the incisive foramina longer and narrower. The feet of this form, as well as of *helaletes*, seem to be wider and stouter, though no longer, than those of the lighter *cooperi* and *stonei*.

The trend of development of both *gossii* and *helaletes* has been toward an increase in the size of the cranium, but with this exception, large size, the skulls of the two are not particularly similar, and even were their ranges contiguous, there would be no reason for considering them closer to each other than to *stonei*. The Kansas race has a long type of skull with rostrum not proportionately very broad, and long incisive foramina, while *helaletes* has a short, broad type of skull with very wide rostrum and usually short incisive foramina.

Specimens from Rosiclare, in extreme southeastern Illinois, are referred to *gossii* because of color, but the skulls are intermediate between that and *stonei* (indicating the true relationship of the Kansas race), and they might almost as well be called one as the other.

Although not typical, the series from Horseshoe Lake, Mo., must be called *gossii*, but the skulls, as long as Kansas ones, have proportions a trifle suggestive of *stonei*.

The affinities of the Hillsboro individual are undoubtedly with *gossii*, but those from Lake City and Odin are too young to be identified with certainty, and they are assigned to this race upon geographic grounds.

Hahn states (1909b, p. 522) that he took lemming mice on the Missouri River in southeastern South Dakota, which he called *gossii* because they were "much larger and clumsier, with larger and heavier skull" than Indiana examples. The writer has not succeeded in locating this material, but presumes that Hahn was correct in his diagnosis.

Specimens examined.—Total number, 47, as follows:

Arkansas: Lake City, 1.
Illinois: Odin, 1; Rosiclare, 11.[24]
Iowa: Hillsboro, 1; Knoxville, 1; Marion, 1.[25]
Kansas: Lawrence, 1[26]; Leavenworth, 7[27]; Neosho Falls, 7.[28]
Missouri: Horseshoe Lake, 16.

Subgenus MICTOMYS True

Mictomys True, Proc. U. S. Nat. Mus. 17: 242, April 26, 1894. (Advance separate.) Type *Mictomys innuitus* True.

Geographic distrubution.—Canadian and Hudsonian Zones of Alaska and British America, barely entering the extreme northwestern part of the United States, and in the east extending southward into New Hampshire. (Fig. 6.)

Essential characters.—Mandibular molars without closed triangles upon the outer sides, and practically no outer reentrant angles. Mandibular incisors relatively slender and sharply pointed. Mammae, 8.

Subgeneric diagnosis.—Neither skull nor rostrum is especially heavy. The maxillary incisors often have the outer corners noticeably unworn and prolonged into sharp splinters of enamel, after the manner commonly seen in the genus Lemmus. This may be accompanied by deep pitting upon the oral surface of the upper incisors, the whole formed by the action of the comparatively long and slender, sharply pointed, lower incisors working against the very much wider upper ones. Mandibular molars are without closed triangles or distinct reentrant angles upon the buccal sides. Palate (fig. 7) with a sharply pointed median projection directed backwards—not Microtus-like. Foramen rotundum and foramen ovale usually, though not always, joined, forming a single vacuity. When separated, the osseous partition is exceedingly thin and frag-

[24] Field Mus. Nat. Hist.
[25] Mus. Comp. Zool. (no skull, identity inferred).
[26] Amer. Mus. Nat. Hist.
[27] U. S. Nat. Mus., 6; Amer. Mus. Nat. Hist., 1.
[28] U. S. Nat. Mus., 6 (including type); Mus. Comp. Zool., 1.

ile. Mammae, 8. A few hairs at the base of the ears distinctly brighter, with a bright rusty tinge, and hairs upon the hip glands of old males usually conspicuously whitish.

Skull.—The skull of Mictomys is smaller and lighter than all but one of the subspecies of the subgenus Synaptomys, and the

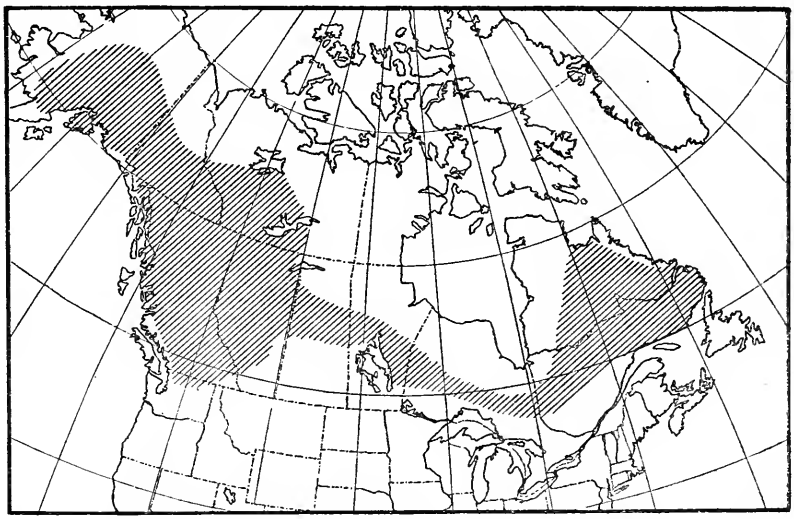

FIG. 6.—Approximate distribution of the subgenus Mictomys

rostrum is lighter and relatively longer, but the interorbital ridges join, thus obliterating the median sulcus, at a rather early age. The bullae are comparatively larger, the incisive foramina longer, the terminations of the ascending branches of the maxillae average more attenuate, the foramen rotundum and the foramen ovale are usually joined into a single vacuity, or else the intervening osseous partition is very fragile, and the median projection of the palate is spinous in character. The crown of the first upper molar is about on a level with a plane passing from the inferior border of the bullae through the crown of the third molar.

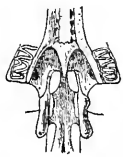

FIG. 7.—Palate of the subgenus Mictomys—*S. borealis chapmani* (Smoky River, Alberta, No. 17437, U. S. Nat. Mus.). Enlarged

Teeth.—The maxillary molars are as in the genus. The mandibular molars (fig. 8) are formed entirely of transverse, wedge-shaped loops, four in the first (including anterior "trefoil"), and three in the second and third. These differ in pattern from the subgenus Synaptomys in the absence of an outer triangle from each tooth, and in having the buccal borders crenulate, with outer reentrant angles barely indicated, except in the third molar, where one is slightly developed.

The incisors (fig. 9) are pale in color, especially upon the outer edges, relatively light, and the grooves of the upper ones are not so close to the outer borders as in the subgenus Synaptomys. The lower incisors are very long, slender, and exceedingly sharply pointed, these terminations fitting into unusually well-defined pits upon the oral surface of the much broader upper incisors. The latter are

usually somewhat unworn upon their outer corners, and there often results a very sharp splinter of enamel that projects at this point.

Remarks.—There is really remarkably little geographic variation, both externally and cranially, in the subgenus Mictomys, and although its range can not, as yet, be demonstrated to be uninterrupted, there is indicated so much continuity in the fluctuation of characters that the various forms are likely no more than subspecifically distinct. The chief handicap to a proper understanding of the interrelationship of the races is the dearth of topotypical material, and it will probably be many years before this condition can be entirely remedied.

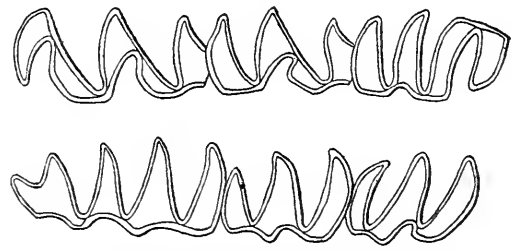

FIG. 8.—Enamel pattern of molars of the subgenus Mictomys—*S. borealis innuitus* (type, Fort Chimo, Ungava, No. 24729, U. S. Nat. Mus.). Enlarged, after Miller, 1896

External characters are more satisfactory than in the subgenus Synaptomys, but there is slight difference in external size, such, whenever indicated by collectors' measurements, usually proving unreliable when a direct comparison of specimens is made.

FIG. 9.—Front view of incisors of the subgenus Mictomys—*S. borealis chapmani* (Shovel Pass, Alberta, No. 3352, Nat. Mus. Canada). Enlarged

The characters of most value in diagnosing the various races of this subgenus consist of size of skull; height and proportion of the brain case; length and width of the rostrum (but seldom of the nasals), incisive foramina, and occasionally the bullae; and length of the pterygoid fossae. Some of these characters, however, may be found to fluctuate, especially in regions of diverse faunal tendencies. Immaturity is indicated chiefly by the lack of pronounced interorbital riding.

The mammae are said to be 8 in number, inguinal 2:2, pectoral 2:2, and such seems to be the case, as well as could be told from dried specimens. Young females may develop a fewer number.

As previously mentioned, the tooth pattern of Mictomys is considered more specialized than that of the subgenus Synaptomys, and the skull is simpler.

Key to Subspecies of Synaptomys borealis (Subgenus Mictomys)

a[1] Races ranging chiefly east of the mountains of western Canada and Alaska.
  b[1] Coloration dark—rich mahogany; pterygoid fossae short; Athabaska-Mackenzie region ..... *S. b. borealis* (p. 22).
  b[2] Coloration duller or paler; pterygoid fossae longer; eastern North America.
    c[1] Skull very small—condylobasilar length 23: color not known ..... *S. b. innuitus* (p. 28).
    c[2] Skull larger—condylobasilar length over 24.
      d[1] Color pale and bright (adult skull unknown) *S. b. medioximus* (p. 29).
      d[2] Color darker; condylobasilar length over 25 *S. b. sphagnicola* (p. 30).

a^2 Races ranging chiefly west of the Athabaska–Mackenzie region of Canada.
  b^1 Coloration usually bright: incisive foramina short.
    c^2 Skull high (9.3): condylobasilar length about 24 or more. *S. b. dalli* (p. 24).
    c^2 Skull low (8.7) and flat: condylobasilar length averaging less than 24 ..... *S. b. wrangeli* (p. 26).
  b^2 Coloration dull, with little chestnut: incisive foramina longer ..... *S. b. chapmani* (p. 25).

SYNAPTOMYS BOREALIS BOREALIS (RICHARDSON)

RICHARDSON LEMMING MOUSE

Arvicola borealis Richardson, Zool. Jour. 3; 517, 1828.
Synaptomys (*Mictomys*) *bullatus* Preble, Proc. Biol. Soc. Washington 15; 181, 1902. Type from Trout Rock, near Fort Rae, Great Slave Lake, Mackenzie, Canada. Male adult; No. 110032, U. S. Nat. Mus. (Biol. Surv. coll.); collected by Edward A. Preble, August 17, 1901; original number 4511.

Type.—Collected at Fort Franklin, Mackenzie, Canada, by John Richardson. Male; No. 42.10.7.10, British Mus.

Geographic distribution.—The Athabaska-Mackenzie region of Canada from Great Bear Lake south to near Edmonton, and eastward (provisionally) to Lake Winnipeg (fig. 10).

General characters.—A dark, richly colored race, with foot somewhat short. Skull rather small, and pterygoid fossae short and crowded.

Color.—The dorsal coloration of this race is very rich and dark, close to the Argus brown of Ridgway, and plentifully mixed with black-tipped hairs. This richness of color is most pronounced on the rump, the anterior portion of the body often being duller, slightly grizzled, and a trifle paler. The plumbeous of the under surface of the specimens at hand is rather dark and without appreciable tinge of buff. The tail is distinctly bicolor and the feet vary from grayish to almost black.

Skull.—The skulls of the few adult topotypes at hand are rather small, with rostrum tapering hardly at all, and high brain cases. The incisive foramina, while not long, are usually quite wide, especially posteriorly. The pterygoid fossae are short and crowded and the pterygoid plates heavy.

Measurements.—Average of collectors' measurements of four adult topotypes: Total length, 129; tail, 26; foot, 18. Average of three skulls of adult topotypes: Condylobasilar length, 24; rostral length, 5.9; rostral breadth, 4.9; interorbital breadth, 3.2; zygomatic breadth, 15.2; lambdoidal width, 12.1; incisive foramina, 4.9; height, 9.6.

Remarks.—The identity of Richardson's *Arvicola borealis* was a puzzle for many years, and it was variously ascribed to Arvicola, Microtus, or Phenacomys. Therefore, when E. A. Preble obtained a series of Synaptomys from the Mackenzie region in 1901, apparently differing from anything before characterized, he named it "*bullatus*," not suspecting the true identity of the species *borealis*. During 1903 he again made a trip to this region and visited Fort Franklin especially for topotypes of some of Richardson's species. A series of eight Synaptomys was obtained, and when reporting upon these, Preble (1908, p. 184) stated his conviction that they constituted the

Arvicola borealis of Richardson. In the interval between Preble's rediscovery of the species and the publication of his report, the fragmentary skull of the type of *borealis* in the British Museum had been removed and examined by Osgood (1907, p. 49) who found that it is indeed a Mictomys. Hence, the name *bullatus* was placed in synonymy by its describer.

Synaptomys b. borealis is not sufficiently differentiated from the more eastern races of Mictomys for the interrelationship to be considered more than subspecific in degree, and the future will probably show the range of the subgenus to be practically continuous between

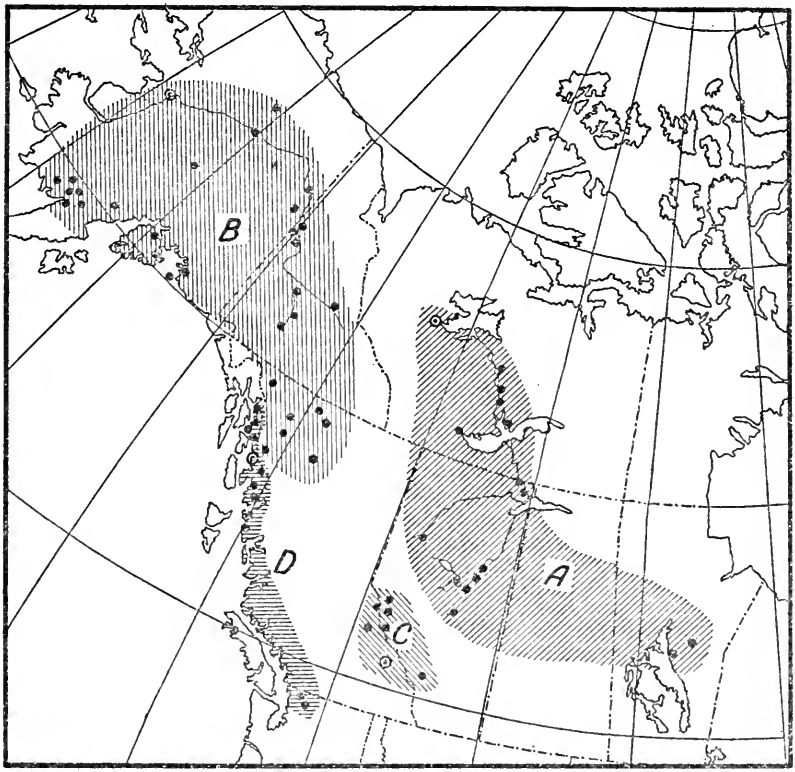

FIG. 10.—Distribution of the western forms of the subgenus Mictomys. Open circles indicate type localities; solid spots, other specimen records. A, *S. b. borealis*; B, *S. b. dalli*; C, *S. b. chapmani*; D, *S. b. wrangeli*

the two regions. Skins in unworn pelage of *borealis* as here recognized may be distinguished from available ones of *medioximus* and *sphagnicola* by the darker, richer color and slightly shorter foot, but there is much variation in the crania, even among the few topotypes. A skull from Echimamish River, just north of Lake Winnipeg, is practically indistinguishable from the type of the small race, *innuitus*, except for slightly greater height. Until something more than a single typical skull of the latter is available, however, it is unwise to extend its range too greatly. At any rate, this Echimamish River specimen is not at all typical *borealis*, and if not

innuitus, may be a type of variant, or even another subspecies, inhabiting the country just to the westward of Hudson Bay.

Some of the examples of *borealis* from the vicinity of Athabaska Landing show a slight tendency toward this small type of skull with light rostrum, while others, notably from Smith Landing, indicate such a close approach to the *dalli-chapmani* type of cranium that the state of affairs can hardly be explained otherwise than by assuming that intergradation occurs at some point slightly to the westward.

Specimens examined.—Total number, 54, as follows:

Alberta: Athabaska Landing (Athabaska), 3; 5 miles above Athabaska Landing, 2; 30 miles above Athabaska Landing, 18; Battle Lake, 1; Peace River Landing, 1[29]; 50 miles above Pelican Rapid, Athabaska River, 2; Slave River, 25 miles below mouth of Peace River, 1; Smith Landing (Fitzgerald), 3; Swift Current, 3.

Manitoba: Echimamish River, 1; Norway House, 1.

Mackenzie: Fort Franklin, 8; Fort Providence, 1; Fort Rae, 6 (including type of "bullatus"); Grandin River, 1; Lake St. Croix, 1; Sarahk Lake, 1.

SYNAPTOMYS BOREALIS DALLI Merriam

Dall Lemming Mouse

Synaptomys (*Mictomys*) *dalli* Merriam, Proc. Biol. Soc. Washington 10:62, 1896.

Synaptomys (*Mictomys*) *andersoni* Allen, Bul. Amer. Mus. Nat. Hist. 19:554, 1903. Type from Level Mountain, northern British Columbia, Canada. Female immature; No. 20467, Amer. Mus. Nat. Hist.; collected by M. P. Anderson, September 11, 1902; original number 736.

Type.—Collected by W. H. Dall, February, 1867, at Nulato, Yukon River, Alaska. Male immature; No. $\frac{49373}{10957}$, U. S. Nat. Mus. (Skull and skeleton only.)

Geographic distribution.—Hudsonian Zone in Alaska and south to central British Columbia to the eastward of the coast district (fig. 10).

General characters.—A rather bright-colored race, with skull of moderate size.

Color.—In the case of Yukon animals, the dorsal coloration is close to the Brussels brown of Ridgway, with the usual admixture of blackish hairs. Tail, quite sharply bicolor.

Skull.—Of moderate size. Incisive foramina fairly short, and bullae rather small. There is some variation in the length of the pterygoid fossae, those of Yukon examples being shortest.

Measurements.—Average of collectors' measurements of three adults from the general vicinity of Fortymile, upper Yukon River Total length, 131; tail, 19; foot, 19. Average of four adult skulls from the same region: Condylobasilar length, 24.1; rostral length, 6.1; rostral breadth, 4.9; interorbital breadth, 3.1; zygomatic breadth, 15.5; lambdoidal width, 11.9; incisive foramina, 4.9; height, 9.3.

Remarks.—The type of *dalli* is not only too immature for salient characters to have appeared, but the skin seems not to have been preserved. Hence, it is necessary to assume that the available ma-

[29] Nat. Mus. Canada.

terial from Charlie Creek, Fortymile, and Eagle, on the upper Yukon River, is typical. In comparison with topotypes of *borealis* there is little average cranial difference, but skulls of the latter are inclined to have slightly longer rostra, wider brain cases, wider incisive foramina, and shorter pterygoid fossae. Skins of *dalli*, however, are paler and lack the rich mahogany tone of true *borealis*.

A large series of specimens from about the base of the Alaska Peninsula exhibit much individual variation, and several of the skulls are very large, with robust rostra. Others from the same or contiguous localities, however, are smaller than what is believed to be typical of *dalli*, and little can be done toward an exact understanding of the animals of this general region until both topotypes of *dalli*, and specimens from the lower Yukon, have been obtained.

Contrary to the statement of the describer, "*andersoni*" proves to be decidedly immature, with skull too young to have developed diagnostic characters of value, and coloration perfectly comparable with that of *dalli*. At the time of its original description, the type specimen seems to have been compared only with *wrangeli* and not with *dalli*, under which name it is now placed.

Intergraduation with *chapmani* probably occurs somewhere in the mountains of northern British Columbia, but there are too few specimens from the region to allow this statement to be made without qualification.

The skulls of the three examples from Great Glacier are not very satisfactory, but upon their careful consideration the writer is convinced that they may more logically be placed with *dalli* than with *wrangeli*.

Specimens examined.—Total number, 135, as follows:

Alaska: Barabori, Kenai Peninsula, 2[30]; Bettles, 7; Caribou Camp, Kenai Peninsula, 5[30]; Charlie Creek, 1; head Chulitna River, 1; mountains near Eagle, 3; Hope, 1; Kenai Peninsula, 1[30]; Kokwok River, 1; Lake Aleknagik, 1; Lake Clark, 12; Lake Iliamna, 5; McKinley fork of Kuskokwim River, 1; Moose Camp, Kenai Peninsula, 7[30]; Nulato, 1 (the type); Nushagak River, 6; Prince William Sound, 9[31]; Seldovia, 38[32]; Sheep Creek, Kenai Peninsula, 11[30]; Tanana, 1.

British Columbia: Atlin, 1[33]; Great Glacier, Stikine River, 3[31]; Klappan River, 1; Level Mountain, 1 (type of "*andersoni*")[30]; McDame Post, 1; Rapid River, 1; Telegraph Creek, 1.

Yukon: Chandindu River, 1; mouth Coal Creek, 1; Fortymile, 1; Lake Lebarge, 2; forks Macmillan River, 5; Rink Rapids, 1; Thirtymile River, 1.

SYNAPTOMYS BOREALIS CHAPMANI Allen

Chapman Lemming Mouse

(Plate 2, C)

Synaptomys (*Mictomys*) *chapmani* Allen, Bul. Amer. Mus. Nat. Hist. 19: 555, 1903.

Type.—Collected by F. M. Chapman, July 20, 1901, at Glacier, Selkirk Range, British Columbia, Canada. Male adult; No. 16908, Amer. Mus. Nat. Hist.; original number 7.

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[30] Amer. Mus. Nat. Hist.
[31] Mus. Vert. Zool.
[32] Field Mus. Nat. Hist., 2; Amer. Mus. Nat. Hist., 36.
[33] Provincial Mus.

Geographic distribution.—Evidently the Canadian Zone of the eastern portion of the southern half of British Columbia, and adjacent mountainous slopes in extreme western Alberta. (Fig. 10.)

General characters.—A dark but dull-colored race with but slight dorsal tinge of chestnut. Incisive foramina and rostrum long.

Color.—Skins from Shovel Pass, the Moose Pass country, and from near Henry House, as well as the type, are very dull and gray. Anteriorly, a number of these skins are decidedly grizzled gray with hardly any brown at all, though in the middle of the rump there is considerable snuff brown of Ridgway, which almost disappears upon the sides. The feet are dark gray or brown, and tail indistinctly bicolor.

Skull.—Of moderate size with rather narrow brain case and long rostrum. Incisive foramina inclined to be long, but this character is quite variable, as is the width of the nasals. Bullae, small.

Measurements.—Average of collectors' measurements of five adults from the Rocky Mountains west of Henry House: Total length, 131; tail, 25; foot, 18. The skull of the type measures: Condylobasilar length, 24.3; rostral length, 6.3; rostral breadth, 4.7; interorbital breadth, 3.2; zygomatic breadth, 15.5; lambdoidal width, 11.6; incisive foramina, 5.2; height, 9.3. Average of four adult skulls from near Henry House: Condylobasilar length, 24.4; rostral length, 6.1; rostral breadth, 4.8; interorbital breadth, 3.1; zygomatic breadth, 15.6; lambdoidal width, 12.2; incisive foramina, 5.2; height, 9.6.

Remarks.—The type of *chapmani* can be matched exactly by several specimens from the Henry House and Moose Pass sections. Cranially, this race differs from *dalli* in very slight degree, having longer incisive foramina, smaller bullae, rostrum inclined to be longer and more slender, brain case narrower, and interorbital constriction extending for a shorter distance. These differences, however, are only average and too slight, in many cases, to prove of practical value in the usual diagnoses of a few random specimens. Typical *chapmani*, though, is always much duller and grayer than *dalli* (and to a proportionately greater degree, than *borealis*), and this constitutes the most reliable character for differentiation.

The Canoe River examples are rather bright for *chapmani*, but as they are without skulls, they are so identified provisionally on geographical grounds.

Specimens examined.—Total number, 41, as follows:

Alberta: Mount Forgetmenot, 1[34]; Rocky Mountains, 25 miles west of Henry House, 12; Shovel Pass, 10[34]; Smoky River, 5; Stony River, 2.
British Columbia: Canoe River, 6[35]; Glacier, 1 (the type)[36]; Moose Pass, 4.

SYNAPTOMYS BOREALIS WRANGELI Merriam

Wrangell Lemming Mouse

(Plate 2, D)

Synaptomys (*Mictomys*) *wrangeli* Merriam, Proc. Biol. Soc. Washington 10: 63, 1896.

Synaptomys (*Mictomys*) *truei* Merriam, Proc. Biol. Soc. Washington 10: 62, 1896. Type from Skagit Valley, Skagit County, Wash. Immature; No. $\frac{37938}{121101}$, U. S. Nat. Mus.; collected by C. B. R. Kennerly, August 6, 1859.

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[34] Nat. Mus. Canada.
[35] Nat. Mus. Canada, 5; W. E. Saunders coll., 1.
[36] Amer. Mus. Nat. Hist.

Type.—Collected at Wrangell, Alexander Archipelago, Alaska, by C. P. Streator, September 6, 1895. Male immature; No. 74720, U. S. Nat. Mus. (Biol. Surv. coll.); original number 4871.

Geographic distribution.—Coastal strip in the Canadian Zone from the Alexander Archipelago southward to the northern border of the United States. (Fig. 10.)

General characters.—A race that is quite variable in coloration, with very low, flat brain case, rather slender rostrum, and anterior nasal aperture very much arched.

Color.—In coloration, ranging from skins that are a perfect match for the brightest, brownest *dalli*, to others that can not be told from gray and grizzled specimens of *chapmani*, but the warmer tone of color seems to be somewhat the more prevalent and to be more typical of the unworn condition of pelage.

Skull.—Skull apparently rather small. Brain case very flat and relatively broad, with postorbital borders square. Rostrum inclined to be slender, with anterior nasal aperture much arched. Zygomatic arches inclined to be weak and palatal pits shallow. Outer reentrant angle of last lower molar usually shallow.

Measurements.—Average of measurements in the flesh of four adult topotypes: Total length, 133; tail, 25; foot, 16. Average of the four largest skulls: Condylobasilar length, 23.6; rostral length, 5.9; rostral breadth, 4.8; interorbital breadth, 3.1; zygomatic breadth, 15; lambdoidal width, 11.8; incisive foramina, 5; height, 8.7.

Remarks.—The race *wrangeli* is rather weakly defined, the chief and only reliable criterion for its identification being the lowness and flatness of the brain case, although the squareness of the postorbital borders, the inclination toward slenderness of the rostrum, and high arching of the anterior nasal apertures are of additional aid in distinguishing this race from its neighbors. All topotypical skulls are undeniably small, but there seems to be no individual among them that is really old and fully mature. As previously mentioned, coloration is not of diagnostic value. The type is decidedly immature and its skull narrower and relatively higher than that of any topotype at hand.

The race *wrangeli* certainly can not be considered as confined to Wrangell Island. An adult from Anan Creek, on the adjacent mainland, has the characters of *wrangeli* more sharply defined than in the case of any topotype available, although the skull is somewhat larger. At any rate, the type locality is hardly sufficiently segregated from the mainland for the existence of a purely insular race of a genus that is not particularly plastic.

Specimens from the coast of British Columbia opposite Queen Charlotte Islands, as well as most of the individuals from the mainland of Alaska, are too young to be identified unqualifiedly.

The writer has debated long concerning the advisability of recognizing "*truei*," and believes it likely that, with perfectly satisfactory material, average differences would be found that would conceivably justify its separation from *wrangeli*, but not on the basis of specimens now available. *S. wrangeli* is a weak race and variable, even in the case of topotypes, and nothing can be gained by adding another and even weaker race to the southward.

The skull of the type of "*truei*" is a juvenile smashed to bits, and there is nothing left of any value except parts of the mandible and the teeth. The original description states that it may be distinguished by the fullness of the molar loops and by the depth of the reentrant angle upon the outer side of the last lower molar. The former case is quite usual in the case of young animals, and the latter is no different from conditions in several skulls of both *dalli* and *chapmani*, nor are the other Washington specimens peculiar in this respect. The posterior part of the brain case of these last is a trifle less flat than is the average in *wrangeli*, but the sum of other cranial characters, including the incisive foramina, places the skulls closer to this race than to *chapmani*.

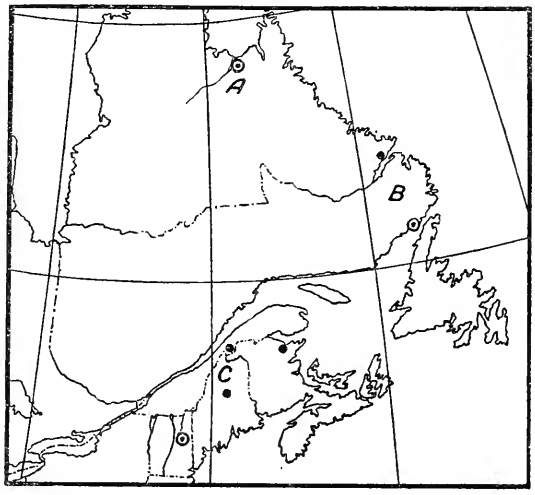

FIG. 11.—Distribution of the eastern forms of the subgenus Mictomys. Open circles indicate type localities; solid spots, other specimen records. A, *S. b. innuitus;* B, *S. b. medioximus;* C, *S. b. sphagnicola*

In the case of one specimen from Mount Baker, Wash., the coloration is of the bright type that is somewhat more prevalent in *wrangeli*, but the others are duller than *chapmani*, this being chiefly due to the fact that the pelage is shorter and more worn.

Specimens examined.—Total number, 33, as follows:

Alaska: Anan Creek, 1 [37]; Chickamin River, 1 [38]; Port Houghton, 1 [37]; Port Snettisham, 1 [33]; Quadra Lake, 1 [37]; Sumdum Village, 1 [37]; Thomas Bay, 1 [38]; Wrangell, 8 (including type) [39].
British Columbia: Metlakatla, 4 [40]; Port Simpson, 1.
Washington: Mount Baker, 12 [41]; Skagit Valley, 1 (type of "*truei*").

SYNAPTOMYS BOREALIS INNUITUS (TRUE)

UNGAVA LEMMING MOUSE

(Plate 2, A)

Mictomys innuitus True, Proc. U. S. Nat. Mus. 17: 243, 1894.

Type.—Collected at Fort Chimo, Ungava, Canada, by L. M. Turner in the spring of 1884.—Female adult; No. $\frac{24729}{14838}$, U. S. Nat. Mus.

Geographic distribution.—Known only from Fort Chimo (fig. 11).

General characters.—Skull very small and flat, with short and narrow rostrum.

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[37] D. R. Dickey coll.
[38] Mus. Vert. Zool.
[39] U. S. Nat. Mus., 5; D. R. Dickey coll., 3.
[40] U. S. Nat. Mus., 3; Nat. Mus. Canada, 1.
[41] Washington State College.

Color.—Not dependable, as the type has been in alcohol ever since collected.

Skull.—The skull of the type, long since removed from the alcoholic specimen, is very small and flat with brain case relatively long. The rostrum is narrow and tapering, and the interparietal moderately developed. The interorbital ridging is sharply defined with median sulcus obliterated, thus indicating that it is fully adult. Molars, very narrow and pale.

Measurements.—Skull of type: Condylobasilar length, 23; rostral length, 5.8; rostral breadth, 4.8; interorbital breadth, 3.3; zygomatic breadth, 15.1; lambdoidal width, 11.6; incisive foramina, 4.7; height, 8.7.

Remarks.—The type of *innuitus* may be distinguished from adults of any other race of Mictomys by its very small size, short, narrow rostrum, and small incisors, and from all other forms except *wrangeli*, by the lowness of the brain case. The paleness of the teeth may well be due to the action of the preservative. Of course, no safe conclusions can be drawn from the body distorted by alcohol, and it can merely be assumed that the characters exhibited by the skull of the type will prove to hold good for all the individuals of the region.

Specimens examined.—One (the type).

SYNAPTOMYS BOREALIS MEDIOXIMUS Bangs

Labrador Lemming Mouse

Synaptomys (Mictomys) innuitus medioximus Bangs, Proc. New Eng. Zool. Club 2: 40, 1900.

Type.—Collected at L'Anse au Loup, Labrador, by E. Doane, April 15, 1899. Male subadult; No. 8852, E. A. and O. Bangs coll.; original number 7.

Geographic distribution.—Known only from the coast district of southern Labrador (fig. 11).

General characters.—Coloration bright. The skull is intermediate in size between those of *innuitus* and *sphagnicola.*

Color.—The type, in very full pelage, is quite bright dorsally. Anteriorly the coloration is slightly darker, because, in large measure, of the more plentiful admixture of black-tipped hairs. Feet and tail dark, the latter scarcely bicolor. Underparts, without buff.

Skull.—The immature skull of the type has practically no indication of interorbital ridging. The rostrum is moderately long, slightly tapered, and the nasals have no median constriction, their posterior terminations being wide. The interparietal is moderately wide and somewhat paraboloidal in outline.

Measurements.—Collector's measurements of the type in the flesh: Total length, 120; tail, 22; foot, 21; ear, 13. Of the skull of the type: Condylobasilar length, 24.5; rostral length, 6.2; rostral breadth, 5.1; interorbital breadth, 3.5; zygomatic breadth, 15.4; lambdoidal width, 12.2; incisive foramina, 5.1; height, 8.5.

Remarks.—The bright coloration of the type serves to distinguish it from all other eastern specimens of Mictomys available, but it is the only one in perfectly unworn pelage, and hence this difference must be considered with caution. The type is an immature animal

and there are so few existing specimens of the eastern races of the subgenus that it is impossible to predict with any certainty just what the chief characters of adult *medioximus* will prove to be. It is certain, however, that it has a larger skull, with better-ridged interorbital constriction than has the type, and it would not be surprising if it is finally shown to be extremely close to *sphagnicola*. It may be easily told from *innuitus* by its larger size, greater height, proportionately larger incisive foramina, and slightly longer and less tapering rostrum. The lateral margins of the nasals are also straighter and their posterior ends wider, but these details may not prove to hold constant. The foot is actually longer than in *borealis*.

The Hamilton Inlet example is too young for proper identification.

Specimens examined.—Total number, 2, as follows:

Labrador: Hamilton Inlet, 1[42]; L'Anse au Loup, 1.[42]

SYNAPTOMYS BOREALIS SPHAGNICOLA Preble

Preble Lemming Mouse

(Plate 2, B)

Synaptomys (*Mictomys*) *sphagnicola* Preble, Proc. Biol. Soc. Washington 13: 43, 1899.

Type.—Collected at Fabyans, near base of Mount Washington, N. H., by E. A. Preble, June 29, 1898. Male adult; No. 96543, U. S. Nat. Mus. (Biol. Surv. coll.); original number 2402.

Geographic distribution.—Canadian Zone in the northern New England States from the type locality north to include New Brunswick and the portion of Quebec east and south of the St. Lawrence River (fig. 11).

General characters.—A race with large, well-ridged skull, long rostrum, and narrow interparietal.

Color.—Dorsal coloration close to the Prout brown of Ridgway, which is most intense upon the rump; anteriorly duller, grayer, and more grizzled. Tail, distinctly bicolor.

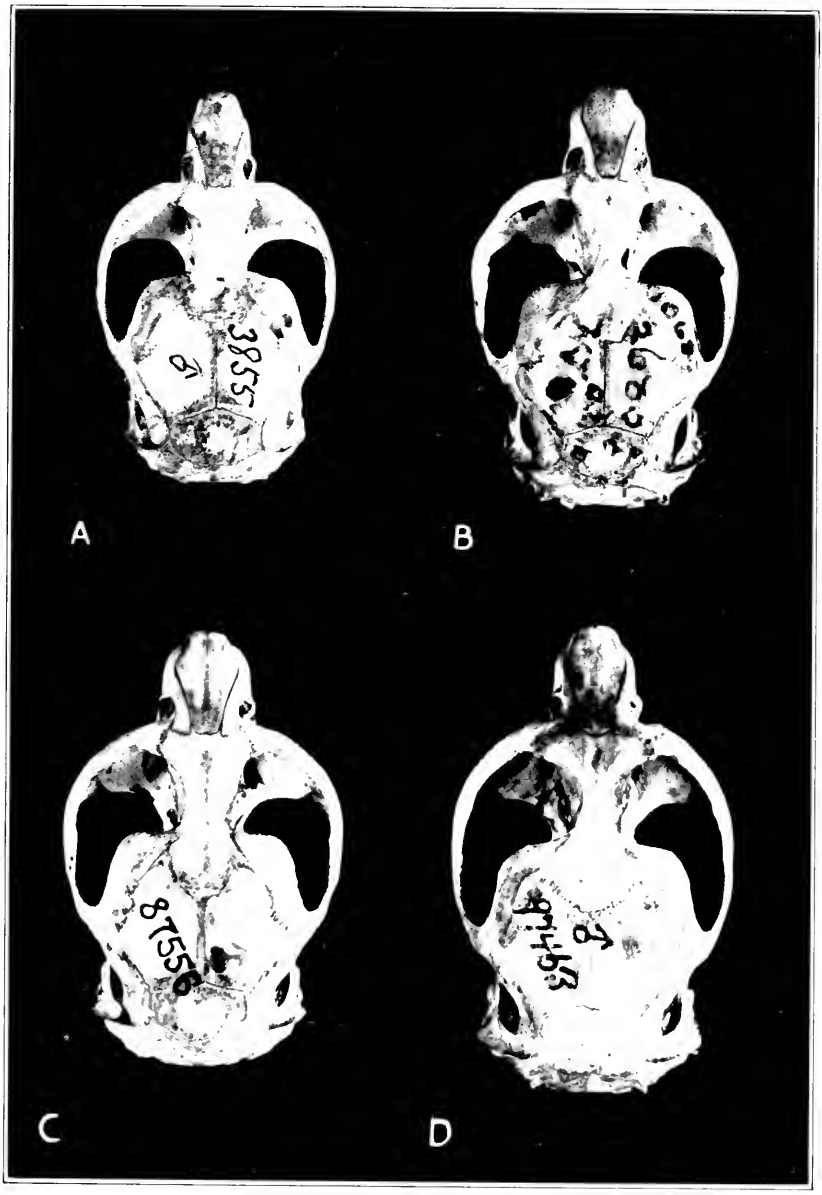
Skull.—Large and high with narrow interorbital sharply ridged, the ridges of the type being joined for a distance of 4 millimeters; interparietal narrow and rectangular. The rostrum is long, tapering very little, and the nasals, slightly constricted medianly, are quite narrow posteriorly. The incisive foramina are long and wide.

Measurements.—Collector's measurements of the type in the flesh: Total length, 132; tail, 24; foot, 20. Of the skull of the type: Condylobasilar length, 25.8; rostral length, 6.8; rostral breadth, 4.9; interorbital breadth, 2.8; zygomatic breadth, 16; lambdoidal width, 12.4; incisive foramina, 5.7; height, 9.3.

Remarks.—The supposed differences in external measurements between this race and *medioximus* are too slight to be used in diagnoses until series of both are available. The difference in coloration may or may not hold when individuals in the same stage of pelage can be compared.

Adult skulls of *sphagnicola* are distinguishable by their large size and length of rostrum, proportionately wide at the tip. It is hard to

[42] Mus. Comp. Zool.



SKULLS (DORSAL VIEWS) OF SUBGENUS SYNAPTOMYS

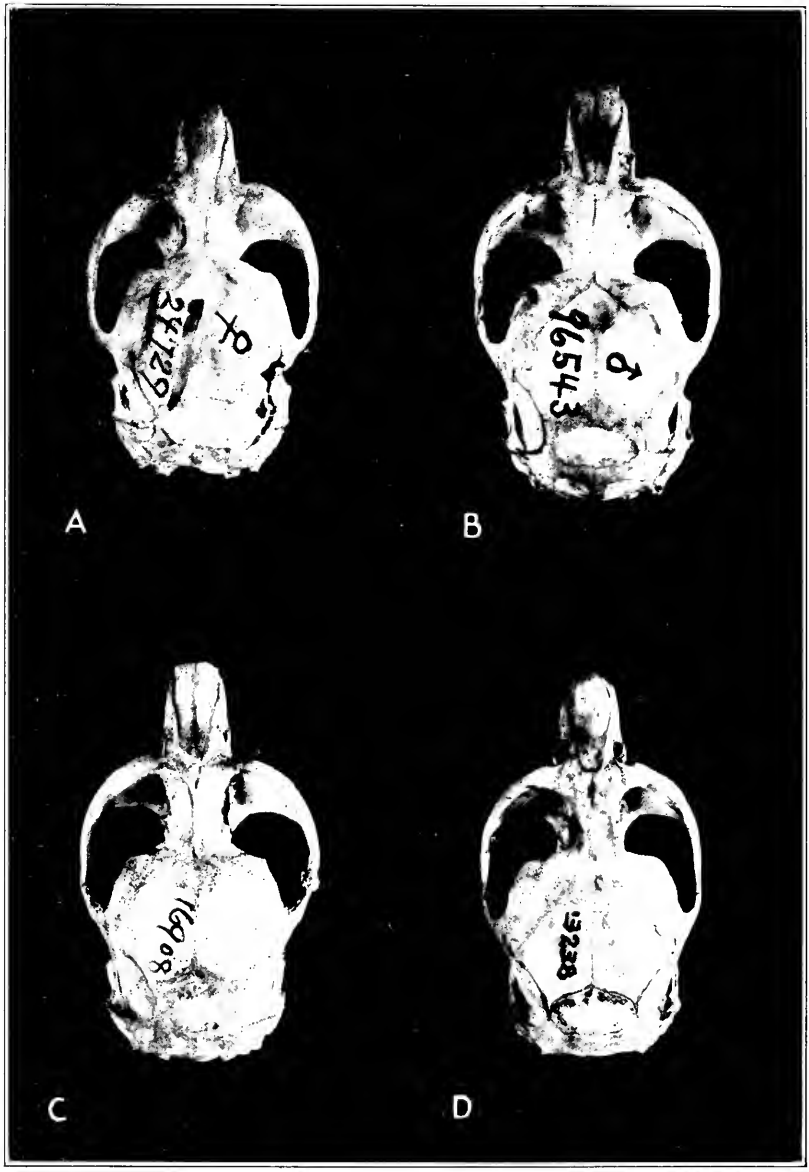
A. *Synaptomys cooperi cooperi*. Lake Edward, Quebec, Canada. Male adult. (No. 3855, Mus. Comp. Zool.)

B. *Synaptomys cooperi stonei*. Port Norris, Cumberland County, N. J. Male adult. (No. 10685, Acad. Nat. Sci. Phila.)

C. *Synaptomys cooperi helaletes*. Chapanoke, N. C. Female adult. (No. 87556, U. S. Nat. Mus., Biol. Surv. coll.)

D. *Synaptomys cooperi gossii*. Fort Leavenworth, Kans. Male adult. (No. 97463, U. S. Nat. Mus., Biol. Surv. coll.)

All twice natural size



SKULLS (DORSAL VIEWS) OF SUBGENUS MICTOMYS

A. *Synaptomys* (*Mictomys*) *borealis innuitus*. Type. Fort Chimo, Ungava, Canada. Female adult. (No. 24729, U. S. Nat. Mus.)
B. *Synaptomys* (*Mictomys*) *borealis sphagnicola*. Type. Fabyans, N. H. Male adult. (No. 96543, U. S. Nat. Mus., Biol. Surv. coll.)
C. *Synaptomys* (*Mictomys*) *borealis chapmani*. Type. Glacier, British Columbia, Canada. Male adult. (No. 16908, Amer. Mus. Nat. Hist.)
D. *Synaptomys* (*Mictomys*) *borealis wrangeli*. Wrangell, Alaska. Male subadult. (No. 3238; D. R. Dickey coll.)
All twice natural size.

predict what will be found to constitute the most valuable cranial characters in distinguishing this race from adult *medioximus*. The discernible differences now are in the shape of the interparietals, rostral characters, and interorbital differences that will probably not hold good when animals of the same age are compared.

Externally, specimens of *sphagnicola* may be told from *borealis* by the former being grayer (less brown) anteriorly, and by the longer foot. The most valuable cranial differences are the longer skull, in the case of the eastern race, and the proportionately longer rostrum.

The only one of the St. Rose specimens that is adult matches the type exactly. The example from near Bathurst is not adult and has a damaged skull, so is identified provisionally. All other specimens are too young for positive diagnosis.

Specimens examined.—Total number, 8, as follows:

Maine: Mount Katahdin, 2.
New Brunswick: Near Bathurst, 1.[43]
New Hampshire: Fabyans, 1 (the type).
Quebec: St. Rose, 4.

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NORTH AMERICAN FAUNA

No. 51

[JULY, 1928]

A TAXONOMIC REVIEW OF THE AMERICAN LONG-TAILED SHREWS

(Genera SOREX and MICROSOREX)

BY

HARTLEY H. T. JACKSON
BIOLOGIST, DIVISION OF BIOLOGICAL INVESTIGATIONS
BUREAU OF BIOLOGICAL SURVEY

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1928

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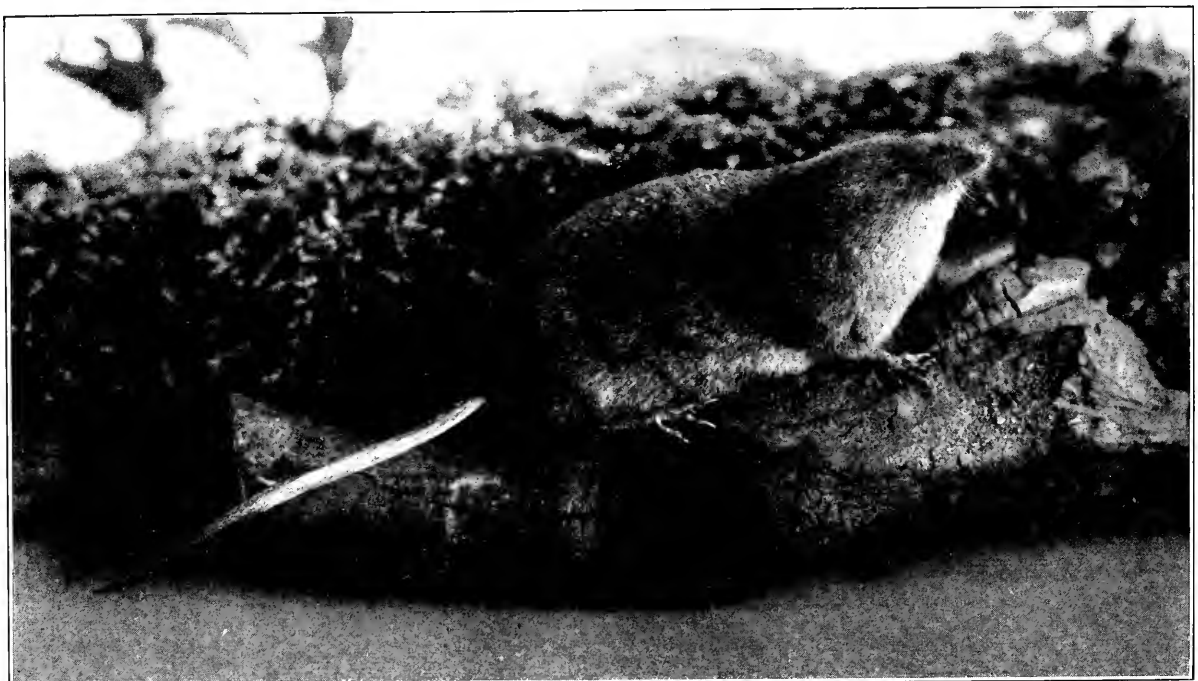

B382M

WHITE-LIPPED WATER-SHREW (SOREX PALUSTRIS ALBIBARBIS)

[Natural size]

From mounted specimen in the Lee Museum of Biology, Bowdoin College, Brunswick, Me. Female, collected April 11, 1909, at Brunswick, Me.

U. S. DEPARTMENT OF AGRICULTURE
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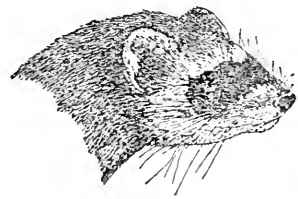
NORTH AMERICAN FAUNA

No. 51

[JULY, 1928]



A TAXONOMIC REVIEW OF THE AMERICAN LONG-TAILED SHREWS

(Genera SOREX and MICROSOREX)

BY

HARTLEY H. T. JACKSON
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A TAXONOMIC REVIEW OF THE AMERICAN LONG-TAILED SHREWS

(GENERA SOREX AND MICROSOREX)

By HARTLEY H. T. JACKSON

INTRODUCTION

No other group of American mammals having a wide distribution, and in many localities an abundance of individuals, is so little known to the nonprofessional mammalogist as the long-tailed shrews belonging to the genera Sorex and Microsorex. Neither are the individuals of any other group of common mammals so seldom seen in life by the professional field mammalogist, nor are the habits of such individuals less known to him. And probably no other group of mammals offers so many difficulties and problems in the way of taxonomic study. These arise from numerous features, no one of which may be peculiar to shrews, but the combination occurs in no other large group of mammals. The small size of shrews makes slight errors of measurements, external or cranial, large proportionally, and makes necessary the constant use of the microscope for the study of cranial and dental characters. The absence of color pattern, and a definite color variation between species that in many cases seems scarcely more than individual, makes identification by color alone possible only in a comparatively few instances. The early anastomosis of the separate cranial bones into one compact whole, which occurs while the animal is yet juvenile, makes comparison of the various individual bones of the skull impossible; all outlines of the individual cranial bones are lost in adult shrews. The simple dentition of shrews offers little opportunity for differentiation of form or cusps. Variability of skulls and teeth due to age of the individual is excessive, so much so that the skull of an adult animal may appear entirely unlike the skull of a young animal of the same subspecies; great care must therefore be exercised in making comparisons to be certain that the individuals are of corresponding age and development. Finally, there is a wide range of individual cranial variation, particularly in the size of the skull; shrews seem more prone to produce "runty" skulls or abnormal dentition than most other mammals.

In popular parlance the American long-tailed shrews might superficially be divided into four groups, namely, the long-tailed shrews proper, the saddleback shrews (the *arcticus* group), the water shrews (*palustris* group), and the marsh shrews (*bendirii* group). So little are shrews known to the layman that when actually seen they are generally confused with mice, though in reality as closely related to

wolves or foxes as to mice. Occasionally, however, they are distinguished by modifying terms, as in sections of Alaska, where O. J. Murie reports that they are known as "sharp-nosed mice"; or in the Gallatin country of Montana, where C. W. Richmond says they are called "dormice," or in the Jackson Hole region of Wyoming, where, according to Alexander Wetmore, the water shrews are known locally as "fish-mice." In many localities shrews are known as "moles" or "young moles," and the water shrew as "water mole." One of the most peculiar local names is reported by A. K. Fisher, who says that in Dismal Swamp, Va., *Sorex longirostris fisheri* is called "smell fast." Shrews are known to some of the Indian tribes, who have special names for them; thus, the Chippewas of northern Wisconsin and Minnesota know the little animals as "oke-pa-ku-kue" or "oke-pa-kue-kue"; the Klamath Indians call *S. vagrans* "shu-zhi"; Vernon Bailey (manuscript notes) reports that the Taos Indians of New Mexico recognize the shrew under the name "pah-ka-che-una"; and the Kwakiool name for the mole or shrew in British Columbia is "kiap-kepu-s" (Dawson, 1888, p. 93). The common shrew of eastern Canada (*S. cinereus*) was known to the Labrador Eskimos as the ukounavik (Packard, 1866, p. 266). According to Nelson the long-tailed shrew was known to the Alaskan Eskimos as the "u-gu-gi-nuk," and when it was found strayed out on the sea ice by them, it was the subject of a curious superstition.

> They claim that there is a kind of water shrew living on the ice at sea which is exactly like the common land shrew in appearance, but which is endowed with demoniac quickness and power to work harm. If one of them is disturbed by a person, it darts at the intruder and burrowing under the skin, works about inside at random and finally enters the heart and kills him. As a consequence of this belief the hunters are in mortal terror if they chance to meet a shrew on the ice at sea, and in one case that I knew of a hunter stood immovable on the ice for several hours until a shrew he happened to meet disappeared from sight, whereupon he hurried home, and his friends all agreed that he had had a very narrow escape. (Nelson, 1887, p. 271.)

DISTRIBUTION AND HABITAT

The genus Sorex is distributed throughout a large portion of the continents of Europe, Asia, and North America. It is absent from the extreme southern and torrid sections and more abundant both in species and individuals in the north-temperate and boreal parts. In North America the range of the genus extends over the entire northern part of the continent from the Arctic Ocean south to northern Florida and Alabama in the eastern United States; Indiana, Illinois, and Nebraska in the middle United States; and in the higher elevations of the mountains of the West to Guatemala. The range of the water and marsh shrews (subgenera Neosorex and Atophyrax) extends from southern Quebec, Ontario, Manitoba, southern Northwest Territories, northern British Columbia, and southeastern Alaska, south to Pennsylvania, Wisconsin, and Minnesota in the eastern United States, to Arizona and New Mexico in the Rocky Mountains, to the Mount Whitney region, California, in the Sierra Nevada, and along the Pacific coast to northern California. The range of the genus Microsorex extends from northern Quebec, northern Ontario, and central and western Alaska south to the northern United States.

The characteristic habitats of long-tailed shrews are moist situations with an abundance of vegetation, such as mossy and grassy banks along streams, meadows, sphagnum bogs, and damp woods, particularly of coniferous trees. There is, however, considerable variation in the dominant habitats among the various species, while certain of the common forms seem less restricted in habitat and may be found at times in associations that could hardly be considered characteristic of the particular species. For example, the species *cinereus* is of wide distribution and ordinarily may be expected in the normal shrew habitat of damp woods, mossy banks of streams, coniferous swamps, and sphagnum bogs: yet there are numerous records of specimens of this species taken in houses and other buildings, particularly in the far north, and of other individuals in dry woods and meadows in the eastern United States. The species *fumeus* is most frequently reported from hemlock woods, but may occasionally occur in meadows near timber.

As a general rule, *Sorex vagrans* prefers damp meadows and *S. obscurus* the mossy banks of streams; at any rate, in many regions where the two species occur, as, for example, *S. v. amoenus* and *S. o. obscurus* in the Sierra Nevada, a majority of each species is trapped in the respective habitats indicated above. In regard to the trapping of a specimen of *S. o. obscurus* in the Manzano Mountains, N. Mex., J. H. Gaut remarks in his field report:

> A gopher trapped in a tunnel made by the animal was discovered to have a small opening in its side with parts of the intestines gone and immediately upon discovering this fact I removed the specimen and replaced it with a small trap baited with some of the remaining portions of the intestines. An hour later the trap was visited and found to be holding fast one of these little shrews. The hole in which the trap was placed was thoroughly covered with dirt, in such manner that no animal could possibly have entered at that particular place.

In the coast region of Washington it is known that *S. o. setosus* frequently inhabits the runways of moles (Scapanus). The species *obscurus* is also occasionally found in buildings, but such cases must be considered exceptional.

Habitat records of the rare *Sorex dispar* would indicate that the species usually lives among rocks. It is said that the type specimen was trapped among some large, angular rocks at the head of a wooded talus of loose rock just below low cliffs, which shaded the spot and kept it cool, and that a second specimen was taken in a crevice between some rocks on the bare, open summit of Mount Marcy, N. Y. (Batchelder, 1896, p. 133.) Mearns also records the species as being trapped in hollows under mossy stones, usually in wet balsam or spruce woods, or in weedy swamps, in the Catskill Mountains, N. Y. (Mearns, 1898, p. 356); and at Mount Greylock, Mass., Copeland caught one specimen under a rock at the edge of a moist grassy clearing surrounded by woods, and another near a small brook in swampy woods of spruce, hemlock, and scattered birches thickly carpeted with sphagnum (Copeland, 1912b, p. 162). The first known specimens of *S. gaspensis* were all caught near small streams. One was trapped among dead tree stumps that were lying partly submerged and almost surrounded by water and shaded by overhanging spruce trees. A second was procured in a trap set in such a position at the foot of a low cliff facing a stream that the animal must have passed through

shallow water to reach the trap; a dark, damp forest spread on all sides; deep moss covered the ground and obscured the stream in places, and many trees bore hanging moss. The third specimen was caught along a small stream that came through a narrow canyon on a cool, north slope covered with a forest of spruce and balsam; the trap was set among driftwood and wet leaves between bowlders. (Anthony and Goodwin, 1924, p. 1; Goodwin, 1924, p. 252.)

One of the western species, *Sorex trowbridgii*, may be found in the regulation damp, mossy habitat of long-tailed shrews, but it also displays a marked preference for the drier woods, and in parts of western Washington and Oregon it is frequently most abundant in dry fir timber.

The two closely related species *Sorex merriami* and *S. leucogenys* have an unusual habitat for shrews, in that they have been found only in an arid sagebrush association. The type and only known specimen of *S. tenellus* was also collected among loose rocks on a dry hillside a long distance from water.

The water shrews (subgenus Neosorex) are seldom found at any great distance from water, which may be a lake or pond, a brook, or merely a pothole in a swamp, bog, or forest. They seem to prefer a more or less wooded habitat and are rarely found in marshes devoid of bushes or trees. They tend to be more boreal than members of the subgenus Atophyrax and in the western United States are usually found at the higher altitudes in the Canadian Zone. Nevertheless, in March, 1920, G. G. Cantwell collected three specimens at an altitude of about 300 feet at Rockport, Skagit County, Wash. The streams in which these specimens were caught, however, came down from mountains 4,000 to 6,000 feet high not more than 2 miles distant.

The marsh shrews (subgenus Atophyrax) seem to be less truly aquatic than the members of the subgenus Neosorex, and although found in damp woods and other habitats such as are frequented by Neosorex, they also occur in tule or sedge marshes. At Lake Cushman, Wash., in the midsummer of 1894, C. P. Streator caught three specimens in traps baited with rolled oats and set on an old beaver dam.

Shrews of the genus Microsorex do not seem to differ particularly in their habitat preference from certain members of the genus Sorex, as, for example, *cinereus*. Such reports as are available indicate that the pigmy shrews are most frequently found in damp woods, sometimes of deciduous trees. But they are also found in tamarack swamps and muskegs, and occasionally in marshes and even in dry woods. The type specimen of *Microsorex h. washingtoni* was found dead in a trail in dry pine woods. E. A. Preble reports one of this genus taken January 4, 1904, in the potato cellar of a dwelling house at Fort Simpson, Northwest Territories, Canada. Of the first two specimens of *M. h. winnemana* collected, one (type specimen) was captured in the decayed interior of a fallen log in mixed woods of maple and other deciduous trees and the other was found in the decayed heart of a dead chestnut tree on a dry hillside some distance from water. The third specimen of *winnemana* was captured by G. W. J. Blume, who sent it to Wirt Robinson, who in turn pre-

sented it to the United States National Museum. In a letter to Colonel Robinson Mr. Blume states:

As I recall the capture of the shrew, I noticed movements in the leaves on one of the hillsides on my place at Alta Vista, Va., and thinking it to be a mole plowing the surface as they sometimes do in gravelly or very rooty ground, I started to scratch among the leaves to catch it. The shrew started to run and I caught it in my hands. I think there was a rock pile not far distant which was probably its home. It was in dry, wooded land, probably not over 100 yards from running water but not close to a swamp. There was no dense underbrush, but plenty of natural concealment afforded by the leaves, rocks, old logs, etc., in the vicinity.

HABITS

Long-tailed shrews are such elusive midgets and such meager definitely planned research has been done on their life history that comparatively little is known about their habits. That the various species have certain general habits more or less in common is self-assertive, but that the different species also have specialized habits varying to meet their different habitats and environments is also evident. For example, one could hardly assume that the habits of the semi-desert species, *Sorex merriami*, would be similar in detail to those of *S. dispar*, which inhabits the comparatively cool, humid coniferous forest region of the eastern United States. Yet almost nothing is known about the specialized habits of either of these species. Shrews are the active, vicious, voracious little imps of the mammal world. They are largely nocturnal, but are not infrequently active during the daytime, particularly under the snow in winter or during cloudy weather at any season of the year. They are apparently active during the entire winter and do not hibernate, although they have small hibernating glands, and it has been erroneously written that they do hibernate. (Ärnbäck-Christie-Linde, 1907, p. 466.) They live for the most part in little burrows and runways underneath logs, rocks, leaves, and grass, where they hunt insects and worms. These runways may be made by the shrews themselves or by various species of mice or other shrews. At Tuckerton, N. J., in the summer of 1892, E. A. Preble captured five specimens of *S. cinereus* under one of several small haystacks scattered over the meadows. Some of these were kept alive in a deep can for several hours. They constantly moved their long snouts in every direction, apparently depending more on the sense of touch and smell than on sight. Residents stated that during especially high tides at this place these shrews would be drowned out of their retreats and would fairly swarm on the driftwood. (Preble manuscript.)

Long-tailed shrews are exceedingly quick and active and move with a queer, jerky, trotlike run, starting and stopping abruptly. They may be considered almost strictly terrestrial, although they occasionally climb small branches of very low bushes, fallen trees, or herbs. Morris M. Green writes (manuscript) that while watching a deer runway on the north branch of Moose River in the Adirondacks, N. Y., during the summer of 1894, he saw a little shrew no bigger than a thimble, which climbed up a fern stock within 5 feet of him. Another shrew went through his pail of fishworms and ate every one of them. Though in no sense aquatic (except the subgenera Neosorex

and Atophyrax), they are good swimmers when occasion demands it of them. Long-tailed shrews evidently have a wide local range, as is witnessed by Nelson's observations in Alaska.

> After snow falls they travel from place to place by forcing a passage under the snow, and frequently keep so near the surface that a slight ridge is left to mark their passage. On the ice of the Yukon I have traced a ridge of this kind over a mile, and was repeatedly surprised to see what a direct course the shrews could make for long distances under the surface. These minute tunnels were noted again and again crossing the Yukon from bank to bank. (Nelson, 1887, p. 271.)

These little animals are exceedingly savage and voracious and will fight and devour one another upon least provocation. Merriam's account of how he confined three of them under a tumbler is familiar to many students:

> Almost immediately they commenced fighting, and in a few minutes one was slaughtered and eaten by the other two. Before night one of these killed and ate its only surviving companion, and its abdomen was much distended by the meal. Hence in less than eight hours one of these tiny wild beasts had attacked, overcome, and ravenously consumed two of its own species, each as large as itself. (Merriam, 1884a, p. 76; 1884c, p. 174.)

Over considerable periods of time, these little gluttons, when in captivity, have been known to eat their own weight in meat on an average of once every three hours. Early in the summer of 1900, W. H. Osgood caught two shrews in the same trap on Vancouver Island, British Columbia. One of them, not killed by the trap, proceeded to devour the other and had nearly accomplished it when Osgood visited the trap. H. H. Sheldon reports (manuscript) an instance in August, 1919, at Ogema, Wis., in which the entire tail of a shrew (*Sorex c. cinereus*) was all that remained in a trap, and about a foot away he found one dead with tail intact but with its head bruised and part of the skin torn from the nose and jaws. This one had evidently fought the one in the trap, the latter losing its tail but winning the fight. George G. Cantwell, in his field report from the Mount Rainier region, Wash., for the summer of 1919, states that on one occasion while he was setting traps beside a small stream a trap on the opposite side containing a freshly caught mouse was visited by a shrew (*S. vagrans*), which at once started feeding on the mouse. On account of its poor eyesight, the shrew failed to detect the observer only a few feet away, but as a twig snapped the little animal at once dodged into a hole in the bank and did not appear again. In a letter dated July 17, 1889, at Plover Mills, Ontario, R. Elliott writes that on May 21, 1888, he captured one (*S. c. cinereus*) under a small log among dry leaves. He placed it in a large bottle with plenty of air and gave it two earthworms, each of which it took by the "tail" and rapidly nipped through and through to the head and left it dead. The shrew afterwards ate part of one of the worms. Mr. Elliott then gave the shrew a May beetle, which it instantly attacked viciously. The sharp feet of the insect seemed to irritate the shrew to an inordinate degree, and at the end of two or three minutes the beetle was torn and entirely eaten. Ten minutes afterwards it was given another May beetle, which, too, was almost entirely eaten, the head and elytra alone remaining. About half an hour later the shrew died.

Very little is known in regard to the nests and home life of long-tailed shrews. They build nests of grass and leaves under logs, in

stumps, and similar situations, but few of these have been found, much less critically studied. On October 14, 1924, Stuart Criddle found eight young of *Sorex cinereus haydeni* several days old dead in a nest made of brome-grass leaves, with a few ground-cherry leaves on the outside, situated under a brome-grass sheaf near Treesbank, Manitoba. In the nest there was also the anterior part of the skull of an adult. Judging from the dates of collection of pregnant specimens, the height of the breeding season is June, July, and August, although a few have been taken as late as the last of September that had been nursing, and others contained embryos as early as March 29 in Inyo County, Calif., and the middle of May on Prince of Wales Island, Alaska.

From the data available as based upon the number of fetuses in specimens trapped, as recorded by collectors, it would appear that the number of young varies in different species. From these records *Sorex cinereus* appears to have the largest litters, with an average of 7.2 for 8 specimens, the minimum being 4 and the maximum 10. The average for 5 specimens of *S. palustris navigator* is 6 fetuses, minimum 5, maximum 7. In 8 litters *S. vagrans* has a minimum of 3 and a maximum of 9, with an average of 5.8. Sixteen records for *S. obscurus* show an average of 5.4 per litter, with a minimum of 4 and a maximum of 8; of these 16 litters one-half were of 5 each. A single specimen of *S. arcticus* had 6 embryos, as did also one of *S. ornatus*. Three embryos were found in a specimen of *S. t. trowbridgii*, and 4 in one of *S. t. mariposae*. The smallest number of fetuses recorded is 2 from the specimen of *S. leucogenys* from Mount Magruder, Esmeraldo County, Nev. This lone record may give a clue to one of the possible causes for the apparent scarcity of shrews of the *merriami* group.

Long-tailed shrews are preyed upon by numerous species of animals, although comparatively few of their enemies will eat them except in cases of extreme hunger. It is well known that domestic cats kill numbers of shrews but seldom eat them, and in olden times it was believed that shrews were poisonous to cats. Fragments of shrew skulls and bones are frequently found in owls' pellets; the only record of *Sorex longirostris* in Alabama is a complete animal, now in alcohol, taken from the stomach of a barred owl. This same species of shrew has been taken from the esophagus of a hooded merganser. (Audubon and Bachman, 1854, p. 250.) Hawks also are known to prey upon shrews occasionally, and one has been recorded from the stomach of a bear. (Osgood, 1907, p. 63.) Certain fishes, particularly trout, may at times catch them, and A. H. Twitchell in a letter dated September 18, 1917, at Flat, Alaska, reports finding during August of that year the remains of six shrews, probably *S. tundrensis*, in the stomachs of three graylings.

Aside from the numbers killed by natural enemies, long-tailed shrews seem to have an unusually high mortality rate, as compared with many mammals, as many of them are accidently trapped in ditches, springs, and wells. It is not at all unusual to find several dead shrews in an uncovered well or spring, and such accidental deaths have been responsible for several specimen records. Although members of the genus Sorex are pugnacious and physically strong in proportion to their size, they seem sensitive to any external

shock or stimulus, and individuals are not infrequently found dead on the surface of the ground. Undoubtedly some of these are killed by other animals and abandoned as unfit for food, but many show no signs of injury and appear to have perished merely from nervous shock, extremes of temperature, or the like. O. J. Murie in a field report states that a Mr. Quinn, of McGrath, Alaska, while traveling in the vicinity of Rainey Pass one winter during a continued severe cold spell, found numerous shrews frozen along the trail. The writer recalls a case late in August, 1919, at Ogema, Wis., when one of the field men in his party, who chanced to come upon a specimen of *Sorex arcticus laricorum*, which was running across a road, dropped a felt hat over the animal. He then carefully raised the brim of the hat, expecting to capture the shrew alive, but to his surprise the animal was dead, though apparently not touched by the hat. An interesting account of sensitiveness in a shrew has been described by Gillman (1876) as follows:

> In the heavily timbered forest in the neighborhood of Cheboygan, Mich., on a cold day in October, 1875, I caught a characteristic full-grown specimen of Thompson's shrew (*Sorex Thompsoni* Baird).[1] The pretty little creature had been busy about an old decayed stump, where it seemed to have its home. It uttered no audible cry, though at first it made several hostile demonstrations, endeavoring to escape, and, seizing my fingers in its mouth, tried to bite them, but the delicacy of its teeth rendered the attempt futile. Having no suitable place in which to deposit it, I carefully wrapped it in paper, allowing its head to protrude, and held it in my hand. Some sportsmen were out shooting on the bay about a mile off, and the reports of their guns came to us from time to time, generally so much muffled by the distance as to be barely distinguishable, yet the shrew invariably responded to each detonation with a quick, spasmodic movement, evidently of alarm. Holding the animal as I did, the movement was immediately perceptible. Though aware that the acuteness of the auditory organs of these animals and their allied genera is most wonderful, I was hardly prepared for so unequivocal a proof of its extreme sensitiveness, which, under the circumstances, I was enabled to test repeatedly in this individual Sorex.
>
> It was my intention to preserve the animal alive, and take it with me on my return home for further experiment and study of its habits; but, to my regret, on unfolding the paper on my way to the house at which I was staying I found the shrew had died. I have little doubt that its death was caused by fright, as I handled it most carefully so as not to hurt it.

Long-tailed shrews seldom use a call note and, as a rule, are not noisy animals. The writer has heard *Sorex c. cinereus* utter a series of sharp squeaks and also a weak purrlike grunt. Charles W. Richmond in his field report states that he observed a shrew (probably *S. o. obscurus*) in Gallatin County, Mont., and says that it frequently stopped to sniff the air suspiciously and occasionally uttered a "little snort." When fighting, either against members of their own species or other enemies, they frequently indulge in much squeaking and make a considerable noise for such mites. In the Mount Hood region, Oreg., in the spring of 1919, George G. Cantwell caught a *S. t. trowbridgii* in his hand from under a flake of bark. The shrew fought vigorously "with much squealing" and finally squirmed out of the grasp of its captor and disappeared like a ghost, for no conspicuous hole or apparent cover was in the vicinity to afford concealment.

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[1] This name is a synonym of *Microsorex hoyi thompsoni* (Baird), but Gillman's animal was probably *Sorex cinereus cinereus* Kerr.

The habits of the water shrews (subgenus Neosorex), so far as known, do not differ essentially from those of other shrews, except in adaptations to a more aquatic habitat. Water shrews rank high among the best swimmers of the nonmarine mammals, although opportunities for observing them in the act of swimming are rarely presented. They can swim, dive, float, run along the bottom of a pool or creek, or actually run on the surface of the water with the greatest ease. In a bog near Rhinelander, Wis., in August, 1906, the author saw one run a distance of about 5 feet across a small pool, the surface of which was glossy smooth. The body and head of the animal were entirely out of water, the surface tension of the water supporting the shrew, and at each step the animal took there appeared to be held by the fibrillae on the foot a little globule of air, which was also discernible in the shadow at the bottom of the pool, exactly as one might notice in the case of the water strider (*Gerris remigis*). (Miall, 1903, p. 12, 349.) It is probable, however, that this water-walking feat can be accomplished by water shrews only when the water is very still and quiet, and in running or rough water it would seem that the animals would be required to swim.

Walter P. Taylor in his field report for Cat Creek, Clallam County, Wash., states that on the evening of September 5, 1921, he saw a *Sorex palustris navigator*, which he at first mistook for a frog, in a shallow "running" creek. He noticed that it was walking rather jerkily through the water, at first in water not so deep but that it could touch the rocks beneath, but soon in water that must have been beyond its depth. It did not sink, but remained half exposed, "walking" rapidly along on top of the water. The animal had a dry, fluffy appearance.

Edward A. Preble saw one running on the water, July 27, 1910, in a small creek some 25 miles east of Telegraph Creek, British Columbia. He noted that the shrew followed the edge of the stream close to the bank and seemed scarcely to sink at all below the water line but gave the impression rather of running on the water film, progressing at a good rate and making only very slight ripples.

At the Three Sisters, Oreg., in July, 1914, Vernon Bailey caught a *S. p. navigator* in his hands, tied a string to its leg, and put it in the water. At first it fluffed out its fur and "sat on top of the water like a duck." Lowering itself into the water, it swam rapidly, though using but one foot, to a log, upon which it climbed. Then it would dive and dart about under water like a silver fish, going to the bottom and under logs and sticks, apparently seeing or knowing its way and just where to hide. According to Bailey, it swam with relatively greater speed and skill than the otter, which always seemed to him the most wonderful mammal in the water.

George G. Cantwell observed one in the Mount Rainier region, Wash., in the summer of 1919, which ran rapidly through the shallow water of a swift mountain stream, and swam or dived through the deeper pools with great speed, using all four feet in swimming with the same motions it used in running over the ground. While under water the thick coat of fur of the animal was surrounded by a silvery layer of air, and when the animal came to the surface again it appeared to be dry.

A. Brazier Howell (1924, p. 27) states in regard to an individual of *S. p. navigator* that "it dived and swam under a bank so quickly that I had opportunity to be sure of nothing except that while swimming it kicked both hind feet in unison after the manner of a frog." This method of swimming is at variance with the observations of others.

An interesting note on this same species made by the late Theodore Roosevelt is extracted from a letter (manuscript) of his dated November 26, 1888:

> I was near Kootanei Lake, in British Columbia, and while taking lunch near a small rapid brook I saw a Water Shrew swimming down it. While swimming its body looked like a flattened disc studded with silvery bubbles. It ran along the bottom and over the rocks very fast, and swam and dived well. I saw it catch a very minute fish and eat it on a wet, water-washed stone. At last by an under grab I caught it. Its tail was conspicuously longer than its head and body, and it was, without doubt, a Neosorex. I skinned it with my pocket knife and put a little hoop in the reversed skin, but as I was traveling very light, had to put it in my pocket. That afternoon I shot a bear and camped by it, being very hungry. I put the little Shrew skin out on a log and turned away a moment, and to my horror, in the interval the Indian who was with me threw the log into the fire, and of course the skin vanished. I was really very sorry.

FOOD AND ECONOMIC STATUS

Shrews are chiefly insectivorous in their food selections, but they will eat other flesh and occasionally vegetable matter. Stomach examinations of true Sorex, including representatives of the species *cinereus*, *fumeus*, *longirostris*, *vagrans*, *obscurus*, and *trowbridgii*, have shown the following among the contents: Hymenoptera, Coleoptera, Diptera (both larval and adult), caterpillars, crickets, spiders, hair and flesh of shrews and mice, and moss, seeds, and other vegetable material. That shrews are not entirely averse to certain vegetable food is attested by the manner in which they will eat rolled oats placed on baited traps. Their food probably does not vary much with the seasons, for shrews, being active in winter and feeding as they do mostly in burrows in the ground and in runways under the leaves, obtain dormant and pupating insects during the colder months of the year. Shrews are known to eat earthworms, although stomach examinations have not shown earthworms in the contents. The food of the water shrew (subgenus Neosorex) does not appear from stomach examinations to differ much from that of other shrews. The water shrew is known to eat small fish, however, and is also reported to feed upon fish eggs. It seems probable that a detailed study of its food would show the insects consumed to be more of aquatic species than those taken by other shrews. Also the stomach examinations of marsh shrews (subgenus Atophyrax) show no marked differences from those of other shrews, although 35 per cent of the contents of one stomach was snails. Nothing is known of the food of the members of the genus Microsorex.

Since shrews are such voracious eaters and feed principally upon insects with an occasional dessert of young mice, they are of considerable economic value in holding down certain pests of agriculture and forestry. Unfortunately, they are usually mistaken for mice by the layman and killed on sight. In parts of the extreme north, par-

ticularly in Alaska, long-tailed shrews are sometimes reported as a nuisance on account of their climbing into caches of fresh meat or fresh or dried fish, some of which they eat and the remainder ruin with their filth. In these same regions they may also become a nuisance in houses during winter. Water shrews, also, are occasionally reported to do damage in fish ponds and trout streams by destroying fish and fish eggs, but these shrews are not plentiful enough to do any serious damage except locally, and then but rarely. On the whole, shrews are among the most beneficial mammals.

YOUNG

Only scant information is available on the young of the genera Sorex and Microsorex. The litter of eight of *Sorex cinereus haydeni* collected by Stuart Criddle, at Aweme, Manitoba, and already referred to (*antea*, p. 7), are the youngest long-tailed shrews that the writer has seen. Although of indeterminable age, they are undoubtedly at least 10 or more days old and more than half the size of adults. They are covered with very short hair, and the tails are proportionately somewhat shorter than in adults. In all probability shrews are born blind, hairless, and, relatively speaking, but slightly developed. Following birth, however, it would seem that development and growth is comparatively rapid, although they remain in the nest until well along toward maturity. It is this habit of remaining in the nest until so nearly mature that makes young shrews so scarce in collections.

In the Criddle specimens the partly developed molariform teeth and first incisors appear above the alveola, while the unicuspids are still covered by the dermis, and difficult to detect in gross examination.

The only other young examined is a litter of five *Sorex longirostris fisheri* collected in May, 1905, by W. L. Ralph and J. W. Daniel, jr., in Dismal Swamp, Va. The young in this litter appear to be a few days older than those in the litter of *S. cinereus haydeni*, and offer no juvenile peculiarities not shown in the other litter.

WEIGHT

Among the species of long-tailed shrews are the smallest of American mammals, and even the larger forms are no bigger than some of the smaller species of mice. The smallest American shrew is *Microsorex hoyi winnemana*, which may also be the smallest mammal known. There are no weights available for this subspecies, however, nor for any others of the pigmy shrews (Microsorex), except two male specimens of *M. h. hoyi* collected by Bernard Bailey at Elk River, Minn. One of these, taken on March 25, 1926, weighed 2.1 grams; the other, collected two days later, weighed 2.9 grams. Neither of these was fat nor was the stomach of the latter so full as that of the first, although the latter weighed more.

Two females of *Sorex cinereus haydeni* weighed by Vernon Bailey at Walhalla, N. Dak., each weighed 3.3 grams, while a third collected

at that time weighed 3.6 grams. Bailey also weighed specimens of *S. c. cinereus* at Michigamme, Mich., late in the summer of 1923, the weights ranging from 3.5 to 5.5 grams. In the Stikine River region of British Columbia, in 1919, Joseph Dixon weighed several specimens of *S. c. cinereus*, 15 adults of which averaged 4.5 grams, with a minimum of 2.8 grams and a maximum of 6.1. Part of these specimens were approaching *S. c. streatori*, which is a larger subspecies than typical *cinereus*. Two males of *S. c. cinereus* collected and weighed by O. J. Murie at Fairbanks, Alaska, January 19, 1922, balanced at 2.7 and 2.8 grams, while a female October 14, 1921, from the same locality weighed 2.84 grams. Another female of this same subspecies collected by Murie February 18, 1922, on the South Fork of the Kuskokwim River, Alaska, weighed 2.85 grams.

Two males of *Sorex v. vagrans* collected at Puyallup, Wash., July 4, 1914, were weighed at 7 grams each by T. H. Scheffer. Eighteen specimens of *S. o. obscurus* from the Stikine region of British Columbia, as weighed by Joseph Dixon in the summer of 1919, averaged 6.9 grams, with a minimum of 4.8 grams and a maximum of 8.7 grams.

Seventeen western water shrews (*Sorex palustris navigator*) collected by parties from the Museum of Vertebrate Zoology, University of California, in various parts of the Sierra Nevada, but chiefly from the Yosemite region, California, averaged 12.3 grams, the minimum being 9.1 grams and the maximum 19.5 grams. A single individual of the marsh shrew (*S. b. bendirii*), a female collected October 14, 1914, at Puyallup, Wash., was found by T. H. Scheffer to weigh 12 grams.

The above data must not be taken for more than their actual value, for the weighing of a few specimens in the field is unsatisfactory for comparative use. Certain individual specimens may be fat, others lean or emaciated; some may be heavy with young, others worn and of light weight from the care of young; young and old may offer different weights; some individuals may be gorged with food, others empty; even the molting process might affect the weight of the animal. For purposes of comparative weights of different species it is therefore essential to weigh individuals that are in every respect in corresponding physical condition, and large series of them. The foregoing weights are therefore merely suggestive of the comparative weights of a few species.

EXPLANATIONS

EXTERNAL MEASUREMENTS

External measurements of shrews, unless otherwise stated in the text, are in millimeters and are those made by the collector from the animal in the flesh. The following have been used:

Total length.—Tip of nose to end of terminal tail vertebra.

Tail vertebrae.—Base of tail at superior surface to end of terminal tail vertebra.

Hind foot.—Posterior border of heel to apex of longest claw.

CRANIAL MEASUREMENTS

Cranial measurements, unless otherwise stated, were made by the author with a vernier caliper. The following (fig. 1) have been employed:

Condylobasal length.—Antero-posterior diameter of skull from anterior median point between bases of first upper incisors to most posterior point of occipital condyle.

Palatal length.—Greatest antero-posterior diameter of palate in median line. (This measurement was taken by use of fine-pointed dividers on vernier caliper.)

Cranial breadth.—Greatest lateral diameter of skull.

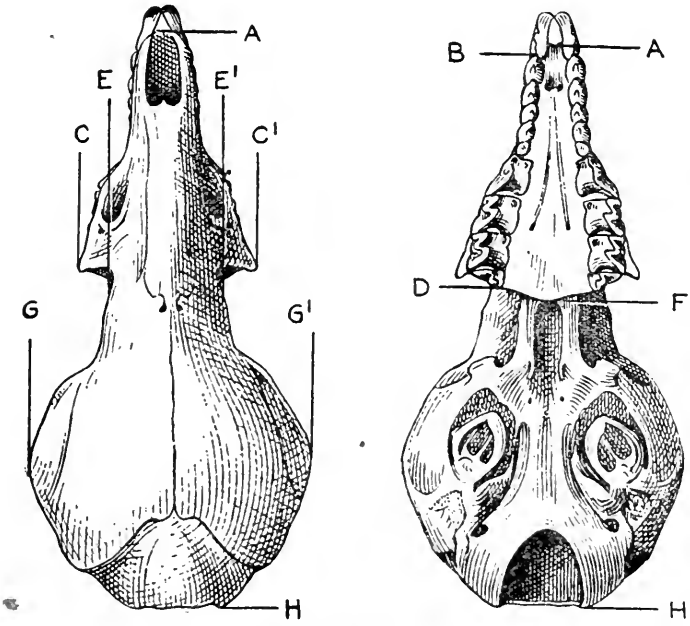

FIG. 1.—Skull of *Sorex bendirii palmeri*, showing cranial measurements employed. Enlarged three diameters

Cranial breadth, G–G'.
Condylobasal length, A–H.
Interorbital breadth, E–E'.
Palatal length, A–F.
Maxillary breadth, C–C'.
Maxillary tooth row, B–D.

Interorbital breadth.—Least lateral diameter of skull measured just posterior to maxillary processes.

Maxillary breadth.—Greatest lateral diameter of skull through maxillary processes.

Maxillary tooth row.—Antero-posterior diameter of upper tooth row between anterior border of second incisor and posterior border of last molar measured at alveolar border.

MATURITY OF SKULLS

On account of the great differences in the skulls of shrews of different ages it is essential in making comparisons to have specimens of approximately the same maturity. There are, of course, no sharp

age-division points in the life of the animal, but in making comparisons skulls have been classed as those of animals that were immature, young adult, adult, and old adult. Skulls of immature and old adult animals show more individual variation than those of the young adult and adult and are therefore less satisfactory for taxonomic purposes. In general terms these four classes of skull maturity may be defined as follows:

Immature.—Brain case usually moderately high, and unflattened, with sutures not distinctly closed; no sagittal or lambdoidal ridge; teeth usually not fully developed, unworn; first upper incisors protruding much beyond premaxillae anteriorly.

Young adult.—Brain case usually high and unflattened, with sutures closed; sagittal ridge absent or weakly developed, lambdoidal ridge absent; teeth fully developed, unworn; first upper incisors protruding much beyond premaxillae anteriorly.

Adult.—Brain case usually slightly flattened, with sutures closed; sagittal ridge moderately developed, lambdoidal ridge absent or weakly developed; teeth fully developed, usually unworn or slightly worn, sometimes moderately worn; first upper incisors protruding slightly beyond premaxillae anteriorly.

Old adult.—Brain case flattened, with sutures closed; sagittal and lambdoidal ridges both usually well developed; teeth usually much worn; first upper incisors scarcely protruding beyond premaxillae.

TEETH

Unless otherwise specified, comparisons of relative sizes of unicuspidate teeth are as they are viewed from an extero-lateral aspect, while comparisons of relative sizes and shapes of molariform teeth are as the upper molariform teeth are viewed from an inferior aspect (that is, looking dorsad). In the detailed examination of teeth a binocular microscope was used, the most satisfactory magnification being obtained with No. 1 oculars and a 40-millimeter objective.

The nomenclature of the tooth cusps and other principal elements of the molariform teeth can be determined from the accompanying diagram. (Fig. 2).

COLORS

The names of colors used throughout the text are those of Ridgway (1912). In some cases, where it has been impossible to match the colors of specimens exactly with those of Ridgway, other modifying or comparative terms are used.

In making comparative studies of the color of mammals, especially those with glossy or iridescent fur, it is essential always to view each specimen from approximately the same angle and to have the light rays from an approximately constant angle. In the author's color studies of moles, the animal was viewed from the anterior end. (Jackson, 1915, p. 20.) In making color observations upon shrews the animal has been viewed from the posterior end. Diffused daylight from a window was allowed to strike the shrew at an agle of 30° to 45° anterior to a plane perpendicular to the longitudinal axis of the animal. The shrew was then viewed at varying angles, usually slightly laterally, from the light rays but always posteriorly

to the animal and in the same plane as the reflected light rays; that is, in the plane at an angle of 30° to 45° posterior to a plane perpendicular to the longitudinal axis of the animal.

GROUPS

As a matter of convenience for other workers in the study and identification of specimens, the writer has divided the American long-tailed shrews into assemblages of one or more species, which he calls

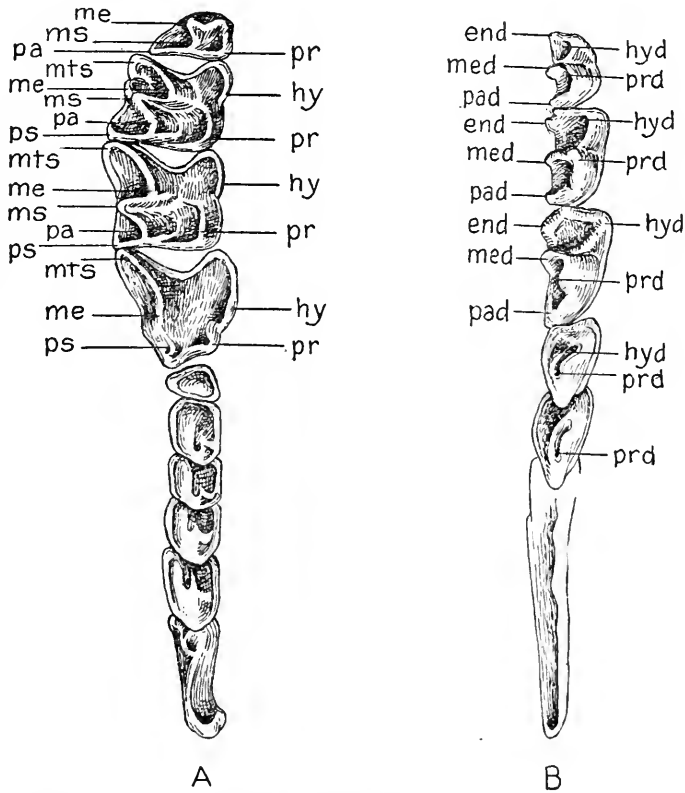

FIG. 2.—Teeth of *Sorex bendirii bendirii*, showing principal cusps. Enlarged about 10 diameters. A, left upper teeth; B, left lower teeth

me = metacone.	ps = parastyle.	med = metaconid.
ms = mesostyle.	hy = hypocone.	pad = paraconid.
mts = metastyle.	pr = protocone.	hyd = hypoconid.
pa = paracone.	end = entoconid.	prd = protoconid.

groups. The author is fully cognizant of the fact that the term "group" as thus used does not, and should not, have any status in the nomenclature of zoological classification and is employed solely for convenience. Nevertheless he has endeavored to bring within each group closely related forms, and, therefore, each group represents more or less a taxonomic unit. Furthermore, an effort has been made to arrange the groups and species in phylogenetic sequence from the more simple morphologically to the more complex, and to arrange subspecies in accordance with intergrading forms. Strict

adherence to such a method, however, has not been possible, since linear arrangement can not express what may actually be radial, parallel, or possibly, in the case of subspecies, even partly concentric. Although "groups," as previously stated, have been made as a matter of convenience, genera, subgenera, species, and subspecies have been recognized on the strength of structural characters and zoological relationships regardless of convenience in classification.

MATERIAL EXAMINED

The present revision recognizes 89 forms of 39 species of American long-tailed shrews and is based upon a study of 10,431 specimens, mostly skins accompanied by skulls. Of this number, the genus Sorex comprises 10,293 (subgenus Sorex, 9,369; subgenus Neosorex, 721; subgenus Atophyrax, 203); and Microsorex, 138. Type specimens or essentially topotypes of all described forms except *Sorex hydrodromus* Dobson have been examined. In some groups and species the material has been fairly adequate for a thorough investigation. In others the number of specimens available has been entirely too small for satisfactory conclusions. And always more juvenile specimens were needed. The study has been based primarily upon specimens in the collection of the United States National Museum, including therein the Merriam collection and the large and important collection of the Bureau of Biological Survey. Without the cooperation of other institutions and individuals, however, this revision in its present completeness could not have been accomplished.[2]

THE FAMILY SORICIDAE

The family Soricidae, exclusive of fossil forms, is composed of some 24 currently recognized genera. The family ranges throughout North America, extreme northern South America, and the the tropical and temperate regions of Europe, Asia, and Africa. It is a compact, rather homogeneous group, the members of which are small to medium-size mouselike animals, with minute eyes, sharp-pointed snouts, and small ears, the ear conch always being present, though inconspicuous in certain genera.

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The clavicle is long and slender; humerus relatively long and slender (length more than twice width); pelvis relatively broad (width more than one-third length); no os falciforme on the fore foot; terminal phalanges of fore foot simple, not bifurcate.

The skull is somewhat conoidal, relatively long and narrow, the individual bones anastomosed into one compact whole with but little indication of the sutures; the zygomatic arch is absent, but represented by a rudimentary zygomatic process of the maxilla; audital bullae absent, the tympanic bone annular and not connected with the skull by osseous tissue; exterior pterygoid region angular and not inflated, no exterior pterygoid plate; mandible with double articulation.

First upper incisor large, elongated, projecting anteriorly, two-lobed, the anterior lobe the larger; first lower incisor greatly elongated, extending anteriorly in line of mandible, the upper edge with two or more slightly developed lobes; remaining incisors and canines, both upper and lower, and first and second upper premolars if present, simple unicuspidate; crowns of upper molars low, W-shaped in inferior outline; crowns of lower molars low, M-shaped in superior outline.

SUBFAMILIES

The family Soricidae is usually divided into three subfamilies, namely, Soricinae, Crocidurinae, and Scutisoricinae. The last two are not represented in the American fauna. Soricinae is represented in America by five genera, namely, Sorex, Microsorex, Blarina, Cryptotis, and Notiosorex. The present revision includes only the two genera Sorex and Microsorex, which, however, represent a greater part of the American species.

PELAGES AND MOLTS

The hair of long-tailed shrews is fine, soft, and silky, but not of such velvet-like texture as is found in moles, though it approaches such a degree in the subgenera Neosorex and Atophyrax and sometimes in immature individuals of any species. The pelage of shrews seldom shows the high gloss common to that of moles, nor, except in a few localized races, does it display the metallic iridescence characteristic of some species of moles in certain pelages.

It is usual for mammals to have two types of hairs; one type is short, fine, and numerous, and forms the underfur; the other is longer, coarser, stiffer, and comparatively sparse, and forms a protective covering, the overhair. In the long-tailed shrews there is no sharp distinction between underfur and overhair, either in texture or length, although in some individuals a few scattered hairs seem slightly heavier than the majority. Shrews are primitive mammals in many respects, and this lack of hair specialization may be another indication of primitive characters.

TIME OF MOLTING

So far as known, every species of long-tailed shrew has two molts annually, one in spring and one in fall. Although there is some variation in the time of molting among the different species, particu-

larly in the spring, nevertheless individuals of nearly any species may be found in process of molt during May and early in June, and without exception of any species the autumnal molt may be looked for late in September or during October, apparently with slight regard to altitude or latitude. The spring molt of *Sorex veraepacis* seems to be earlier than in other forms, and *S. cinereus* may also molt as early as early April, while *S. bendirii* is not apt to begin molting before June. The time of molting is considered in more detail in the discussion under each species in the text following.

MANNER OF MOLTING

In general, during the spring molt the first appearance of the new fur is on the crown and nape, from where it gradually replaces the old on the head. The molt line then passes caudad over the shoulders and back, and ventrad over the sides, in the earlier stages moving more rapidly dorsally than ventrally, but in the later stages apparently more rapidly on the ventral parts, since often the entire underparts are in fresh pelage before the fur on the posterior part of the back has molted. In fact, during spring the rump is nearly always the last part of a shrew to retain the old hair. Often, in the early stages of molting the old fur over the entire body is underlaid with the new, short hairs. Occasionally the mid-dorsal region will molt before the nape and the region over the shoulders do, but such cases are exceptions and seem to occur more frequently in the water and marsh shrews (subgenera Neosorex and Atophyrax) than in true Sorex.

The characteristic autumnal molt almost reverses the sequence of that of spring. Usually the first new fur in the fall appears on the rump and posterior half of back; the molt then works cephalad and ventrad, gradually covering the entire animal, the head usually being the last part to change pelage. Sometimes, however, molt may start earlier on the head, leaving the shoulders and anterior portion of the back the last to molt.

VARIATIONS

GEOGRAPHIC VARIATION

Geographic variation in long-tailed shrews manifests itself chiefly in variations of paleness or darkness, in size both external and cranial, in tail length, and in general shape of the skull, particularly in degree of deflation of brain case, in breadth of rostrum and brain case, and in size of teeth and, correlated with it, length of molar tooth row. Geographic variations when constant in character and of commensurate degree may be recognized nomenclatorially as subspecific characters, particularly when such characters occur over a definite geographic area.

As a rule there is comparatively little geographic variation in long-tailed shrews, and individual subspecies usually have an extensive geographic range. This is especially noticeable in such forms as *Sorex c. cinereus*, which ranges nearly across the North American Continent from east to west and has a north and south range from extreme northern Canada to the northern United States; and in *S. o. obscurus*, which is found with scarcely any variation from north-

central Alaska to northern New Mexico. As in all groups of mammals, there are certain forms with restricted ranges apparently dependent upon peculiar environmental factors or upon more or less complete geographic isolation, but such forms, although superficially similar, are usually specifically distinct from their nearest allies.

There are several reasons for this lack of pronounced geographic variations in long-tailed shrews. The members of the family Soricidae are all comparatively simple colored grays and browns without distinct patterns. As the skull structure and the dentition are also very simple, there is little opportunity for variation in chromatic, cranial, or dental characters. In other words, the mere simplicity of the mammal tends to limit the possibilities for variations. Probably a more important factor in limiting these variations, however, is the phylogenetic age of the group. Shrews are geologically among the oldest of true placental mammals, and as such their characters are deep-seated and fixed. As an example the western water shrew (*Sorex palustris navigator*), which inhabits the boreal elevations of many of the mountains of the western United States, might be cited. These shrews from the different ranges are very constant in characters and show comparatively little variation, yet their habitats on the different mountains are often separated by broad expanses of desert or arid plain, which to this species has been an absolute barrier for possibly millions of years.

INDIVIDUAL VARIATION

The general shape and proportions of skulls of any form of long-tailed shrew, if of corresponding maturity and from the same locality, are seemingly very constant, yet when placed upon percentage basis the variation may amount to as much as 5 per cent from an average. Variation in actual size of skull, based upon any of several measurements, such as condylobasal length, greatest length, or breadth of cranium, may be even greater and in rare instances in large series has amounted to 7.5 per cent from the average. There is also a correspondingly great variation in the external measurements of total length, tail length, and hind foot, as computed from measurements taken by collectors in the field.

There is a tendency for certain skulls of shrews to be "runty," or to have an abnormally shortened rostrum, or abnormal dentition. This does not occur in any great number of specimens, but nevertheless appears to be more frequent than in most other families of Mammalia. Thus a skull of *Sorex c. cinereus* (No. 150083, U. S. Nat. Mus.) from Mount Washington, N. H., has an abnormally shortened rostrum and interorbital region. A specimen of *S. v. vagrans* (No. 233087, U. S. Nat. Mus.) from Bear Prairie, Mount Rainier, Wash., has the third upper incisor (second "unicispid") on the right side bicuspidate. In a specimen of *S. p. pacificus* (No. 9648, Field Mus. Nat. Hist.) from Eureka, Calif., the left upper first premolar (fifth unicuspid) has two distinct cusps, one directly caudad to the other. A specimen of *S. o. obscurus* (No. 988, Nat. Mus. Canada) from the mouth of Salmon River, British Columbia, has a supernumerary unicuspidate tooth interposed between the third and fourth unicuspids;

the accessory tooth is smaller than either of the normally third or fourth unicuspids, and considerably smaller than the fourth. Two skulls of *S. o. longicauda* (Nos. 74702 and 100570, U. S. Nat. Mus.) from Wrangell, Alaska, have each only four unicuspids on each side in the upper tooth row; the first premolar (fifth unicuspid) is evidently the one lacking.

One of the most peculiar dental abnormalities occurs in a skull of *Microsorex h. hoyi* (No. 373, collection of Stuart Criddle, Treesbank, Manitoba) from Aweme, Manitoba. In each of the upper tooth rows one of the unicuspids is lacking, apparently the first one (second incisor), though it may possibly be the second (third incisor). The tooth row is compact, the space that would normally have been occupied by the missing tooth being taken up by a slight increase in the postero-anterior diameter of each of the other unicuspids. The increase in the size of the unicuspids is particularly noticeable in the case of the third. In normal individuals of Microsorex this tooth is so thin in postero-anterior diameter as to be a mere plate, but in the aberrant specimen this diameter is nearly half the lateral dimension. The two tooth rows are symmetrical with each other and present a striking anomaly.

Except for some fading or "rusting," due to wear, the color of shrews of a given species from the same locality and in the same pelage is fairly constant. The fresh pelage is usually a trifle darker and more grayish than the old, and this sometimes gives the appearance of actual color variation. Shrews seldom exhibit abnormal color phases, such as melanism and albinism. The author has never seen a melanistic long-tailed shrew. A specimen of *Sorex o. obscurus* (No. 932, Prov. Mus. British Columbia) collected February 13, 1917, at Okanagan, British Columbia, seems to be a partial albino. This specimen is white on the chin and upper throat, the white extending ventrad and caudad on the left almost to the left fore leg. The color of the eyes of this specimen was not indicated by the collector. Another specimen of *S. o. obscurus* (No. 22060, Mus. Vert. Zool., Univ. Calif.), a male collected July 21, 1915, at an altitude of 10,800 feet at the head of Lyell Canyon, Yosemite National Park, Calif., has a general tone of color over the entire animal of pale ochraceous buff, the underparts being paler and more whitish; the base of hairs is pale smoke gray. A skin without skull (No. 241190, U. S. Nat. Mus.) of what is apparently *S. tundrensis*, received at the National Museum on February 18, 1926, from H. O. Brown, of Shungnak, Alaska, is entirely white, although the color of the eyes is unknown.

SEXUAL VARIATION

So far as known, there is no sexual variation of color, size, or proportions in any of the American long-tailed shrews. The adult males of all species have a relatively long and narrow gland on each flank, which develops conspicuously during the breeding season. The relative size of this gland varies with the different species, and in the genus Microsorex it is particularly large in proportion to the size of the animal, being about 9 millimeters long or nearly equal to the length of the hind foot; it is small in *Sorex cinereus*, being only about 2 or 3 millimeters long; in *S. obscurus* and *S. arcticus* it is

about half the length of the hind foot, or about 6.5 millimeters in the former and 7 millimeters in the latter (Preble, 1908, p. 243–249). The use of this gland as a taxonomic character, however, is not satisfactory, since not only is its use as such limited to less than half the specimens available, but also the gland is exceedingly difficult to measure accurately because of its position in the hair and the varying degrees of stretching it receives in different skins as made by different collectors.

AGE VARIATION

Externally, shrews display little variation with age. As a rule, younger animals appear slenderer than adults and have their tails a trifle more hairy and sometimes slenderer.

Cranially, long-tailed shrews display great variation from the juvenile to the senile stage. The brain case flattens and appears to broaden with advancing age; the sutures of the cranium close; the sagittal and lambdoidal ridges develop; the first incisors gradually grow anteriorly, then inferiorly, producing an entirely different aspect in old age from that of young; and the unicuspids seem to become somewhat swollen and broadened with age. These variations are described in more detail under the heading "Maturity of Skulls," page 13.

SEASONAL VARIATION

The only pronounced seasonal variation in the long-tailed shrews is in color and length of pelage. In nearly all species the winter pelage is longer and the color at that season is decidedly more grayish than in summer. The color difference between summer and winter fur is very marked in some species, as *Sorex cinereus*, *S. fumeus*, *S. vagrans*, and *S. ornatus*, in all of which the winter fur not only is more grayish but tends to be actually paler than is summer. In *S. arcticus* the winter pelage is darker than in summer, producing a more noticeable saddleback effect. The marsh and water shrews (*S. bendirii* and *S. palustris*) and *S. trowbridgii*, species already gray in summer pelage, have paler color in the winter coat.

HISTORY

The earliest reference in literature to a long-tailed shrew inhabiting America is that of Forster, who recorded a specimen sent in by Mr. Graham from the settlement on Severn River, Hudson Bay, under the name *Sorex araneus* Linn. (Forster, 1772, p. 370, 380). Forster's specimen was of the species known to-day as *S. arcticus* Kerr, a shrew superficially like the European *S. araneus*, but which did not receive a scientific name until 20 years after its discovery, although Forster actually noticed differences between the two forms. Forster also had two other specimens of shrews from the same region, which he did not identify (op. cit., p. 381) and which belonged to the species now known as *S. cinereus* Kerr. A few years later Pennant (1784, p. 139) redescribed the three Forster specimens, virtually copying Forster's descriptions, and placed them under "Foetid?" shrew, a common name for *S. araneus* Linn. Forster and Pennant, however, used no Latin binomials. It remained for Kerr (1792, p. 206), basing his descriptions upon Pennant, to give valid names to

both of Forster's species; the first one he calls "Labradore Shrew—*Sorex arcticus*"; the second species he named "Gray Labradore Shrew—*Sorex arcticus cinereus*" (vide Jackson, 1925a, p. 55).

In November, 1826, Isidor Geoffroy St. Hilaire read an account of this same shrew, which had been named *Sorex arcticus cinereus* by Kerr, before the Société d'Histoire Naturelle at Paris, and, about two months later, published a description of the animal under the name *Sorex personatus* (Geoffroy, 1827a, p. 319), a name used for many years for the common long-tailed shrew of the eastern United States and Canada, always erroneously dating, however, from a redescription by Geoffroy published late in the same year (Geoffroy, 1827b, p. 122).

In 1828, Richardson was responsible for another name for *Sorex arcticus cinereus* Kerr, when he described *Sorex forsteri* (Richardson, 1828, p. 516). In this same paper, moreover, Richardson described the first American water-shrew known, under the name *Sorex palustris* (Richardson, 1828, p. 517). Thus, at this date, April, 1828, only three species of shrews had been described from the American continent. This is not so suprising, when one recalls the difficulties of collecting small mammals, particularly shrews, in those days when there were no small-mammal traps and when the capture of any small mammal was more or less chance or the result of the hard labor of digging for nests, setting snares, or making deadfalls.

Probably the first contribution to the knowledge of the American shrews, which in any way could be dignified by the title of a revision or review of the group, was that of Bachman in 1837. Bachman listed and described 13 species of shrews, 7 of which were long-tailed ones. Of the 7, 4 were described as new, only 1 of which, his *Sorex longirostris* (Bachman, 1837, p. 370), stands to-day. His name *Sorex richardsonii* (op. cit., p. 383), now a synonym of *S. arcticus* Kerr, was for many years used for the common saddle-backed shrew of America. Bachman also named *Sorex cooperi* (op. cit., p. 388) and *Sorex fimbripes* (op. cit., p. 391), both now synonyms of *S. cinereus* Kerr. He also listed *Sorex palustris* Richardson (op. cit., p. 396), which he had not seen, and *Sorex forsteri* Richardson (op. cit., p. 386) and *Sorex personatus* I. Geoffroy (op. cit., p. 398), the last also not seen, both synonyms of *S. cinereus* Kerr.

One year after Bachman's paper appeared, Gray (1838) classified the family into two major divisions, namely, land shrews and water shrews. Under his land shrews were three genera, Corsira, Myosorex, and Sorex. Only Corsira was represented by American species, where he placed *Sorex forsteri*, *S. longirostris*, *S. cooperi*, and *S. richardsonii* Bachman. Gray also first used the name Blarina, as a subgenus of Corsira, where he placed all the American short-tailed species of shrews then known, and also *S. personatus* [*S. c. cinereus*] (op. cit., p. 124). Under his water shrews were two genera, Amphisorex and Crossopus; of American species, *S. palustris* Richardson was included under Amphisorex (op. cit., p. 125); and *S. fimbripes* Bachman, under Crossopus (op. cit., p. 126). Gray was confused in the actual relationships of many of the species, and his paper added little new, except his attempted arrangement of the species into genera and subgenera.

In 1842, the genus Otisorex was named, with *Otisorex platyrhinus* the type species (De Kay, 1842, p. 22), a name, however, which is a synonym of *Sorex cinereus* Kerr. De Kay also included Bachman's species *Sorex longirostris* in the genus Otisorex (op. cit., p. 23.) This same year Duvernoy described *Amphisorex lesueurii* from Indiana (Duvernoy, 1842a, p. 33), a synonym of *S. c. cinereus* Kerr, and in another contribution dwelt in considerable detail upon the structure, development, and function of shrews' teeth (Duvernoy, 1842b). This latter paper was supplemented the following year (Duvernoy, 1843), and an essentially modified and revised edition of the whole work with the addition of illustrations was published a few years later (Duvernoy, 1846).

Sundevall, in a synopsis with brief descriptions of the shrews, divides the genus Sorex into three subgenera, the second of which, Sorex proper, he classifies into divisions 1 and 2 (Sundevall, 1843). In the first division he includes the American short-tailed shrews; under the second ("*Corsira* Gray, *Amphisorex* Duvern.") he lists ("omnes mihi ignotae") five species, namely, *S. richardsoni* Bachman, *S. forsteri* Rich., *S. lesueurii* Duvernoy, *S. personatus* Is. Geoffry, and *S. longirostris* Bachm. (Sundevall, 1843, p. 182–183). The third subgenus recognized by Sundevall is Crossopus, where he allocates *S. palustris* Rich., but remarks "Non vidi." (Op. cit., p. 187.) Under the heading "Sorices incerti," Sundevall lists among several other species *S. fimbripes* Bachman. (Op. cit., p. 188.) Although Sundevall had apparently never seen a specimen of an American shrew, his grouping of the species was probably the best that had been presented up to that time.

In 1848 Pomel classified the insectivores into families, tribes, genera, and sections, each with a name and description. He used Hydrogale as a section name under the genus Sorex, but raised it to generic rank in the remark "si ce caractère se confirmait, ce type pourrait être érigé en un genre distinct: *H. fimbripes*, l'espèce est le *sorex fimbripes* Bachm." (Pomel, 1848, p. 248.) He also described the genus Galemys (not of Kaup, 1829) and placed therein the American species *Sorex palustris* under the section Crossopus (op. cit., p. 249.) Pomel placed *S. longirostris* Bachman in the genus Musaraneus Brisson and in the section Crocidura, thus: [*Musar.* (*Croc.*)] *Bachmani* (*longirostris junior* Bachm.) (Op. cit., p. 249.) Pomel's sections were in reality subgenera.

A few years later Baird's epoch-marking work on the mammals of North America appeared in which he recognized 13 species of long-tailed shrews. (Baird, 1857, p. 7–56.) Baird described the genus Neosorex with *Neosorex navigator* the type species. (Op. cit., p. 11.) He also described as new 7 other species, namely: *Sorex trowbridgii*, *S. vagrans*, *S. suckleyi*, *S. pachyurus*, *S. haydeni*, *S. hoyi*, and *S. thompsoni*. In spite of the inadequacy of the material with which Baird worked, of the 8 new specific names that he proposed all except *suckleyi* and *pachyurus* are applicable to forms recognized today. Baird, however, recognized *S. forsteri*, *S. platyrhinus*, *S. cooperi*, and *S. personatus*, all of which are synonymous. He listed *S. palustris* Rich. and *S. fimbripes* Bachman, species of which he had not examined specimens. (Op. cit., p. 55.)

In 1867 and 1868 Mivart published a somewhat detailed account of the osteology of the Insectivora (Mivart, 1867, p. 68) and divided the order into seven families, the family Sorices being represented by a single genus Sorex (op. cit., p. 141). Mivart made many comparisons between Sorex and other genera, but inasmuch as he designated no species in these comparisons the value of his work is nullified.

Almost simultaneously with the appearance of the last part of Mivart's osteological work appeared the first part of the account of the shrews of the world by Fitzinger (1868). He recognized 10 species of American long-tailed shrews, 6 of which, however, are synonymous among his other 4 species as known to-day. He described as new *Sorex wagneri* (Fitzinger, 1868, p. 512), a synonym of *S. longirostris* Bachman. Fitzinger evidently did not consult the important contribution of Baird (1857), since he listed none of the species described as new in Baird's work.

The results of the important investigations of E. Brandt on the dentition of shrews was published in three sections, which appeared, respectively, in 1869, 1871, and 1874. This study was based upon specimens of nine species of shrews belonging to 5 genera, the dentition of which are described in detail. Although Brandt included no American species, his work is valuable in its general application to certain American species and for comparative purposes. Previous to the German issue of this publication (Brandt, 1869–1874) there had been an edition in Russian (Brandt, 1865).

In his "Synopsis of Insectivorous Mammals," Gill (1875) classified the order into families, subfamilies, and genera, giving detailed descriptions of families and subfamilies and a review of the more important works to that date. Gill recognized two genera of American long-tailed shrews, namely, Sorex Linnaeus and Hydrogale Pomel, using the latter name to replace that of Neosorex Baird (Gill, 1875, p. 111). Two years later appeared the important studies on American insectivorous mammals by Coues (1877), in which he recognized two genera of American long-tailed shrews, Neosorex and Sorex, and as a subgenus of Sorex named Microsorex, with the type species *Sorex hoyi* Baird. Coues did not discuss or list the various species and subspecies, but described two new species of long-tailed shrews (op. cit., p. 650), one, *Sorex pacificus* from Baird MS., a valid species; the other, *Sorex sphagnicola*, now a synonym of *S. arcticus*. Later in this same year, Alston (1877) described the first-known long-tailed shrew from Central America under the name *Sorex verae-pacis*, although the animal had been known to Gray (1843, p. 79) many years previously.

In 1884, Merriam described as a new genus and species *Atophyrax bendirii* (Merriam, 1884b, p. 217), a large marsh shrew from Klamath County, Oreg. Shortly afterwards there appeared an important anatomical paper by Parker (1885), in which was described and beautifully illustrated the development of the skull of *Sorex vulgaris* (=*S. araneus*), not an American species, but one directly comparable, as far as ontogeny is concerned, particularly with *S. arcticus* Kerr.

The problematical *Sorex hydrodromus* from Unalaska Island, Alaska, was described by Dobson in 1889 in a paper in which he also remarks upon the uselessness of retaining Neosorex as a distinct

genus. (Dobson, 1889, p. 374.) At the time this paper appeared Dobson was working upon the part on the Soricidae of his monograph of the Insectivora, the first number of that part appearing in May of the following year (Dobson, 1890). Unfortunately Dobson's ill health and death prevented him from completing the momentous task, so that all that was published on the Soricidae was the fascicle of six plates, and these bear evidence in misnamed figures of not being proof-read by their careful and able author. In this work, the interesting American species, *Sorex merriami*, is named and figured. (Dobson, 1890, pl. 23, fig. 6.)

During the next three years in three papers Merriam (1890, 1891, and 1892b) described six new forms of Sorex. It was not until 1895, however, when the revisions by Miller and Merriam were published, that a clear presentation of the relationships of the American species as understood at that time was had. Miller's contribution was a review of the members of the genus Sorex (including subgenera Sorex, Microsorex, and Neosorex) occurring east of the Great Plains of the United States. He had examined in the British Museum the original specimens of *Sorex palustris*, *S. forsteri*, and *S. parvus* described by Richardson, which enabled him to describe more accurately these specimens and clarify questions of their relationships. He recognized seven species from the eastern United States, one of which, *S. fumeus*, he described as new (Miller, 1895, p. 50). Merriam's synopsis (1895) comprises the most complete account published of the long-tailed shrews of the entire region of North America and Central America. Merriam recognized 41 species and subspecies, which he included in the single genus Sorex, divided into four subgenera; 33 species and subspecies were placed in the subgenus Sorex, 1 in the subgenus Microsorex, 4 in the subgenus Neosorex, and 3 in the subgenus Atophyrax. In this revision, Merriam described 21 new species and subspecies, all of which are recognized in the present revision. And of the 41 forms recognized by Merriam, all except *S. sphagnicola* (=*S. arcticus*) and *S. vagrans dobsoni* (=*S. v. monticola*) are recognized in the present work, although his *S. personatus* here appears under the name *S. cinereus*, and his *S. richardsoni* as *S. arcticus*. Merriam's contribution was a big stepping-stone in the climb toward a knowledge of this difficult group.

In 1896 Batchelder described an interesting and distinctive species of shrew from New York under the name *Sorex macrurus*, which being preoccupied he later renamed *Sorex dispar* (Batchelder, 1911). During the 30 years following the revisions by Miller and Merriam (1895), there appeared numerous other descriptions of new species or subspecies of American long-tailed shrews by Merriam (1897, 1899, 1900, 1902), Bangs (1899), Elliot (1899, 1903b), Osgood (1901a, 1901b, 1909), Preble (1902, 1910), Nelson and Goldman (1909), Bailey (1913), Jackson (1917, 1918, 1919, 1921b, 1922, 1925a, 1925b, 1925c, 1926), and Anthony and Goodwin (1924); there were also published several papers treating upon the distribution or habits of American forms. During this period, however, only four contributions stand out above the others as needing special mention here. The first of these is an anatomical paper by Ärnbäck-Christie-Linde (1907), which treats in some detail of the muscles of *S. pygmaeus* and *S. vulgaris*, European forms, the latter not far removed from *S.*

arcticus. In this account, also, the side glands are mentioned as occurring only in males, and the investigator considers that the members of the family Soricidae hibernate because they are provided with "Winterschlafdrusen oder braunem Fettgewebe," a case where present knowledge of habits apparently does not substantiate a supposed structural adaptation.

Hollister's paper (1911) was a brief review of the Sorex of the Eastern United States, in which was described the new species *Sorex fontinalis*. Hollister recognized five species from the region. He considered *Amphisorex lesueurii* Duvernoy to be a synonym of *S. longirostris* Bachman, and *S. fimbripes* Bachman to be unidentifiable; he identified *S. acadicus* Gilpin with *S. personatus* Geoffroy.

Grinnell (1913a) discussed the characters, relationships, and distribution of six species and subspecies of Sorex from west-central California. Three new forms were described, all of which are recognized in the present monograph.

Glover M. Allen (1915) described as new *Neosorex palustris acadicus* (=*S. p. gloveralleni* Jackson), carefully compared it with related forms, and listed all the other known subspecies with an outline of their respective geographic ranges.

LIST OF GENERIC NAMES USED FOR AMERICAN LONG-TAILED SHREWS

Amphisorex Duvernoy, Mém. de la Soc. Mus. d'Hist. Nat. Strasbourg, tome 2 sig. 5, p. 23, 1835. Type species *Sorex hermanni* Duvernoy, the animal o which is *Sorex arcuus tetragonurus* Hermann and the skull, *Neomy fodiens fodiens* Schreber (vide Miller, 1912a, pp. 29, 42, 70). Used generi cally for *Amphisorex lesueurii* Duvernoy qui *Sorex cinereus cinereus* Ker

Atophyrax Merriam, Trans. Linn. Soc. New York 2: 217, August, 1884. Typ species *Atophyrax bendirii* Merriam. A subgenus of Sorex Linnaeus.

Corsira Gray, Proc. Zool. Soc. London, part 5, 1837, p. 123, May, 1838. Typ species *Sorex vulgaris* Linnaeus. A synonym of Sorex Linnaeus to whic Gray referred *Sorex forsteri* Richardson qui *Sorex cinereus cinereus* Ker

Crocidura Wagler, Isis von Oken 25: 275, 1832. Earliest available name for th Old World genus of which *Sorex leucodon* Hermann is the type specie Used generically in synonymy for several species of American Sorex b Fitzinger (1868), who refers to Reichenbach.

Croscopus ? Fitzinger, Sitzungber. Kaiserl. Akad. Wissensch., math.-natürwis sensch. Classe, Wien, Band 57, Abt. 1, p. 632, 1868. Misprint for Crossopu Wagler. Used in synonymy under *Crossopus fimbripes* qui *Sorex cinereu cinereus* Kerr.

Crossopus Wagler, Isis von Oken 25: 275, 1832. Type species *Sorex fodien* Beckstein=*Sorex fodiens* Schreber. A synonym of Neomys Kaup. Firs used for an American species as *Crossopus palustris* Reichenbach (1847, 1 161), qui *Sorex palustris palustris* Richardson.

Galemys Pomel, Archives Sci. Physiques et Nat., Genève 9: 249, Novembe 1848. Included Brachysorex Duvernoy, Crossopus Wagler, and Pachyur de Sélys-Longchamps. Not Galemys Kaup (1829), which is a genus Talpidae. Included *Sorex palustris* Richardson.

Hydrogale Pomel, Archives Sci. Physiques et Nat., Genève 9: 248, Novembe 1848. Type species *Sorex fimbripes* Bachman. Not Hydrogale Kaup, 182 qui Neomys Kaup. Used to replace Neosorex Baird by Gill (1875, p. 111

Microsorex Coues, Bul. U. S. Geol. and Geogr. Surv. Territories 3: no. 3, p. 64 May 15, 1877. Earliest available name for the genus of which *Sorex ho* Baird is the type species. Described as a subgenus by Coues from Bai manuscript. Raised to rank of genus by Elliot (1901a, p. 377).

Musaraneus Brisson, Regnum Animale, p. 126, 1762. A synonym of Sorex Li naeus. Pomel placed *Sorex longirostris* Bachman in this genus and in h "section" *Crocidura* under the specific name *bachmani*, thus: "[*Musa (Croc.)*] *Bachmani* (*longirostris junior* Bachm.)."

Neosorex Baird, Report Pacific Railroad Survey, vol. 8, part 1, Mammals, p. 11, 1857. Type species *Neosorex navigator* Baird. A subgenus of Sorex Linnaeus.

Otisorex DeKay, Zoology of New York, part 1, Mammalia, p. 22, and plate 5, fig. 1, 1842. Type species *Otisorex platyrhinus* DeKay, qui *Sorex cinereus* Kerr. A synonym of Sorex Linnaeus. DeKay also included *Sorex longirostris* Bachman in the genus.

Sorax Hollister, Proc. U. S. National Museum 40: 378, April 17, 1911. Misprint for Sorex.

Sorex Linnaeus, Systema Naturae, edition 10, vol. 1, p. 53, 1758. Available name for the genus of which *Sorex araneus* Linnaeus is the type species.

KEY TO THE GENERA AND SUBGENERA OF AMERICAN LONG-TAILED SHREWS

a^1. Unicuspids 5, in superficial lateral view appearing to be only 3, the third and fifth being scarcely, if at all, visible; third unicuspid disklike, antero-posteriorly flattened; primary (anterior) lobe of first upper incisor relatively long and narrow, the length more than twice the width and more than twice the length of secondary lobe ..... Genus Microsorex (p. 200)

a^2. Unicuspids 5, in superficial lateral view appearing to be 5, the fifth sometimes minute and indistinct; third unicuspid not disklike, not antero-posteriorly flattened; primary (anterior) lobe of first upper incisor relatively broad, the length less than twice the width and usually less than twice the length of secondary lobe ..... Genus Sorex (p. 30)

b^1. Size smaller; hind foot less than 18; and if hind foot is over 16, color distinctly brown ..... Subgenus Sorex (p. 31)

b^2. Size larger; hind foot 18 or more; color grayish, never distinctly brown.

c^1. Rostrum shorter and little down-curved; anterior end of premaxilla scarcely narrower dorso-ventrally than middle portion; dorso-ventral diameter of rostrum measured at third unicuspid equal about half the diameter between anterior border of infraorbital foramen and posterior border of first incisor; posterior end of interior cutting edge of anterior portion of internal basal shelf of first and second upper molars usually without cusplike lobe; hind foot distinctly fimbriate. Subgenus Neosorex (p. 175)

c^2.. Rostrum relatively longer and distinctly down-curved; anterior end of premaxilla much narrower dorso-ventrally than middle portion; dorso-ventral diameter of rostrum measured at third unicuspid less than half the diameter between anterior border of infraorbital foramen and posterior border of first incisor; posterior end of interior cutting edge of anterior portion of internal basal shelf of first and second upper molars usually with distinct cusplike lobe; hind foot slightly fimbriate. Subgenus Atophyrax (p. 192)

LIST OF AMERICAN GENERA, SPECIES, AND SUBSPECIES OF LONG-TAILED SHREWS, WITH TYPE LOCALITIES

SOREX CINEREUS GROUP

Sorex cinereus cinereus Kerr	Fort Severn, Ontario (p. 40).
cinereus miscix Bangs	Black Bay, Labrador (p. 50).
cinereus haydeni Baird	Fort Buford, N. Dak. (p. 51).
cinereus streatori Merriam	Yakutat, Alaska (p. 53).
cinereus hollisteri Jackson	St. Michael, Alaska (p. 55).
fontinalis Hollister	Near Beltsville, Md. (p. 56).
lyelli Merriam	Mount Lyell, Calif. (p. 57).
preblei Jackson	Jordan Valley, Oreg. (p. 58).

SOREX FUMEUS GROUP

Sorex fumeus fumeus Miller ..... Peterboro, N. Y. (p. 63).
fumeus umbrosus Jackson ..... James River, Nova Scotia (p. 65).

SOREX ARCTICUS GROUP

Sorex arcticus arcticus Kerr ..... Fort Severn, Ontario (p. 68).
arcticus laricorum Jackson ..... Elk River, Minn. (p. 71).
tundrensis Merriam ..... St. Michael, Alaska (p. 72).
hydrodromus Dobson ..... Unalaska Island, Alaska (p. 74).

SOREX PRIBILOFENSIS GROUP

Sorex pribilofensis Merriam ..... St. Paul Island, Pribilof Group, Alaska (p. 76).

SOREX MERRIAMI GROUP

Sorex merriami Dobson ..... Fort Custer, Mont. (p. 78).
leucogenys Osgood ..... 3 miles east of Beaver, Utah (p. 81).

SOREX SCLATERI GROUP

Sorex sclateri Merriam ..... Tumbala, Chiapas, Mexico (p. 82).

SOREX LONGIROSTRIS GROUP

Sorex longirostris longirostris Bachman ..... Cat Island, mouth of Santee River, S. C. (p. 85).
longirostris fisheri Merriam ..... Lake Drummond, Dismal Swamp, Va. (p. 87).

SOREX DISPAR GROUP

Sorex dispar Batchelder ..... Beedes, N. Y. (p. 89).
gaspensis Anthony and Goodwin ..... Mount Albert, Quebec (p. 91).

SOREX TROWBRIDGII GROUP

Sorex trowbridgii trowbridgii Baird ..... Astoria, Oreg. (p. 94).
trowbridgii humboldtensis Jackson ..... Mad River, Calif. (p. 96).
trowbridgii montereyensis Merriam ..... Monterey, Calif. (p. 97).
trowbridgii mariposae Grinnell ..... Yosemite Valley, Calif. (p. 98).

SOREX VAGRANS-OBSCURUS GROUP

Sorex vagrans vagrans Baird ..... Shoalwater Bay, Wash. (p. 104).
vagrans vancouverensis Merriam ..... Goldstream, British Columbia (p. 106).
vagrans nevadensis Merriam ..... Reese River, Nev. (p. 107).
vagrans halicoetes Grinnell ..... Palo Alto, Calif. (p. 108).
vagrans amoenus Merriam ..... Near Mammoth, Calif. (p. 109).
vagrans monticola Merriam ..... San Francisco Mountain, Ariz. (p. 110).
vagrans orizabae Merriam ..... Mount Orizaba, Puebla, Mexico (p. 113).
durangae Jackson ..... El Salto, Durango, Mexico (p. 114).
obscurus obscurus Merriam ..... Lemhi Mountains, Idaho (p. 117).
obscurus neomexicanus Bailey ..... Cloudcroft, N. Mex. (p. 123).
obscurus parvidens Jackson ..... Bluff Lake, San Bernardino Mountains, Calif. (p. 124).

Sorex obscurus shumaginensis Merriam	Popof Island, Alaska (p. 125).
obscurus alascensis Merriam	Yakutat, Alaska (p. 126).
obscurus malitiosus Jackson	Warren Island, Alaska (p. 128).
obscurus elassodon Osgood	Moresby Island, Queen Charlotte Islands, British Columbia (p. 130).
obscurus longicauda Merriam	Wrangell, Alaska (p. 131).
obscurus prevostensis Osgood	Prevost Island, Queen Charlotte Islands, British Columbia (p. 133).
obscurus isolatus Jackson	Nanaimo, Vancouver Island, British Columbia (p. 134).
obscurus setosus Elliot	Happy Lake, Olympic Mountains, Wash. (p. 135)
obscurus permiliensis Jackson	Mount Jefferson, Oreg. (p. 137).
obscurus bairdi Merriam	Astoria, Oreg. (p. 139).
yaquinae Jackson	Yaquina Bay, Oreg. (p. 140).
pacificus pacificus Coues	Fort Umpqua, Oreg. (p. 142).
pacificus sonomae Jackson	Gualala, Calif. (p. 143).

SOREX STIZODON GROUP

Sorex stizodon Merriam	San Cristobal, Chiapas, Mexico (p. 147).

SOREX VERAEPACIS GROUP

Sorex veraepacis veraepacis Alston	Coban, Guatemala (p. 149).
veraepacis chiapensis Jackson	San Cristobal, Chiapas, Mexico (p. 150).
veraepacis mutabilis Merriam	Reyes, Oaxaca, Mexico (p. 151).
macrodon Merriam	Orizaba, Vera Cruz, Mexico (p. 152).

SOREX SAUSSUREI GROUP

Sorex saussurei saussurei Merriam	North slope of Sierra Nevada de Colima, Jalisco, Mexico (p. 155).
saussurei veraecrucis Jackson	Xico, Vera Cruz, Mexico (p. 156).
saussurei oaxacae Jackson	Mountains near Ozolotepec, Oaxaca, Mexico (p. 157).
saussurei cristobalensis Jackson	San Cristobal, Chiapas, Mexico (p. 157).
saussurei godmani Merriam	Volcan Santa Maria, Guatemala (p. 158).
saussurei salvini Merriam	Calel, Guatemala (p. 159).
emarginatus Jackson	Sierra Madre near Bolanos, Jalisco, Mexico (p. 159).
ventralis Merriam	Cerro San Felipe, Oaxaca, Mexico (p. 160).
oreopolus Merriam	North slope Sierra Nevada de Colima, Jalisco, Mexico (p. 162).

SOREX ORNATUS GROUP

Sorex ornatus ornatus Merriam	Mount Pinos, Calif. (p. 166).
ornatus californicus Merriam	Walnut Creek, Calif. (p. 168).
ornatus lagunae Nelson and Goldman	La Laguna, Sierra Laguna, Lower California, Mexico (p. 169).
trigonirostris Jackson	Ashland, Oreg. (p. 170).
sinuosus Grinnell	Grizzly Island, near Suisun, Calif. (p. 171).
juncensis Nelson and Goldman	Socorro, Lower California, Mexico (p. 172).
tenellus Merriam	Lone Pine Creek, Alabama Hills, near Lone Pine, Calif. (p. 172).
myops Merriam	Pipers Creek, White Mountains, Calif. (p. 173).
nanus Merriam	Estes Park, Colo. (p. 174).

SOREX PALUSTRIS GROUP

Sorex palustris palustris Richardson	Between Hudson Bay and Rocky Mountains, Canada (p. 178).
palustris hydrobadistes Jackson	Withee, Wis. (p. 180).
palustris albibarbis (Cope)	Profile Lake, Franconia Mountains, N. H. (p. 181).
palustris gloveralleni Jackson	Digby, Nova Scotia (p. 183).
palustris navigator (Baird)	Near head of Yakima River, Cascade Mountains, Wash. (p. 184).
alaskanus Merriam	Point Gustavus, Glacier Bay, Alaska (p. 189).

SOREX BENDIRII GROUP

Sorex bendirii bendirii (Merriam)	Eighteen miles southeast of Fort Klamath, Oreg. (p. 194).
bendirii palmeri Merriam	Astoria, Oreg. (p. 197).
bendirii albiventer Merriam	Lake Cushman, Olympic Mountains, Wash. (p. 198).

MICROSOREX HOYI GROUP

Microsorex hoyi hoyi (Baird)	Racine, Wis. (p. 202).
hoyi thompsoni (Baird)	Burlington, Vt. (p. 204).
hoyi winnemana Preble	Bank of Potomac River, 4 miles below Great Falls, Fairfax County, Va. (p. 206).
hoyi intervectus Jackson	Lakewood, Wis. (p. 206).
hoyi alnorum (Preble)	Robinson Portage, Manitoba (p. 208).
hoyi eximius (Osgood)	Tyonek, Alaska (p. 208).
hoyi washingtoni Jackson	Loon Lake, Wash. (p. 209).

Genus SOREX Linnaeus

Sorex Linnaeus, Systema Naturae, ed. 10, vol. 1, p. 53, 1758.
Musaraneus Brisson, Regnum Animale, p. 126, 1762.
Oxyrhin Kaup, Skizzirte Entwickelungs-Geschich. und natürl. System europäischen Thierwelt, p. 120, 1829.
Amphisorex Duvernoy, Mém. de la Soc. Mus. d'Hist. Nat. Strasbourg 2, sig. 5 p. 23, 1835.
Corsira Gray, Proc. Zool. Soc. London, part 5, 1837, p. 123, May, 1838.
Otisorex, DeKay, Zoology of New York, part 1, Mammalia, p. 22 and pl. 5, fig 1, 1842.
Hydrogale Pomel, Archives Sci. Physiques et Nat. Genève 9: 248, November 1848.
Neosorex Baird, Rept. Pacific Railroad Survey 8, part 1, Mammals, p. 11, 1857
Atophyrax Merriam, Trans. Linnaean Soc. New York 2: 217, August, 1884.
Homalurus Schulze, Schriften des Naturwissenschaft. Vereins des Harzes Wernigerode, 5: 28, 1890.

Type species.—*Sorex araneus* Linnaeus.

Geographic range of American species.—From the Arctic Ocean south through Alaska, Yukon, Northwest Territories, Quebec, and Labrador, to central South Carolina, northern Florida, Alabama, and southern Illinois in the eastern United States, to central Nebraska in the Great Plains region, to southern Utah and southern Nevada in the Great Basin region, to southern Lower California on the Pacific coast, and in the mountains of Utah, Colorado, New Mexico, and Arizona, and south through the mountains of Mexico to western Guatemala.

Generic characters.—Size small, form murine; pelage soft and velvetlike tail more or less completely covered with hairs, moderately long, in most species about three-fourths length of head and body, but varying from one-half length of head and body (*Sorex tundrensis*) to about equal length o

head and body (*S. trowbridgii*); ears small, moderately haired, nearly concealed by the fur, the auditory meatus covered by a lobe from the antitragus and a fold of the inner side of the conch; eyes minute; snout acute, extending well beyond incisors anteriorly; hind feet of relatively medium size, varying from scarcely to heavily fimbriate, the soles naked, with normally 6 tubercles; mammae, 6: abdominal, 1: 1; inguinal, 2: 2.

Skull somewhat conoidal, rather elongate, not much deflated, relatively weak, yet compact, the separate bones anastomosing very early and the sutures disappearing before maturity; moderately broad brain case; considerably constricted interorbitally. Zygomatic arch absent, represented by a rudimentary zygomatic process of the maxilla. Rostrum moderately long, more or less triangular in superior outline, broad posteriorly, narrow and greatly attenuated anteriorly. Anterior nares opening at an anterior-superior angle. Infraorbital foramina large and prominent. Foramen magnum oval, comparatively large. Mesopterygoid space moderately elongate, relatively narrow, the sides nearly parallel but slightly converging posteriorly. Palate long and narrow, abruptly converging anterior to first molariform tooth. Posterior border of palate truncate, straight, slightly thickened into a noticeable ridge. Palatine foramina small, scarcely distinguishable. Horizontal ramus of mandible moderately heavy and nearly straight, being but slightly curved ventrad medially; angle of mandible long and slender; coronoid long, moderately heavy, tapering gradually toward tip.

Dentition simple. First upper incisor large, elongate, two-lobed, the anterior (primary) lobe relatively broad, the length less than twice the width and usually less than twice the length of secondary lobe. The five teeth following the first upper incisor, namely, second and third upper incisors, canine, and first and second premolars, are simple peglike teeth, essentially unicuspidate in all species and actually so in most species, and are designated as "unicuspids." Second and third upper incisors with or without distinct ridge from apex to inner border of cingulum, sometimes in certain species with a very slight cusp near terminus of ridge; ridge from cusp of second or third incisor not distinctly and sharply curved caudad toward terminus and not with a pronounced secondary cusp near terminus of ridge on cingulum. Canine essentially like second incisor in shape, possibly variable in size, but never noticeably antero-posteriorly flattened. First and second premolars essentially like other unicuspids, variable in relative size, tending to be less cuspidate and less pigmented. Third premolar (first "molariform tooth") more or less triangular in ventral surface outline, broad posteriorly, narrower anteriorly, posterior border emarginate; metacone well developed, the mesostyle and parastyle practically obsolete. First and second molars relatively large, squarish in ventral surface outline, emarginate posteriorly; parastyle, paracone, mesostyle, metacone, metastyle, and protoconule well developed; hypocone moderately developed. Third upper molar small, somewhat triangular, broad anteriorly, acute exteriorly, abruptly narrowing posteriorly; paracone, metacone, and protoconule moderately developed, parastyle and mesastyle only slightly developed.

Lower incisor elongate and narrow, in line with horizontal ramus of mandible, the cutting edge with three lobes. Canine unicuspidate, somewhat flattened laterally. Premolar simple, slightly larger than canine and relatively broader, with secondary cusp and longitudinal groove. First and second lower molars moderate in size, truncate posteriorly, gradually rounded on exterior of anterior half to become acute anteriorly; protoconulid, hypoconid, paraconid, metaconid, and entoconid well developed. Third lower molar similar in outline to second, somewhat smaller, with the hypoconid and entoconid somewhat reduced. Bases of lower incisor and premolar not closely approximated, separated by space nearly equal antero-posterior diameter of canine.

Dentition: i., $\frac{3}{1}$; c., $\frac{1}{1}$ pm., $\frac{3}{1}$; m., $\frac{3}{3}$; total, 32.

Subgenus SOREX Linnaeus

Type species.—Sorex araneus Linnaeus.

Geographic range of American species.—That of the genus Sorex.

Diagnostic characters.—Size relatively small; hind foot less than 18; feet never densely fimbriate, sometimes slightly fimbriate; rostrum moderately short, not distinctly curved ventrad.

Remarks.—The subgenus Sorex as here constituted is divided for convenience into 14 groups containing 35 species. Several of these

species display very fundamental differences when compared with certain others, and future more detailed investigations upon genera and subgenera of Soricidae may possibly necessitate subgeneric or even generic divisions among species here classified in the subgenus Sorex. Any conclusions that will in any way approach finality in regard to the major divisions in the classification of the Soricidae can be reached only after a detailed study, not alone of skins and skulls, but also of alcoholics and skeletons, both of young and adult individuals, representing every distinctive species in the family. Such material, even of American species, is not now available in any institution.

KEY TO THE SUBSPECIES OF THE SUBGENUS SOREX

a^1. Third unicuspid not smaller than fourth.
  b^1. Known geographic range north of United States-Mexico boundary.
    c^1. Infraorbital foramen with posterior border lying caudad to plane of interspace between m^1 and m^2.
      d^1. Size larger; total length more than 115; hind foot more than 13; condylobasal length more than 16.8 ------ *dispar* (p. 89).
      d^2. Size smaller; total length less than 115; hind foot less than 13; condylobasal length less than 16.8 ------ *gaspensis* (p. 91).
    c^2. Infraorbital foramen with posterior border lying even with or anterior to plane of interspace between m^1 and m^2.
      d^1. Maxillary breadth less than 4.6.
        e^1. Condylobasal length 15 or more.
          f^1. Palatal length 6.2 or more; maxillary tooth row usually more than 5.7.
            g^1. Color more grayish; cranial breadth 8 or more; geographic range northeastern coast region of North America ---------- *miscix* (p. 50).
            g^2. Color more brownish; cranial breadth less than 8; geographic range northwestern coast region of North America ---------- *streatori* (p. 53).
          f^2. Palatal length less than 6.2; maxillary tooth row usually less than 5.7.
            g^1. Size smaller; maxillary tooth row 5.2 or less ---- *haydeni* (p. 51).
            g^2. Size larger; maxillary tooth row more than 5.2.
              h^1. Known geographic range confined to California ---- *lyelli* (p. 57).
              h^2. Known geographic range not including California.
                i^1. Color paler; tail shorter; rostrum narrower ---------- *hollisteri* (p. 55).
                i^2. Color darker; tail longer; rostrum broader ---- *cinereus* (p. 40).
        e^2. Condylobasal length usually less than 15.
          f^1. Condylobasal length less than 14.7; interorbital breadth 3.1 or more; known geographic range confined to eastern Oregon ---------- *preblei* (p. 58).
          f^2. Condylobasal length more than 14.7; interorbital breadth less than 3.1; known geographic range confined to Maryland ---------- *fontinalis* (p. 56).
      d^2. Maxillary breadth more than 4.6.
        e^1. Known geographic range confined to Unalaska Island, Alaska ---------- *hydrodromus* (p. 74).
        e^2. Known geographic range not including Unalaska Island, Alaska.
          f^1. Condylobasal length more than 17.5; cranial breadth 8.5 or more; maxillary tooth row 6.1 or more.
            g^1. Coloration distinctly tricolor (color of back sharply darker than sides); tail less than 45.
              h^1. Color paler; tail usually less than 38; condylobasal length usually less than 18.5 ------ *tundrensis* (p. 72)
              h^2. Color darker; tail usually more than 38; condylobasal length more than 18.5.

i^1. Brain case relatively flatter; interorbital breadth usually more than 3.7 ..... *laricorum* (p. 71).
i^2. Brain case relatively higher; interorbital breadth usually less than 3.7 ..... *arcticus* (p. 68).
g^2. Coloration distinctly bicolor (back same color as sides); tail 45 or more.
h^1. Slightly smaller; more reddish; known geographic range entirely within United States ..... *fumeus* (p. 63).
h^2. Slightly larger; more grayish; known geographic range Maine and eastern Canada ..... *umbrosus* (p. 65).
f^2. Condylobasal length less than 17.5; cranial breadth less than 8.5; maxillary tooth row less than 6.1.
g^1. Hind foot 13 or more; palatal length less than 6; maxillary breadth less than 5; known geographic range confined to Pribilof Islands, Alaska ..... *pribilofensis* (p. 76).
g^2. Hind foot less than 13; palatal length more than 6; maxillary breadth 5 or more.
h^1. Total length less than 100; condylobasal length less than 16.4; cranial breadth less than 8.1 ..... *merriami* (p. 78).
h^2. Total length more than 100; condylobasal length more than 16.4; cranial breadth more than 8.1 ..... *leucogenys* (p. 81).
b^2 Known geographic range south of United States-Mexico boundary.
c^1. Condylobasal length less than 17.9; maxillary tooth row less than 6.5.
d^1. Tail less than 50.
e^1. Condylobasal length less than 17.4; maxillary tooth row less than 6.3.
f^1. Cranial breadth less than 8.3 ..... *emarginatus* (p. 159).
f^2. Cranial breadth more than 8.3 ..... *ventralis* (p. 160).
e^2. Condylobasal length more than 17.4; maxillary tooth row more than 6.3.
f^1. Cranial breadth less than 8.5; maxillary breadth less than 5.2 ..... *oreopolus* (p. 162).
f^2. Cranial breadth more than 8.5; maxillary breadth more than 5.2 ..... *stizodon* (p. 147).
d^2. Tail more than 50 ..... *godmani* (p. 158).
c^2. Condylobasal length more than 17.9; maxillary tooth row 6.5 or more.
d^1. Tail less than 50.
e^1. Cranial breadth 9 or more ..... *oaxacae* (p. 157).
e^2. Cranial breadth less than 9.
f^1. Total length usually more than 109; tail more than 45.
g^1. Hind foot 14 or more; cranial breadth 8.6 or more ..... *saussurei* (p. 155).
g^2. Hind foot less than 14; cranial breadth less than 8.6 ..... *cristobalensis* (p. 157).
f^2. Total length less than 109; tail less than 45 ..... *salvini* (p. 159).
d^2. Tail more than 50.
e^1. Hind foot about 15; condylobasal length less than 19; cranial breadth less than 9 ..... *veraecrucis* (p. 156).
e^2. Hind foot about 16; condylobasal length more than 19; cranial breadth more than 9 ..... *sclateri* (p. 82).
a^2. Third unicuspid smaller than fourth.
b^1. Known geographic range east of Mississippi River.
c^1. Total length less than 95; condylobasal length less than 15 ..... *longirostris* (p. 85).
c^2. Total length 95 or more; condylobasal length 15 or more ..... *fisheri* (p. 87).
b^2. Known geographic range west of Mississippi River.
c^1. Known geographic range north of United States-Mexico boundary.

d^1. Tail sharply bicolor; underparts of body scarcely, if any, paler than upper parts; ridge extending from apex of unicuspid toward interior edge of cingulum but slightly pigmented and rarely pigmented to cingulum, separated from cingulum by longitudinal groove, and never ending in distinct cusplet.

e^1. Color gray rather than brown; tail more than 0.8 of head-and-body length; maxillary breadth usually less than 5.4.

f^1. Size smaller; condylobasal length less than 17.7; maxillary breadth less than 5.1 ..... *trowbridgii* (p. 94).

f^2. Size larger; condylobasal length more than 17.7; maxillary breadth more than 5.1 ..... *humboldtensis* (p. 96).

e^2. Color brown rather than gray; tail less than 0.8 of head-and-body length; maxillary breadth 5.4 or more.

f^1. Color darker; condylobasal length usually less than 18.4; cranial breadth usually less than 9.2; range western California ..... *montereyensis* (p. 97).

f^2. Color paler; condylobasal length usually more than 18.4; cranial breadth usually more than 9.2; range eastern California and extreme western Nevada ..... *mariposae* (p. 98).

d^2. Tail not sharply bicolor; underparts of body distinctly paler than upper parts; ridge extending from apex of unicuspid toward interior edge of cingulum well pigmented usually to cingulum, not separated from cingulum by longitudinal groove, and usually ending in a distinct cusplet more or less pigmented.

e^1. Foramen magnum placed relatively ventrad, encroaching less into supraoccipital and more into basioccipital; mesoconid of first upper molariform tooth (pm^3) comparatively low.

f^1. Geographic range north of United States-Canada boundary.

g^1. Known geographic range confined to Vancouver Island.

h^1. Tail length less than 45; condylobasal length less than 17; maxillary breadth 4.7 or less ..... *vancouverensis* (p. 106).

h^2. Tail length more than 45; condylobasal length more than 17; maxillary breadth more than 4.7 ..... *isolatus* (p. 134).

g^2. Known geographic range not including Vancouver Island.

h^1. Tail length usually less than 52.

i^1. Total length usually less than 110; tail usually less than 44; protoconulid of m_1 comparatively low.

j^1. Color darker; hind foot usually 12 or less; geographic range coast region of southwestern British Columbia ..... *vagrans* (p. 104).

j^2. Color paler; hind foot usually 12 to 13; geographic range interior region of southern British Columbia and Alberta ..... *monticola* (p. 110).

i^2. Total length usually more than 110; tail usually more than 44; protoconulid of m_1 comparatively high.

j^1. Color paler; brain case usually rising abruptly in frontal region ..... *shumaginensis* (p. 125).

j^2. Color darker; brain case usually not rising abruptly in frontal region.

k^1. Hind foot less than 14; cranial breadth less than 8.6 ..... *obscurus* (p. 117).

k^2. Hind foot 14 or more; cranial breadth 8.6 or more ..... *alascensis* (p. 126).

h^2. Tail length usually more than 52.
i^1. Known geographic range confined to Prevost Island, British Columbia ..... *prevostensis* (p. 133).
i^2. Known geographic range not including Prevost Island, British Columbia.
j^1. Hind foot over 14.
k^1. Known geographic range confined to Warren and Coronation Islands, Alaska ..... *malitiosus* (p. 128).
k^2. Known geographic range not including Warren and Coronation Islands, Alaska ..... *longicauda* (p. 131).
j^2. Hind foot 14 or less.
k^1. Tail usually more than 55; skull higher and more arched; dental pigmentation heavier ..... *setosus* (p. 135).
k^2. Tail usually less than 55; skull lower and less arched; dental pigmentation lighter ..... *elassodon* (p. 130).
f^2. Geographic range south of United States-Canada boundary.
g^1. Length of tail less than 50.
h^1. Hind foot 14 or more; maxillary tooth row more than 6.5 ..... *neomexicanus* (p. 123).
h^2. Hind foot less than 14; maxillary tooth row less than 6.5.
i^1. Total length usually more than 110; tail usually more than 44; interorbital breadth 3.7 or more ..... *obscurus* (p. 117).
i^2. Total length usually less than 110; tail usually less than 44; interorbital breadth usually less than 3.7.
j^1. Tail usually more than 40.
k^1. Metaconid of m_1 comparatively high; superior border of foramen magnum less acute ..... *parvidens* (p. 124).
k^2. Metaconid of m_1 comparatively low; superior border of foramen magnum more acute.
l^1. Color darker; hind foot usually 12 or less; maxillary tooth row usually less than 5.7 ..... *vagrans* (p. 104).
l^2. Color paler; hind foot usually more than 12; maxillary tooth row usually more than 5.7 ..... *monticola* (p. 110).
j^2. Tail usually less than 40.
k^1. Total length less than 100; cranial breadth usually less than 8.2; maxillary breadth less than 4.7 ..... *nevadensis* (p. 107).
k^2. Total length usually 100 or more; cranial breadth usually more than 8.2; maxillary breadth more than 4.7.
l^1. Color paler; interorbital breadth less than 3.4 ..... *amoenus* (p. 109).
l^2. Color darker; interorbital breadth more than 3.4 ..... *halicoetes* (p. 108).
g^2. Length of tail more than 50.
h^1. Hind foot more than 15.5; cranial breadth more than 9.5; maxillary tooth row more than 7.2.
i^1. Condylobasal length less than 21; cranial breadth less than 10; maxillary tooth row less than 7.8 ..... *yaquinae* (p. 140).
i^2. Condylobasal length 21 or more; cranial breadth more than 10; maxillary tooth row more than 7.8.

j^1. Color paler; size larger; known geographic range Pacific coast region north of Point Arena, Calif.---*pacificus* (p. 142).
j^2. Color darker; size smaller; known geographic range Pacific coast region from Point Arena, Calif., south---*sonomae* (p. 143).
h^2. Hind foot less than 15.5; cranial breadth less than 9.5; maxillary tooth row less than 7.2.
i^1. Color less reddish; cranial breadth less than 8.8---*setosus* (p. 135).
i^2. Color more reddish; cranial breadth more than 8.8.
j^1. Total length more than 122; maxillary tooth row usually more than 6.6---*bairdi* (p. 139).
j^2. Total length less than 122; maxillary tooth row usually less than 6.6---*permiliensis* (p. 137).
e^2. Foramen magnum placed relatively dorsad, encroaching more into supraoccipital and less into basio-occipital; mesoconid of first upper molariform tooth (pm^3) comparatively high.
f^1. Condylobasal length more than 16.3; maxillary breadth usually more than 4.7.
g^1. Color darker, blackish; palate shorter, less than 6.7---*sinuosus* (p. 171).
g^2. Color paler, never blackish; palate longer, 6.7 or more---*ornatus* (p. 166).
f^2. Condylobasal length less than 16.3; maxillary breadth usually less than 4.7.
g^1. Tail less than 40; condylobasal length less than 15.4; cranial breadth less than 7.2.
h^1. Hind foot less than 11; condylobasal length less than 14.8; known geographic range Colorado---*nanus* (p. 174).
h^2. Hind foot more than 11; condylobasal length more than 14.8; known geographic range California.
i^1. Interorbital breadth less than 3.2---*tenellus* (p. 172).
i^2. Interorbital breadth more than 3.2---*myops* (p. 173).
g^2. Tail more than 40; condylobasal length more than 15.4; cranial breadth more than 7.2.
h^1. Condylobasal length more than 15.8; palatal length more than 6; known geographic range confined to California---*californicus* (p. 168).
h^2. Condylobasal length less than 15.8; palatal length less than 6; known geographic range confined to Oregon---*trigonirostris* (p. 170).
c^1. Known geographic range south of United States-Mexico boundary.
d^1. Known geographic range confined to Lower California.
e^1. Condylobasal length less than 16; maxillary breadth less than 4.6---*juncensis* (p. 172).
e^2. Condylobasal length more than 16; maxillary breadth more than 4.6.
f^1. Color paler ventrally---*ornatus* (p. 166).
f^2. Color darker ventrally---*lagunae* (p. 169).
d^2. Known geographic range not including Lower California.
e^1. Condylobasal length less than 17.9; maxillary tooth row less than 6.5.
f^1. Tail less than 48.
g^1. Palatal length less than 6.8; interorbital breadth usually less than 3.6; maxillary breadth usually less than 5.
h^1. Tail usually more than 40; cranial breadth 8.2 or more---*monticola* (p. 110).
h^2. Tail usually less than 40; cranial breadth usually less than 8.2---*orizabae* (p. 113).

g^2. Palatal length more than 6.8; interorbital breadth more than 3.6; maxillary breadth 5 or more.
h^1. Condylobasal length more than 17.5; maxillary tooth row more than 6.3 ..... *oreopolus* (p. 162).
h^2. Condylobasal length less than 17.5; maxillary tooth row less than 6.3 ..... *ventralis* (p. 160).
f^2. Tail more than 48.
g^1. Total length less than 115; hind foot less than 14 ..... *durangae* (p. 114).
g^2. Total length more than 115; hind foot more than 14 ..... *godmani* (p. 158).
e^2. Condylobasal length more than 17.9; maxillary tooth row 6.5 or more.
f^1. Condylobasal length more than 19; cranial breadth more than 9.6.
g^1. Cranial breadth more than 10; molariform teeth weaker ..... *veraepacis* (p. 149).
g^2. Cranial breadth less than 10; molariform teeth heavier ..... *macrodon* (p. 152).
f^2. Condylobasal length less than 19; cranial breadth less than 9.6.
g^1. Cranial breadth 9 or more.
h^1. Tail more than 52 ..... *mutabilis* (p. 151).
h^2. Tail less than 52.
i^1. Condylobasal length more than 9.2; maxillary tooth row more than 6.8 ..... *chiapensis* (p. 150).
i^2. Condylobasal length less than 9.2; maxillary tooth row less than 6.8 ..... *oaxacae* (p. 157).
g^2. Cranial breadth less than 9.
h^1. Tail more than 50 ..... *veraecrucis* (p. 156).
h^2. Tail less than 50.
i^1. Total length usually more than 109; tail more than 45.
j^1. Hind foot 14 or more; cranial breadth 8.6 or more ..... *saussurei* (p. 155).
j^2. Hind foot less than 14; cranial breadth less than 8.6 ..... *cristobalensis* (p. 157).
i^2. Total length less than 109; tail less than 45 ..... *salvini* (p. 159).

SOREX CINEREUS GROUP

The *cinereus* group includes four species: *Sorex cinereus*, *S. lyelli*, *S. preblei*, and *S. fontinalis*.

Geographic range.—Labrador, northern Quebec, and all of Canada and Alaska, except certain islands; south through the eastern United States to southeastern Maryland, and in the mountains to North Carolina and Tennessee, to central Ohio, southern Indiana, northern Illinois, Iowa, northern Nebraska, in the Rocky Mountains to northern New Mexico, eastern Oregon, and the coast region of Washington; also the Sierra Nevada of central California.

Diagnostic characters.—Size small, tail medium in length, hind foot small. Skull relatively weak, with narrow rostrum, weak dentition; the fourth unicuspidate tooth generally smaller than the third, rarely about equal; unicuspids with pigmented ridge extending from apex of tooth to interior edge of cingulum, in unworn teeth sometimes ending in very minute pigmented cusplet on cingulum. Members of the *cinereus* group may be distinguished from any of the *longirostris* or *vagrans-obscurus* groups by the relatively narrower rostrum of *cinereus*, narrower (extero-interiorly) molariform teeth, and by the relative size of the fourth unicuspid to the third, usually smaller than or rarely equal to the third in *cinereus* group; larger than the third in *longirostris* and *vagrans-obscurus* groups. Smaller than any form of the *arcticus*, *fumeus*, or *dispar* groups, with smaller hind foot, and distinctly smaller skull, weaker dentition,

the molariform teeth being narrower (extero-interior diameter); rostrum decidedly narrower both actually and relatively than in members of *arcticus* and *fumeus* groups. Tail relatively longer than in *pribilofensis* group, and coloration not tricolor; skull relatively much narrower, particularly interorbitally and rostrally; dentition weaker, the internal ridge on unicuspids less heavily pigmented. Somewhat smaller than either species of the *merriami* group, darker ventrally and on feet; skull relatively longer, higher, and narrower, not swollen interorbitally (as in *merriami* group), unicuspidate teeth less crowded and not relatively deeper (supero-inferiorly) than broad (antero-posteriorly) in lateral aspect.

Remarks.—The *cinereus* group, although comprising only eight recognizable forms belonging to four species, has a wide geographic range entirely across the northern half of the North American Continent. In many places in the Canadian and Boreal Zones shrews of this group are among the more common mammals.

Although members of the *cinereus* group are superficially similar both externally and cranially to *S. minutus* of Europe, the two appear to be actually not closely related. The dentition of *S. minutus*, particularly as shown in the characters in the first upper incisor, is very different from that of *S. cinereus* and its related forms.

SOREX CINEREUS Kerr

[Synonymy under subspecies]

Geographic range.—That of the *cinereus* group, except that part of California inhabited by *Sorex lyelli*, that part of eastern Oregon inhabited by *S. preblei*, and that part of Maryland inhabited by *S. fontinalis*. (Fig. 3.)

Diagnostic characters.—Somewhat larger in all respects than *S. lyelli*, *S. fontinalis*, or *S. preblei*, with correspondingly larger skull, relatively higher brain case (except in certain specimens of *S. c. haydeni*), and usually with longer, narrower rostrum; unicuspidate tooth row relatively and actually longer than in *S. lyelli*, *S. fontinalis*, or *S. preblei*, the unicuspids being less crowded and with greater antero-posterior diameter.

Subspecies and geographic variation.—The species *cinereus* is divided into five subspecies: *cinereus*, *miscix*, *haydeni*, *streatori*, and *hollisteri*.

The species as a whole is rather variable, as is also each of the subspecies. Each subspecies, however, in its extreme form is well defined and has average differences over considerable geographic areas. Beginning from the southern border of the range of the species, there is a general tendency for an increase in size toward the northeast and northwest, which culminates in the subspecies *miscix* and *streatori*, each recognizable also by color differences. Still farther northward along the Arctic coast the animal becomes somewhat smaller again, and on the Bering coast of Alaska this tendency reaches a climax in the pale, small, rather short-tailed form *hollisteri*. The form from the Great Plains region is small, in keeping with other specimens from the southern part of the range of the species, but has additional characters of pale color, short tail, and short, broad rostrum, and is recognized under the name *haydeni*.

Time of molting.—The transition from winter to summer pelage may occur any time between the first of April and the last of June, depending somewhat upon latitude and altitude. A male of *S. c. cinereus* in early process of molt was collected at Hinckley, Minn., March 31, 1890. A female from Fort Totten, N. Y., is at about the same stage, April 4, 1908. Two other females from Jobs Knob, W. Va. (April 10 and 13, 1897), have the summer fur well advanced under the old over the entire backs, the one collected on the earlier date having the underparts in fresh pelage. A male from St. Marys Lake, Mont., has the summer hair appearing under the worn winter fur over the entire animal (June 7, 1895). A male of *S. c. haydeni* from Fairmount, N. Dak., is in the height of the molting process (May 22, 1915); while another collected on June 7, 1915,

at the near-by locality of Blackmer is in complete summer pelage. A male from Ekalaka, Mont., collected on May 29, 1916, is about half molted. Three other males have about completed the molt in the Bear Lodge Mountains, Wyo., June 22, 1912, others of the same date and locality being in summer fur. A male *S. c. streatori* from Skagway, Alaska, June 1, 1899, and one from Orca, Alaska, June 25, 1899, are in process of change from winter to summer pelage.

The winter pelage is usually acquired during October in the southern part of the range of the species, and in the more northern parts during early September or even late August. Two females of *S. c. cinereus*, one collected September 4, 1893, at Montauk Point, Suffolk County, N. Y., and the other taken November 20, 1893, at Wilmington, Mass., are both in early stages of the autumnal molt. A series from Prince Edward Island collected between October

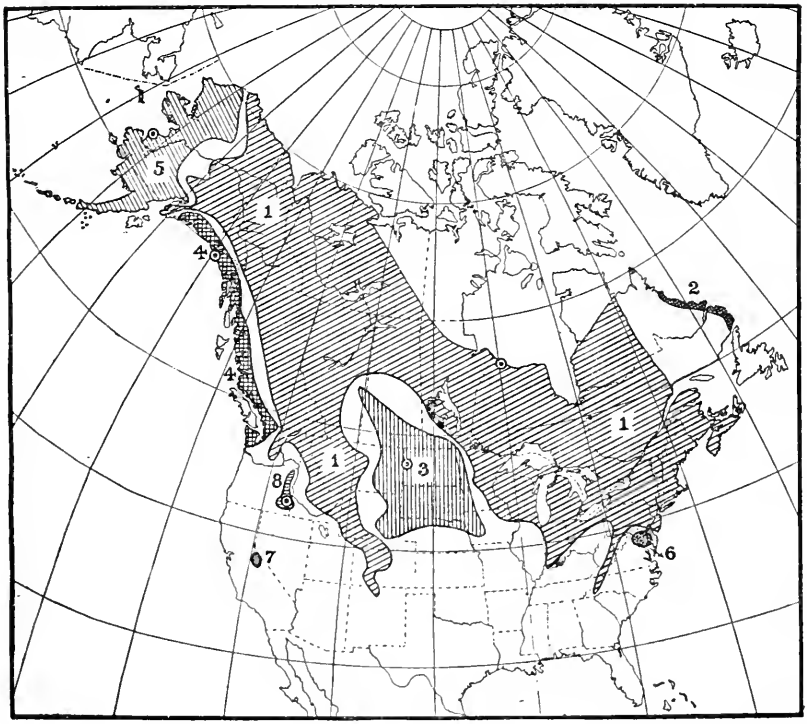

FIG. 3.—Geographic range of the species and subspecies of *Sorex cinereus* group

1. *S. cinereus cinereus.*
2. *S. c. miscix.*
3. *S. c. haydeni.*
4. *S. c. streatori.*
5. *S. c. hollisteri.*
6. *S. fontinalis.*
7. *S. lyelli.*
8. *S. preblei.*

27 and November 10, 1897, is for the most part in full winter pelage; two males from this series taken November 3 and 10 are in early stages of transition. Another series from St. Elmo, Colo., is in winter pelage early in October, 1907, and numerous specimens from the mountains of Wyoming are in process of molt during middle September. A female from the Highwood Mountains, Mont., has the molt well begun, August 22, 1910. Numerous specimens from west-central Alberta were molting the last few days of August and the first week of September. Specimens from British Columbia (Bennett, Cariboo Lake, Glenora, and Sicamous) were undergoing change of pelage from the middle to the last of September; and the same is true of a large series from Great Bear Lake, Northwest Territories, many of which are in full winter pelage. Specimens from the Cook Inlet region of Alaska were changing from summer to winter pelage between August 24 and September 20, 1900, while a few from the

mountains near Eagle, Alaska, show beginning of the molt during the last half of August. The majority of specimens of *S. c. miscix* are in winter pelage in October. A female from Black Bay, Labrador, is in summer pelage October 3; another female is in early process of molt September 24; while a male is at about the same stage October 20. Representatives of *S. c. haydeni* from Fort Custer, Mont., are with one exception in full winter pelage the middle of November, 1895; a female, taken November 13, is still in process of molting. Two females collected October 26, 1893, at Portland, N. Dak., are in full winter pelage. One taken October 9, 1901, 10 miles south of Cody, Nebr., shows the beginning of the pelage change. Two males of *S. c. streatori* from Wrangell, Alaska, had begun to molt September 12, 1895. The majority of specimens in the topotype series of *S. c. hollisteri*, collected during the middle of September, 1899, are changing from summer to winter fur; several had already acquired the full winter coat, even as early as September 10. Other specimens of *hollisteri* from Nushagak, Alaska, were molting during the middle of September, 1902; and specimens from Kakhtul River, Alaska, show molt as early as August 29, the same year.

SOREX CINEREUS CINEREUS Kerr

Cinereous Shrew

(Pls. 2, A; 4, U; 5, S; 7, A; 11, A; 12, A)

Sorex arcticus cinereus Kerr, Animal Kingdom, p. 206, 1792.

Sorex personatus I. Geoffroy-Saint Hilaire, Dictionnaire Classique d'Hist. Nat. 11: 319, January, 1827.

Sorex forsteri Richardson, Zool. Journ. 3: no. 12, January–April, 1828, p. 516, April, 1828. Type locality, "Hudson's Bay countries."

Sorex cooperi Bachman, Journ. Acad. Nat. Sci. Philadelphia 7: part 2, p. 388, 1837. Type locality, "North Western Territory."

Sorex fimbripes Bachman, Journ. Acad. Nat. Sci. Philadelphia 7: part 2, p. 391, 1837. Type locality, Drury Run, Pa.

Corsira forsteri J. E. Gray, Proc. Zool. Soc. London, part 5, 1837, p. 124, May, 1838.

Otisorex platyrhinus De Kay, Zool. New York, part 1, Mammalia, p. 22, 1842. Type locality, Tappan, Rockland County, N. Y.

S[orex] platyrrhinchus Linsley, Amer. Journ. Sci. and Arts 43: no. 2, p. 346, October 6, 1842. Type locality, Stratford, Conn. (Misspelling or emendation of *platyrhinus* De Kay, with redescription.)

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[*Sorex*] *lesneurii* (sic) Reichenbach, Praktische Naturgesch. Menschen und Säugth., p. 165, 1847.

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S[orex] platyrrhinus (sic) Wagner, Suppl. Schreber Säugth. 5: 547, 1855.

Sorex platyrhinus Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 25, 1857.

Amphisorex lesuerii (sic) Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 27, 1857. (In questionable synonymy under *Sorex cooperi* Bachman.)

Sorex lesueri (sic) Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 27, 1857. (In synonymy under *S. cooperi* Bachman.)

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Sorex acadicus Gilpin, Proc. and Trans. Nova Scotian Inst. Nat. Sci. 1: part 2 (erroneously marked vol. 2, part 2), p. 2, 1867. Type locality, Nova Scotia.

Amphisorex forsteri Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 509, 1868. (In synonymy.)

Crocidura cooperi Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 513, 1868. (In synonymy.)

Otisorex platyrrhinus Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 584, 1868. (In synonymy.)

Sorex platyrhynchus Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 584, 1868. (In synonymy.)
Crocidura platyrhyncha Fitzinger, Sitzungber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 585, 1868. (In synonymy.)
Crossopus fimbripes Fitzinger, Sitzungber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 631, 1868.
Crocidura fimbripes Fitzinger, Sitzungber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 631, 1868. (In synonymy.)
Croscopus ? fimbripes Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abt. 1, p. 632, 1868. (In synonymy.)
Sorex platyrinus Gilpin, Proc. and Trans. Nova Scotian Inst. Nat. Sci. 2: part 2, p. 59, 1869.
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Sorex idahoensis Merriam, North Amer. Fauna No. 5, p. 32, July 30, 1891. Type locality, Timber Creek, altitude 8,200 feet, Salmon River Mountains [now Lemhi Mountains], Idaho.
Amphisorex lesueri (sic) Herrick, Mammals of Minnesota, Geol. and Nat. Hist. Surv. Minnesota. Bul. 7, p. 48, 1892. (In synonymy under *Sorex cooperi* Bachman.)
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Amphisorex leseueri (sic) Miller, North Amer. Fauna No. 10, p. 53, December 31, 1895. (In synonymy under *Sorex personatus* Geoffroy.)
Amphisorex lesueuri Merriam, North Amer. Fauna No. 10, p. 60, December 31, 1895. (In synonymy under *Sorex personatus* Geoffroy.)
[*Sorex personatus*] *lesueuri* Merriam, North Amer. Fauna No. 10, p. 61, December 31, 1895.
[*Sorex*] *platyrhnchus* (sic) Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 366, 1901.
Sorex personatus lesueurii Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 235, December 27, 1901.
Sorax (sic) *personatus lesueurii* Hollister, Proc. U. S. Nat. Mus. 40: 378, April 17, 1911.
Sorex longirostris lesueurii Hollister, Proc. U. S. Nat. Mus. 40: 380, April 17, 1911.
Sorex foresteri (sic) Fleming, Nat. Hist. Toronto Region (Publ. by Canadian Inst.), p. 209, November, 1913.
Sorex cinereus cinereus Jackson, Journ. Mamm. 6: 56, February, 1925.
Sorex frankstownensis Peterson, Ann. Carnegie Mus. 16: 292, March, 1926. Type locality, Frankstown Cave, near Hollidaysburg, Blair County, Pa.

Type specimen.—None now known to exist.

Type locality.—Fort Severn, Ontario, Canada.

Geographic range.—Northern Quebec and all of northern Canada, west to central Alaska, northern Kenai Peninsula, western British Columbia (except coastal region); south to New Jersey, the mountains of North Carolina and Tennessee, central Ohio, southern Indiana, northern Illinois, northeastern Iowa, eastern Minnesota, northern and eastern Manitoba, northern Saskatchewan, through the mountains of Idaho, western Montana and western Wyoming to northern New Mexico, and northeastern and central Washington (fig. 3).

Diagnostic characters.—Size medium; larger than *Sorex fontinalis*, *S. lyelli*, *S. preblei*, *S. c. haydeni* or *S. c. hollisteri*, smaller than *S. c. streatori* or *S. c. miscix*. Darker and more brownish (less grayish) than *miscix*, particularly in winter pelage; skull shorter than that of *miscix* with relatively shorter and broader rostrum, and lower brain case. Larger and with relatively longer tail than *S. c. haydeni*; color darker both in summer and winter, particularly on the sides, tending less to development of tricolor pattern; skull averaging slightly larger than that of *haydeni*, with relatively and actually

longer palate, and relatively narrower rostrum. Larger and with slightly longer tail than *hollisteri;* color darker, particularly in summer, underparts in both winter and summer pelages less whitish; skull about the size of that of *hollisteri* or slightly larger, with broader rostrum. Paler than *streatori*, especially on the underparts; tail shorter and hind feet smaller; skull smaller than that of *streatori*, with weaker rostrum.

Color.—Winter pelage: Upper parts grayish fuscous, frequently tending toward chaetura drab or hair brown, extending well down on the sides; underparts smoke gray or between smoke gray and pale smoke gray; tail essentially bicolor, chaetura drab or fuscous above, buffy below nearly to tip. *Summer pelage:* Much more brownish than winter pelage. Upper parts rather variable, fuscous-black, mummy brown, or sometimes Prout's brown, usually extending well onto the sides and gradually blending with colors of underparts; sometimes with a distinct lateral ribbon of drab or buffy brown; underparts usually smoke gray, sometimes light grayish olive, or even tinged with deep olive-buff tending toward avellaneous; tail as in winter.

Skull.—Medium in size for the *cinereus* group (condylobasal length about 15.8 mm.). Smaller than that of *S. c. miscix*, with relatively shorter and broader rostrum, and shallower brain case. Averaging larger than that of *S. c. haydeni*, with relatively and actually longer palate, relatively narrower rostrum, and usually with less densely pigmented dentition. About the size of that of *S. c. hollisteri* or slightly larger, with broader, less attenuate rostrum. Smaller than that of *S. c. streatori*, with rostrum smaller, dentition weaker, and the molariform teeth usually less deeply emarginate posteriorly.

Measurements.—Adult male and adult female from Drury Run, Clinton County, Pa.: Total length, 98; 95; tail vertebrae, 40; 39; hind foot, 11; 12. Average of four adult females from Washington County, R. I.: Total length, 100.5 (99–102); tail vertebrae, 41.5 (40–43); hind foot, 12.4 (11.8–12.7). Average of three adult females from Mamie Lake, Vilas County, Wis.: Total length, 101.7 (99–103); tail vertebrae, 38.7 (38–40); hind foot, 12 (12–12). Average of three adult males from Pahaska (mouth of Grinnell Creek), Park County, Wyo.: Total length, 96.3 (95–97); tail vertebrae, 41.7 (39–44); hind foot, 12 (12–12). Skull: Skull of adult male (teeth moderately worn) and adult female (teeth slightly worn) from Drury Run, Clinton County, Pa.: Condylobasal length, 15.6; 16.0; palatal length, 5.9; 6.0; cranial breadth, 7.6; 7.6; interorbital breadth, 3.1; 2.9; maxillary breadth, 4.1 4.0 maxillary tooth row, 5.5; 5.5. Average of four skulls of adult females (teeth slightly worn) from Washington County, R. I.: Condylobasal length, 15.7 (15.4–16.2); palatal length, 6.0 (6.0–6.0); cranial breadth 7.6 (7.6–7.7); interorbital breadth, 3.0 (2.9–3.1); maxillary breadth, 4.1 (4.0–4.3); maxillary tooth row, 5.5 (5.4–5.6). Average of four skulls of adult males (teeth moderately worn) from Roan Mountain, N. C.: Condylobasal length, 15.5 (15.1–15.9); palatal length, 5.9 (5.8–6.0); cranial breadth, 7.5 (7.3–7.6); interorbital breadth, 3.1 (2.9–3.2); maxillary breadth, 4.1 (4.0–4.2); maxillary tooth row, 5.4 (5.3–5.5). Average of five skulls of adult females (teeth slightly worn) from Mamie Lake, Vilas County, Wis.; Condylobasal length, 15.8 (15.5–16.0); palatal length, 6.0 (5.8–6.1); cranial breadth, 7.6 (7.5–7.8); interorbital breadth, 3.0 (3.0–3.1); maxillary breadth, 4.0 (3.9–4.1); maxillary tooth row, 5.5 (5.3–5.7). Average of three skulls of adult males (teeth slightly worn) from Pahaska (mouth of Grinnell Creek), Park County, Wyo.: Condylobasal length, 15.5 (15.4–15.5); palatal length, 6.0; (6.0–6.0); cranial breadth, 7.6 (7.4–7.7); interorbital breadth, 3.0 (3.0–3.1); maxillary breadth, 4.0 (4.0–4.1); maxillary tooth row, 5.4 (5.3–5.5). Average of five skulls of adult females (teeth slightly worn) from Fort Resolution, Northwest Territories: Condylobasal length, 16.0 (15.9–16.1); palatal length, 6.0 (6.0–6.0); cranial breadth, 7.8 (7.6–8.0); interorbital breadth, 3.0 (2.9–3.1); maxillary breadth, 4.0 (3.9–4.1); maxillary tooth row, 5.5 (5.4–5.6).

Remarks.—The common long-tailed shrew of the northeastern United States and Canada was first given recognition with a valid scientific name by Kerr (1792, p. 206), who described the species under the name *Sorex arcticus cinereus*, basing his description upon the account given by Pennant (1784, p. 139), which in turn was based upon that of Forster (1772, p. 381), neither Pennant nor Forster giving the animal a Latin designation (Jackson, 1925a, p. 55).

Several years later, November 17, 1826, Isidor Geoffroy Saint Hilaire read an account of the animal before the Société d'Histoire Naturelle at Paris, and the following year, 1827, he published two descriptions of the species under the name *Sorex personatus*, which has been generally used for the species since Miller's and Merriam's revisions of 1895. The earlier of these descriptions appeared in Dictionnaire Classique d'Histoire Naturelle (Geoffroy, 1827a, p. 319). This volume bears date of January, 1827, on the title page, and was actually distributed before February 10, 1827. The other account, and the one which has heretofore been quoted as the original description of *personatus*, appeared in Mémoires du Muséum d'Histoire Naturelle (Geoffroy, 1827b, p. 122). The latter volume bears as a date upon the title page only the year, 1827; Sherborn, however (Sherborn, 1914, p. 368), is authority for fixation of its date of publication as December, 1827. Further evidence that the article in the Dictionnaire appeared earlier than the one in the Mémoires is furnished in a footnote in which Geoffroy states:

> Ce Mémoire a été composé en octobre 1826, et lu le 17 novembre suivant à la Société d'Histoire naturelle: quelques recueils scientifiques et même quelques gazettes en ont rendu compte à cette époque, d'après ma lecture; et j'en ai moi-même, désirant prendre date sur les faits nouveaux qu'il renferme, inséré un extrait dans le tome onzième du Dictionnaire classique. (Geoffroy, 1827b, p. 122.)

The following year Richardson (1828, p. 516) described the same species from the vicinity of Hudson Bay, giving it the name *Sorex forsteri*, the type of which is in the British Museum and has been examined by Miller, who states that the specimen is a typical *S. personatus* [=*cinereus*]. (Miller, 1895, p. 41.)

Bachman's description and type locality of *Sorex cooperi* (Bachman, 1837, p. 388) are too indefinite for positive subspecific identification, but it seems most logical that the name should be treated as a synonym of *S. c. cinereus*. His species *S. fimbripes* (Bachman, 1837, p. 391) according to Hollister is not positively identifiable even as to species (Hollister, 1911, p. 40), but it seems to the present reviser that Bachman's description and figure of *fimbripes* clearly refer to *S. c. cinereus*, and it is placed in synonymy under this form. De Kay's *Otisorex platyrhinus* (De Kay, 1842, p. 22) certainly belongs in synonymy here.

The name *Amphisorex lesueurii* Duvernoy (1842a, p. 33) has been placed in synonymy under both *S. personatus* I. Geoffroy and *S. longirostris* Bachman. Merriam, in his remarks under *S. personatus*, states:

> Another form that will probably require separation comes from the extreme southern limit of range of the species, where it overlaps from the Transition into the Upper Austral or Carolinian Zone. If worthy of recognition, it will probably take the name *lesueuri*, proposed by Duvernoy in 1842 for a specimen from Wabash Valley, Indiana. Specimens of this form are extremely rare, and have been examined from only two localities—Sandy Spring, Md., and New Harmony, Ind. (Merriam, 1895, p. 61.)

And in a footnote he states:

> Unfortunately, the skull of the specimen from New Harmony can not be found.

Hahn placed *Amphisorex lesueurii* Duvernoy in synonymy under *Sorex longirostris* Bachman on the basis that all available specimens

from southern Indiana had proved to be *longirostris*. (Hahn, 1909, p. 607.)

Hollister, a few years later, writes:

> The name *Sorex personatus lesueurii* (Duvernoy), based on a specimen from the Wabash Valley, Ind., has been used for a southern form of *personatus*. As no specimen of a shrew of the *personatus* type is known from southern Indiana, and the few specimens collected in that region have all very surprisingly proved referable to *Sorex longirostris* Bachman, it is obvious that the name *Amphisorex lesueurii* Duvernoy is not applicable to a *personatus* shrew. (Hollister, 1911, p. 378.)

Hollister further states:

> The skin without skull, from New Harmony, Ind., recorded somewhat doubtfully by Doctor Merriam as *Sorex personatus lesueurii*, seems certainly to be *S. longirostris*. At that time the occurrence of this species in Indiana was unthought of, and the determination of a skin alone, with so few specimens of *longirostris* for comparison, was virtually impossible. . . . If larger series from Illinois and Indiana should show the northern specimens to be separable, the name *Sorex longirostris lesueurii* (Duvernoy), type-locality Wabash River, Ind., is available. (Hollister, 1911, pp. 379–380.)

An examination of the New Harmony specimen has disclosed the skull concealed in the skin from which the writer has had it removed and finds it to be that of *S. c. cinereus*. It is smaller than typical *cinereus*, but in this respect it is only in keeping with the general tendency for certain skulls from the southern part of the range of the species to be smaller than average northern specimens. In external measurements the specimen is also a trifle smaller than normal individuals, but in color it does not differ from true *cinereus*.

The type specimen of *Amphisorex lesueurii* Duvernoy is not known to be in existence. The original description of it (Duvernoy, 1842a, p. 8, pp. 33–34, pl. 50) is rather unsatisfactory and difficult to assign to either *S. longirostris* or *S. cinereus;* certainly it does not refer to any other shrew. There is nothing in the description that would seem to apply specifically to *S. longirostris* as distinguished from *S. cinereus*. There are, however, certain parts of the description that would lead one to believe that the Duvernoy specimen was of the species *cinereus* rather than *longirostris*. Under the subgenus *Amphisorex* the upper unicuspidate teeth are characterized as five in number diminishing gradually from the first to the last,[3] a character that fits *S. cinereus* but technically would not apply to *S. longirostris*. Moreover *S. longirostris*, so far as known, does not assume in any pelage what could reasonably be called a "couleur * * * d'un gris cendré assez foncé" (Duvernoy, 1842a, p. 33), while some specimens of *S. cinereus* might be so described. Duvernoy (1842a, p. 50) figures the animal natural size, indicating a color distinctly more grayish than in either of the species *longirostris* or *cinereus*. On the same plate are found sketches of the side of the lower jaw and sole of the hind foot. The sketch of the foot shows no diagnostic characters. That of the mandible indicates the length (antero-posterior diameter) of the first incisor to be considerably greater than it would be in *S. longirostris*, and the ascending ramus arises more obliquely from the horizontal ramus, in both these respects being like *S. cinereus*. In view of these facts it is necessary to consider *Amphisorex lesueurii* Duvernoy, a synonym of *S. c. cinereus* Kerr.

[3] "Les incisives inférieures à tranchant dentelé; les supérieures fourchues, ayant leur talon prolongé. Les petites dents qui les suivent, au nombre de cinq, diminuent graduellement de la première à la dernière, qui est rudimentaire." (Duvernoy, 1842a, p. 8.)

Gilpin was next to add a distinctly new name to the synonymy of this form when he called a shrew from Nova Scotia *Sorex acadicus*. (Gilpin, 1867, p. 2.) The measurements given by Gilpin agree favorably with *S. cinereus* from that region and can apply to no other shrew.

The type specimen of *Sorex idahoensis* Merriam (Merriam, 1891, p. 32) and other specimens of "*idahoensis*" from the type region agree almost exactly with specimens of *S. c. cinereus* from the eastern United States and Canada.

As late as the year 1890 Dobson misidentified *S. c. cinereus* for *S. arcticus*, under the name *richardsonii*, when he figured the teeth of one from Nova Scotia. (Dobson, 1890, pl. 23, fig. 9.)

Peterson (1926) named *Sorex frankstounensis*, basing his description upon Pleistocene material consisting of a right mandible with all the teeth and a fragment of a left mandible with M_1 and M_2, from Frankstown Cave, near Hollidaysburg, Blair County, Pa. The type specimen is No. 11159a, Carnegie Museum, catalogue of vertebrate fossils. The describer designates several distinctive characters for his new species as compared with *S. personatus* (=*S. cinereus*). Through the kindness of Mr. Peterson, the author has been privileged to examine the type mandible and finds that all of these distinctive characters are covered by the variation in *S. c. cinereus*. As compared with certain specimens of *S. c. cinereus* from Maine, New York, Michigan, and Wisconsin, the type mandible of *S. frankstounensis* agrees perfectly. *S. frankstounensis* Peterson must therefore become a synonym of *S. c. cinereus* Kerr.

There are indeed few, if any, subspecies of American mammals that have the extensive geographic range of *S. c. cinereus*, and the uniformity of its characters over this range is surprising. Not that there is no individual and local geographic variation. Often specimens from the same bog or forest are distinctly different, and frequently series of specimens from adjoining localities show average differences. But these can always be matched perfectly by other series of specimens from some distant localities, so that it is impossible to assign these slight variations to any geographic area.

Intergradation between *S. c. cinereus* and *S. c. miscix* is clearly indicated in specimens from Nova Scotia and eastern Quebec, many of which have skulls almost identical with those of *miscix*, but all are more nearly like true *cinereus* in color. The seven rather unsatisfactory alcoholic specimens from Fort Chimo, Quebec, are provisionally referred to *S. c. cinereus*, although on geographic grounds one might suspect specimens from this locality would be nearer *miscix*.

Specimens from Indiana, southern Wisconsin, and Iowa show an approach toward *S. c. haydeni* in size, but in other respects are like typical *S. c. cinereus*. Specimens from Boulder, Pearl, and Loveland, Colo., show a slight tendency toward *haydeni;* most of the skulls from these localities, however, match those of true *cinereus*. The single specimen from Loveland, an old male, has a peculiar, runty skull, smaller even than that of typical *haydeni*, with a small, short brain case, but with a rostrum comparable in size and proportions with that of *S. c. cinereus*. Externally the animal is more like *haydeni* than *S. c. cinereus*, and the writer would be inclined to refer

it to the former subspecies were it not for the fact that it would be the only representative of *haydeni* examined from this region, and furthermore that the series of several specimens from the near-by vicinity of Boulder are easily referable to the subspecies *cinereus*. A single specimen from 8,800 feet in the Sierra Madre Mountains, Wyo., shows a slight approach toward *haydeni*, and certain specimens from the valleys of western Montana could about as well be called *haydeni* as *S. c. cinereus*.

Intergradation with *S. c. streatori* is definitely shown in specimens from western British Columbia; and specimens from southern British Columbia, even as far east as Glacier, show tendencies toward *streatori* in color, size, and cranial characters.

The majority of specimens from interior Alaska are chromatically essentially typical of the subspecies *cinereus*, but show an inclination toward *S. c. hollisteri* in certain skulls that are somewhat narrower than in true *cinereus* and have correspondingly narrower rostra. Mount McKinley and the region at the head of the Toklat River produce skulls typical of *S. c. cinereus*, but the skins show an approach toward *hollisteri* in their apparently somewhat paler color of the underparts, and in their shorter tails than in typical *cinereus*. Specimens from Kenai Peninsula and the region of Cook Inlet, Alaska, are referred to *S. c. cinereus;* in reality they may be intermediates between *S. c. streatori* and *hollisteri;* their skulls are essentially like those of typical *cinereus*, but the rostra average narrower, indicating the influence of *hollisteri*. In fact, many of the specimens from Kenai Peninsula can be referred to either *S. c. cinereus* or *hollisteri* with about equal propriety.

Specimens examined.—Total number, 2,063, as follows:

Alaska: Barabori (Kenai Peninsula), 9[4]; Barroa, 1[4]; Caribou Camp (Kenai Peninsula), 14[4]; Chandlar River (Endicott Mountains), 1[4]; Charlie Creek (near), Yukon River, 1; Circle, 4; Circle (20 miles above, Yukon River), 3; Circle (40 miles above, Yukon River), 4; Eagle (mountains near), 40; Eagle City, 2; Fairbanks, 4; Fort Yukon, 3; Hope (Cook Inlet), 16; Hope (mountains near Cook Inlet), 4; Hulahula River, 1[4]; Kenai Mountains, 9[4]; Kenai Peninsula, 11[4]; Kuskokwim River (north fork, base Mount Sischoo), 2; Kuskokwim River (south fork, 10 miles above mouth of Post River), 1; Little Moose Creek (tributary of Clearwater, fork of Toklat River), 4; Moose Camp (Kenai Peninsula), 24[4]; Mount McKinley (Bear Creek), 2; Mount McKinley (Glacier Creek), 1; Mount McKinley (north side), 2; Mount Sischoo, 1; Nenana, 1; Point Barrow, 4[5]; Seldovia, 96[4]; Sheep Creek, Kenai Peninsula, 4[4]; Sheep Creek (Kenai Peninsula), 34[4]; Tanana, 12; Toklat River (head of), 2; Tyonek (Cook Inlet), 20; White Pass (Glacier), 1; Yukon River, 1; Yukon River (mouth of Porcupine River), 1.

Alberta: Athabaska Delta (east branch, 1 mile north of outlet of Jack Fish Lake), 1[6]; Athabaska Delta (15 miles northwest of Fort Chipewyan, Egg Lake, 2[7]; Athabaska Lake, 1; Athabaska Lake (outlet), 5; Athabaska Landing, 1; Athabaska River (30 miles above Athabaska Landing), 6; Athabaska River (Calling River), 1; Athabaska River (Cascade Rapid, 20 miles above Fort McMurray), 2; Athabaska River (Mountain Rapid), 2; Athabaska River (Pelican Rapid), 1; Athabaska River (50 miles above Pelican Rapid), 1; Athabaska River (30 miles above Pelican River), 1; Banff, 3; Blindman River, 4[4]; Calgary, 1; Canmore, 1; Cavell Creek (mouth of, Jasper Park, altitude 4,000 feet),

[4] Amer. Mus. Nat. Hist.
[5] Acad. Nat. Sci. Philadelphia, 3.
[6] Acad. Nat. Sci. Philadelphia.
[7] Mus. Comp. Zool., 1.

1[8]; Crows Nest Pass, 4[9]; Dunvegan (about 75 miles north, Fort St. John Trail, Peace River), 1[10]; Edmonton, 1[11]; forks of Blindmans and Red Deer Rivers, 7[6]; Fort Chipewyan, 7; Fort McMurray, 1[6]; Henry House, 2[12]; Henry House (15 miles south), 1; Henry House (25 miles west), 5; Island Lake (15 miles west of Lake St. Ann), 1; Lake Athabaska (Cypress Point), 2; Lake Athabaska (Goose Island), 1[6]; Lake Athabaska (10 miles west, northeast of Sand Point), 1[13]; Mount Forget-me-not, 1[8]; Muskeg Creek (15 miles from mouth), 2; Muskeg Creek (20 miles from mouth), 13; Ptarmigan Lake, 1[4]; Red Deer River, 13[14]; St. Albert, 1; Shovel Pass (Jasper Park, altitude 7,500 feet), 1[8]; Slave River (Smith Landing), 4; Slave River (10 miles below Peace River), 3; Smoky River Trail (midway between Muskeg Creek and Baptiste River), 2; Smoky Valley (50 miles north of Jasper House), 4; South Edmonton, 2; Stony River, 3; Stony River (25 miles north Jasper), 1; Waterton Lakes Park, 12.[8]

British Columbia: Atlin, 1[15]; Bad River (on lake, 2,350 feet), 1; Bear Lake (site Fort Connolly), 1; Bennett, 6; Big Salmon River (near Canyon), 1; Cariboo Lake (near Kamloops), 1; Fernie, 3[5]; Field, 4[16]; Fort Grahame, 1; Glacier, 8[17]; Hazleton, 8; Hazleton (altitude 959 feet), 3[10]; Hope (Lake House), 2[6]; Kispiox Valley (23 miles north of Hazelton), 3[10]; Klappan River Valley, 1; Level Mountain, 1[4]; Liard River (mouth of Kachika River), 1[4]; McDame Creek (Quartz Creek, altitude 3,600 feet), 1; McDame Post (Dease River), 8; Monashee, 2[6]; Moose Lake, 5; Moose Pass, 1; Moose River (south fork), 1; Moose River (north fork), 4; Parsnip River (head), 1; Penticton, 3[18]; Pine River (head east branch South Pine River), 2; Raspberry Creek, 6[4]; Salmon River, 2[5]; Sicamous, 1; Stikine River (at Great Glacier), 7[19]; Tacla Lake (north end), 1; Tacla Lake (Babine Trail, 12 miles west), 1; Tatletuey Lake (12 miles west Thudade Lake), 1; Telegraph Creek, 23[19]; Yellowhead Lake, 3.

Colorado: Blackhawk, 1; Boulder County, 7; Buchanan Pass, Boulder County, 3; Dixie Lake, Boulder County, 1[20]; Hermit, 1; Homestead Ranch, Larimer County, 1[20]; Loveland, 1; Mount Bross, Grant County, 1[20]; Pearl (North Park, altitude 9,000 feet), 1; Rabbit Ear Mountains (Arapahoe Pass), 1; Ruby Lake, 1; St. Elmo (altitude 10,100 feet), 7.

Connecticut: Hamden, 1; Stonington, 1.

Idaho: American Falls, 1; Bitterroot Mountains, 2[4]; Cedar Mountain (W. S. C. Camp, altitude 4,000–4,500 feet), 2[21]; Ketchum, 1[6]; Lemhi Mountains (type locality of *idahoensis*), 4; Packers Meadow, 1; Sawtooth City, 1; Sawtooth Lake, 1; Sawtooth National Forest, 1.

Illinois: West Northfield, 2.

Indiana: New Harmony, 1; Porter County, 4.

Iowa: Buchanan County, 2.

Maine: Brooklin, 3; Campobello Island, 2[6]; Caribou, Aroostook County, 1[13]; Haven, 1; Mount Katahdin (altitude 4,250 feet), 1; North Haven, 2; Orono, 1; Sebec Lake, 2; Small Point, 1; South Twin Lake, Penobscot County, 11[4]; Third Mopang Lake, Washington County, 6[22]; Upton, 1[6]; South West Harbor, Mount Desert Island, 2.

Manitoba: Echimamish River, 4; Fort Garry, 1; Hill River (near Swampy Lake), 1; Knee Lake (near outlet), 1; Lake Winnipeg, 4; Norway House, 3; Norway House (Island Lake), 1[4]; Oak Lake, 2[5]; Oxford House, 7; Pine Lake, 1; Red River Settlement, 3; Robinson Portage, 3; Swampy Lake (near outlet), 1; York Factory, 2.

Maryland: Bittinger, Garrett County, 2.

Massachusetts: Barnstable Neck, 2[6]; Bedford, 3[6]; Danvers, 1; Harvard, 4[23]; Lunenburg, 2; Marshfield (near Snake Hill), South River, 2; Middleboro, 14; Mount Greylock, 2[6]; Nantucket, 7[6]; Randolph, 2[6]; Wareham, 6[6]; Williamstown, 1; Wilmington, Middlesex County, 3; Woburn, 1; Woods Hole, 2.

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[4] Amer. Mus. Nat. Hist.
[5] Acad. Nat. Sci. Philadelphia.
[6] Nat. Mus. Canada.
[8] Nat. Mus. Canada, 3; Acad. Nat. Sci. Philadelphia, 1.
[10] Mus. Vert. Zool., Univ. Calif.
[11] J. D. Soper coll., Edmonton, Alberta.
[12] Nat. Mus. Canada, 1.
[13] Univ. Mich.
[14] Amer. Mus. Nat. Hist., 12.
[15] Provincial Mus. British Columbia.
[16] Acad. Nat. Sci. Philadelphia, 2.
[17] Amer. Mus. Nat. Hist., 2.
[18] Nat. Mus. Canada, 2.
[19] Amer. Mus. Nat. Hist., 13; Mus. Vert. Zool., 9.
[20] Colo. Mus. Nat. Hist.
[21] State Coll. Wash.
[22] Acad. Nat. Sci. Philadelphia.
[23] Mus. Comp. Zool., 2.

Michigan: Alger County, 2[13]; Ann Arbor, 5[24]; Chippewa County, 3[13]; Fish Hawk Lake, Gogebic County, 5[13]; Honey Creek, Washtenaw County, 1[13]; Michigamme, 3; Palmer, 1; Pleasant Lake, Livingston County, 1[13]; Porcupine Mountains, Ontonagon County (T. 51 N., R. 43 W., S. 14), 1[13]; Rush Lake, Huron County, 1[13]; Whitefish Point, Chippewa County, 1.[13]

Minnesota: Burntside Lake, 1; Elk River, 60; Fort Ripley, 1; Fort Snelling, 31[25]; Hinckley, 3; Long Prairie, 1; Minneapolis, 12; Ottertail County, 2[26]; Princeton, 1; Steele County, 1[22]; Tower, 1.

Montana: Big Belt Mountains (Camas Creek, 4 miles south of Fort Logan), 1; Big Timber (14 miles south), 1; Boulder Creek (8 miles south of Big Timber), 1; Bozeman, 1[27]; Carter (National Bison Range), 1; Chief Mountain, 1; Crazy Mountains (near head Big Timber Creek), 2; Deer Lodge County, 1; Dry Creek, 1; Fish Creek, Glacier Park, 1; Florence, 5[28]; Highwood Mountains, 2; Hilger (7 miles northeast), 2; Indian Creek, Glacier Park, 1; Lake McDonald, 1; Little Belt Mountains (Sheep Creek, 16 miles north of White Sulphur Springs), 2; Little Belt Mountains (Dry Wolf Creek, 20 miles southwest of Stanford), 2; Lolo, 1; St. Marys Lake, 4[29]; Stevensville, 1; Sun River, 1; Waterton Lake, 1; West Fork of West Gallatin River (Gallatin National Forest, altitude 6,500 feet), 7; Yellowstone (4 miles southwest), 1[30]; Zortman, 1; Zortman (Ruby Creek), 1.

New Brunswick: Bathurst (15 miles from, Miramichi Road), 40[8]; Gulquac Lake, Victoria County, 4[4]; Hampton, 1; Long Lake, Victoria County, 4[4]; Maugerville, Sunbury County, 2[31]; Point Le Preaux, 1[6]; Restigouche River, 1[6]; St. Johns, 1; Tobique Point, Victoria County, 3[4]; Tobique River (forks of), Victoria County, 13[4]; Tracy Station, Sunbury County, 1[6]; Trousers Lake, Victoria County, 40[4]; Yougall, 17.[8]

New Hampshire: Fabyans, 1; Fitzwilliam, 1; Mount Washington (summit), 4; Ossipee, Carroll County, 1.

New Jersey: Beach Haven, Ocean County, 1[22]; Bear Swamp (south side), Burlington County, 3[22]; Bridgeport (near), Gloucester County, 1[22]; Cape May, 16[22]; Chairville Pond, Burlington County, 3[22]; Essex County Park, 3[4]; Haddonfield, 1[22]; Mauricetown, Cumberland County, 7[22]; Mays Landing, 23[22]; Millburn, 5[4]; Port Norris, Cumberland County, 8[22]; South Mountain Reservation, Essex County, 19[4]; South Orange Reservation, 4[4]; Tabor, 2[4]; Tuckerton, 5.

New Mexico: Pecos Baldy, 1; Pecos Baldy (altitude 11,000 feet), 1; Twining (altitude 10,500–10,700 feet), 6.

New York: Adirondacks, 1; Amityville, Long Island, 1; Berlin (altitude 1,100 feet), 2[4]; Big Moose Lake, 2; Catskill Mountains, 2; Fort Totten, 4; Gull Lake, Adirondack Mountains, 1; Highland Falls, 1; Locust Grove, 7; Minerva, 1[4]; Montauk, 2[4]; Montauk Point, Suffolk County, 11; Mountain View, 3; Northwood, 10[4]; Ossining, 1; Peterboro, 2; Piseco, 1; Point Rock, 1; Tupper Lake, 3[6]; Waterville, 1; West Hampton, 1.

North Carolina: Roan Mountain, 4; Roan Mountain (altitude 4,700 feet), 2; Roan Mountain (altitude 6,000 feet), 14; Roan Mountain (altitude 6,300 feet), 1.

Northwest Territories: Anderson River region, 5; Anderson River region (Fort Anderson), 3; Anderson River region (Lower Anderson River), 2; Fort Liard, 1; Fort Norman, 2[23]; Fort Providence, 10; Fort Rae, 23; Fort Resolution, 15; Fort Resolution (Mission Island), 2; Fort Simpson, 11; Fort Smith, 2[29]; Fort Wrigley, 2; Franklin Bay, 2; Grandin River, 1; Great Bear Lake (Fort Franklin), 24; Great Slave Lake, 5; Great Slave Lake (Big Island), 1; Harrowby Bay, 1[4]; Horton River (Coal Creek), 2[4]; Kozaryuak River, Coronation Gulf, 1[8]; Lake St. Croix, 3; Mackenzie River (Nahanni River Mountains), 3; Old Fort Good Hope (near), 1; Peels River, 4; Richard Island (east of,

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[4] Amer. Mus. Nat. Hist.
[6] Acad. Nat. Sci. Philadelphia.
[8] Nat. Mus. Canada.
[13] Univ. Mich.
[22] Acad. Nat. Sci. Philadelphia.
[24] Univ. Mich., 1.
[25] Amer. Mus. Nat. Hist., 4.
[26] G. G. Cantwell coll., Palms, Calif.
[27] Mont. State Coll.
[28] Mont. State Coll., 1.
[29] Amer. Mus. Nat. Hist., 1.
[30] D. R. Dickey coll., Pasadena, Calif.
[31] Miramichi Nat. Hist. Soc., Chatham, New Brunswick.
[32] Acad. Nat. Sci. Philadelphia, 12.

Mackenzie Delta), 1[4]; Slave River (100 miles below Fort Smith), 3; Toker Point (south of), 3.[4]

Nova Scotia: Barren, Victoria County, 1[8]; Barrington Passage, 23[8]; Brier Island (Digby Neck, extremity), 1; Camp Point, Cape Breton Island, 1[8]; Cheticamp Lake, Cape Breton Island, 4[8]; Digby, 12[33]; Halifax, 9[7]; Ingonish Centre, 1[8]; James River, 5; Kedgemakooge Lake, 1; Kings County, 6[8]; Little River (Digby Neck, 1/2 mile from shore), 3; Newport, 2.[4]

Ontario: Algonquin Park, 6; Dows Swamp (near Ottawa), 1[8]; Emsdale. 5; Lac Seul, 1[8]; Humboldt Bay, Lake Nipigon, 3[34]; Long Swamp (near Billing Bridge), 1[8]; Lorne Park, 2[8]; Macdiarmid (Lake Nipigon), 5[34]; Macgregor Bay (District of Manitoba), 3[34]; Michipicoton Island, 6; North Bay, 2[8]; Ottawa. 1; Rat Portage. 1; Sand Lake, 2.

Ohio: Cleveland, 1; Ellsworth, 1; Milford Center, 1.

Pennsylvania: Drury Run, Clinton County (type locality of *fimbripes*), 3; Frankstown Cave, near Hollidaysburg, Blair County (type locality of *frankstounensis*), 1[34a]; Kennett Square, 2[22]; Lake Ganoga, Sullivan County, 2[22]; Lake Leigh (North Mountain), 2[22]; Summit Mills, Somerset County, 1.[22]

Prince Edward Island: Alberton, 1[4]; Georgetown, 8[29]; Kensington, 2[49]; Lennox Island, 2; Mount Stewart, 7.[17]

Quebec: Alymer, 2[8]; Berry Mountain Camp, Matane County, 1[8]; Big Island, Blue Sea Lake, 1[8]; Burbridge, 2[8]; Clearwater Lake, 1[8]; Federal Mine, Gaspé County, 2[8]; Fort Chimo, 7; Gaspé Peninsula (Cascapedia River), 1[4]; Gaspé Peninsula (Cascapedia River, Lazy Bogan Mountain), 1[4]; Gaspé Peninsula (Cascapedia River, Loon Lake), 1[4]; Gaspé Peninsula (Cascapedia River, Tracadie), 2[4]; Godbout, 58; Lac Aux Sables, 8[22]; Lake Edward, 16[6]; Mount Albert, 5[4]; Rupert, 2; St. Rose, 4; Seal Lake, 1[8]; Ste. Anne des Monts (Gaspé), 3[4]; Ste. Anne River, Gaspé County, 4.[8]

Rhode Island: Washington County, 15.

Saskatchewan: Lake Athabaska (Fair Point), 1; Lake Athabaska (Poplar Point), 4[7]; Lake Athabaska (8 miles northeast of Moose Island), 2[7]; Lake Athabaska (mouth Beaver River), 1.[10]

Tennessee: Roan Mountain, Carter County (altitude 6,000 feet), 2[22]; Roan Mountain, Carter County (altitude 6,200 feet), 1.[22]

Vermont: Burlington, 2; Mount Mansfield, 4; Newfane, 1[4]; Pico Peak, 5[4].

Virginia: Mount Rogers, Grayson County (altitude 5,719 feet), 1.

Washington: Bauerman Ridge (west end, at Tungsten Mine, altitude 6,800 feet, Okanogan County), 1; Conrad Meadows (3 miles above, south fork Tieton River, altitude 4,200 feet), 1[21]; Curlew (5 miles west, Ferry County, altitude 2,800 feet), 2; Lake Chelan (head of), 1; Lake Keechelus, 1[13]; Loon Lake, Stevens County (altitude 2,400 feet), 2; Metaline, Pend Oreille County, 1; Mount Rainier (Paradise Creek, altitude 5,200 feet), 1; Tunk Mountain, Okanogan County (altitude 3,500 feet), 1; Yakima Indian Reservation (Signal Peak, altitude 4,000 feet, Yakima County), 1.

West Virginia: Cranberry Glades, Pocahontas County, 5; Jobs Knob, 8[35]; Pocahontas County (near head of Cranberry River), 8.

Wisconsin: Beaver Dam, 3[36]; Cataline, Marinette County, 4[37]; Clarks Lake, Door County, 2; Connors Lake (18 miles west-northwest of Phillips, Sawyer County), 8; Conover (near), 1[38]; Crescent Lake, Oneida County, 8; Danbury, 1; Delavan, 7[39]; Dousman, 1; Eagle River, 2; Elco, 2[40]; Elkhart Lake (Sheboygan Swamp), 6; Ellison Bay, 1; Ellsworth, Pierce County, 1; Fish Creek. 1; Florence, 3; Herbster, 4; Kelley Brook, Oconto County, 2[37]; Kelly Lake, Oconto County, 11; Lac Vieux Desert, 4[38]; Lake St. Germain, Vilas County, 6; Lakewood, 10; Long Lake, Washburn County, 13; Madeline Island (Apostle

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[4] Amer. Mus. Nat. Hist.
[6] Acad. Nat. Sci. Philadelphia.
[7] Mus. Comp. Zool., 1.
[8] Nat. Mus. Canada.
[10] Mus. Vert. Zool., Univ. Calif.
[13] Univ. Mich.
[17] Amer. Mus. Nat. Hist., 2.
[21] State Coll. Wash.
[22] Acad. Nat. Sci. Philadelphia.
[29] Amer. Mus. Nat. Hist., 1.
[33] Mus. Comp. Zool., 8.
[34] Royal Ontario Mus. Zool.
[34a] Carnegie Mus.
[35] Mus. Comp. Zool., 6.
[36] D. R. Dickey coll., 1; Univ. Wis. Zool Mus., 1; Field Mus. Nat. Hist., 1.
[37] Public Mus. Milwaukee.
[38] Field Mus. Nat. Hist.
[39] Public Mus. Milwaukee, 2.
[40] Univ. Wis. Zool. Mus.
[49] Mus. Comp. Zool.

Islands), 3; Mamie Lake, 15; Mather, 1; McAllister, 2; Mercer, 3; Meridean, 2; Milton, 1[38]; Milwaukee, 1; Milwaukee County, 1[37]; Nashotah, 1; Newport, Door County, 1[37]; Ogema, 6; Outer Island (Apostle Islands), 12; Prairie du Sac, Sauk County, 4[37]; Prescott, Pierce County, 3[37]; Presque Isle (Apostle Islands), 1; Racine, 3; Rhinelander, 8[41]; Rib Hill, Marathon County, 7; Sand Island (Apostle Islands), 1; Sayner, 22[38]; Solon Springs, 11[42]; Spread Eagle, 1[38]; Stevens Point, 1; Sumner, 2[38]; Washington Island, Door County, 3; Wild Rose, 3; Withee, 2.

Wyoming: Big Horn Mountains (west slope, head of Trappers Creek, altitude 8,500 feet), 19; Big Horn Mountains (west slope, head of Trappers Creek, altitude 9,500 feet), 1; Big Horn Mountains (head north fork Powder River), 1; Big Piney, 1; Black Rock Creek, Lincoln County, 1; Cokeville, 1; Evanston, 1; Moran (1 mile north), 5; Moran (Lake Emma Matilda), 6; Pacific Creek, 2; Pahaska (Grinnell Creek), 8; Pahaska (Grinnell Creek, altitude 7,000 feet), 15; Pahaska (mouth of Grinnell Creek, altitude 6,600 feet), 3; Pahaska Tepee (mouth of Grinnell Creek, altitude 6,300 feet), 6; Salt River Mountains (10 miles southeast of Afton, 7,500 feet), 2; Sierra Madre Mountains (south base, Bridger Peak, altitude 8,800 feet), 1; Teton Mountains (Moose Creek, altitude 6,800 feet), 8; Teton Pass (above Fish Creek, altitude 7,200 feet), 12; Valley (altitude 7,500 feet), 2; Yellowstone Park (Mountain Creek), 1.

Yukon: Caribou Crossing (Yukon River), 2; Chandindu River (Yukon River), 1; Dawson (near Stewart River), 1; Forks Macmillan River, 1; Fort Selkirk (50 miles below, Yukon River), 1; Lake Lebarge (Yukon River), 1; Yukon River (Carbiou Crossing), 1.

SOREX CINEREUS MISCIX Bangs

Labrador Cinereous Shrew

(Pl. 2, b)

Sorex personatus miscix Bangs, Proc. New England Zool. Club 1: 15, February 28, 1899.

[*Sorex*] [*merriami*] *miscix* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 376, 1901.

Sorex cinereus miscix Jackson, Journ. Mamm. 6: 56, February, 1925.

Type specimen.—No. 8651, Museum of Comparative Zoology, Harvard College, Bangs collection; ♂ adult (teeth very slightly worn), skin and skull; collected October 10, 1898, by Ernest Doane.

Type locality.—Black Bay, Labrador.

Geographic range.—Labrador south of latitude 58° north. (Fig. 3.)

Diagnostic characters.—Somewhat larger than *Sorex c. cinereus*, with paler, more grayish color, particularly in winter pelage. Skull longer than average skulls of *S. c. cinereus*, with relatively longer and narrower rostrum and higher brain case.

Color.—*Winter pelage:* Upper parts drab more or less tending toward smoke gray, sometimes almost grayish hair brown; becoming paler on the sides. Underparts between pale olive-gray and pale smoke gray, sometimes tinged with pale pinkish buff. Tail drab above; avellaneous to light pinkish cinnamon below, nearly to tip. *Summer pelage:* Darker and more brownish than winter pelage. Upper parts sepia or slightly paler, usually becoming somewhat darker on the rump, and paler on the sides. Underparts pale smoke gray sometimes tinged with pinkish buff or avellaneous. Tail about as in winter.

Skull.—Similar to that of *S. c. streatori*. Longer than average skulls of *S. c. cinereus*, with relatively longer, narrower, and more attenuate rostrum, higher brain case, and longer tooth row.

Measurements.—Type specimen (adult male): Total length, 104; tail vertebrae 44; hind foot, 14. Average of eight adult females from type locality: Total length, 100.9 (95–110); tail vertebrae, 43 (39–46); hind foot, 13.1 (12–14)

[37] Public Mus. Milwaukee.
[38] Field Mus. Nat. Hist.
[41] Univ. Wis. Zool. Mus., 2.
[42] Field Mus. Nat. Hist., 10.

Skull: Type specimen (adult male; teeth very slightly worn): Condylobasal length, 16.9; palatal length, 6.6; cranial breadth, 8.1; interorbital breadth, 3.2; maxillary breadth, 4.0; maxillary tooth row, 6.0. Average of four skulls of adult females (teeth very slightly worn) from type locality: Condylobasal length, 16.6 (16.5–16.8); palatal length, 6.6 (6.4–6.7); cranial breadth, 8.1 (8.0–8.3); interorbital breadth, 3.2 (3.1–3.2); maxillary breadth, 4.1 (4.1–4.2); maxillary tooth row, 5.8 (5.7–5.9).

Remarks.—The Labrador form of *S. cinereus* is at best a poorly defined subspecies, distinguished from typical *cinereus* chiefly by slight average color differences in winter pelage. The skull of *S. c. miscix* also averages larger and with narrower rostrum than that of the subspecies *cinereus*, but there are many skulls of the latter, particularly from the northern part of its range, which are practically inseparable from skulls of *miscix*. Certain specimens of *cinereus* from eastern Quebec, Prince Edward Island, Nova Scotia, and New Brunswick show a tendency in color toward *miscix* but on the whole are nearer *S. c. cinereus*, to which they have been referred.

Specimens examined.—Total number, 75, as follows:

Labrador: Black Bay (type locality), 48[43]; Hopedale, 3[43]; L'Anse au Loup, 5[43]; Maddovik, 3[43]; Okak, 4[43]; Paradise, 9; Paradise River (20 miles above mouth), 2; Sandwich Bay, 1.[43]

SOREX CINEREUS HAYDENI Baird

PLAINS CINEREOUS SHREW

(Pl. 2, c)

Sorex haydeni Baird. Report Pacific R. R. Survey 8: part 1, Mammals, p. 29, 1857.

Sorex personatus haydeni Allen, Bul. Amer. Mus. Nat. Hist. 8: 257, November 25, 1896.

Sorex cinereus haydeni Jackson, Journ. Mamm. 6: 56, February, 1925.

Type specimen.—No. 1685, U. S. Nat. Mus., adult, sex unknown, alcoholic with broken skull unremoved; collected in 1855 by F. V. Hayden.

Type locality.—Fort Union, Nebr. (later Fort Buford, now Mondak, Mont., near Buford, Williams County, N. Dak.).

Geographic range.—Extreme east-central Alberta (Islay), southern Saskatchewan, southwestern Manitoba, south through extreme western Minnesota to northwestern Iowa, northern Nebraska, and through eastern Montana to southeastern Wyoming. (Fig. 3.)

Diagnostic characters.—Smaller than *Sorex c. cinereus*, with shorter tail; color paler, both in summer and winter, tending more to develop a tricolor pattern, darkest on the back, paler on the sides in a longitudinal ribbon, palest on the underparts; skull slightly smaller than that of *S. c. cinereus*, with relatively and actually shorter palate and relatively broader rostrum. About the size of *S. c. hollisteri*, or slightly smaller, with shorter tail, and tending more to develop tricolor pattern (dorsally usually darker, paler on the sides); rostrum decidedly shorter and broader than in *hollisteri*.

Color.—Winter pelage: Upper parts averaging paler than corresponding pelage of *S. c. cinereus*, usually hair brown or drab, sometimes nearly fuscous posteriorly; color of upper parts usually not extending onto the sides, which are generally rather sharply defined from the back and more nearly the color of the underparts; underparts between pale olive-gray and pale smoke gray, sometimes smoke gray; tail cinnamon brown or Saccardo's umber above, avellaneous or pinkish buff below, nearly to tip. *Summer pelage:* Paler than corresponding pelage of *S. c. cinereus*. Upper parts hair brown, drab, or olive-brown, paler on the sides, which frequently are rather sharply contrasted from

[43] Mus. Comp. Zool.

both the back and underparts in a distinct longitudinal ribbon of wood brown or avellaneous; under parts smoke gray or pale smoke gray, usually faintly tinged with pinkish buff; tail as in winter.

Skull.—Smaller than that of *S. c. cinereus* (condylobasal length about 15.3), with relatively and actually shorter palate, relatively broader rostrum, and more densely pigmented dentition. About the size of that of *S. c. hollisteri*, but with decidedly shorter, broader, less attenuate rostrum.

Measurements.—Average of five adult females from Lostwood, N. Dak.: Total length, 88.2 (85–92); tail vertebrae, 32.8 (30–36); hind foot, 11.4 (11–12). *Skull:* Skulls of two adult females (teeth slightly worn) from Lostwood, N. Dak.: Condylobasal length, 15.3; 15.0; palatal length, 5.5; 5.5; cranial breadth, 7.5; 7.5; interorbital breadth, 3.0; 3.0; maxillary breadth, 4.3; 4.4; maxillary tooth row, 5.2; 5.0. Skull of adult female (teeth slightly worn) from Williston, N. Dak.: Condylobasal length, 15.0; palatal length, 5.6; cranial breadth, 7.3; interorbital breadth, 3.0; maxillary breadth, 4.2; maxillary tooth row, 5.2.

Remarks.—The pale, short-tailed form of *S. cinereus* inhabiting the northern part of the central plains region is confined largely to the Transition Zone. It is a rather variable form particularly in cranial characters, which show everywhere in a broad border along its range an approach toward *S. c. cinereus*. Specimens referable to *S. c. haydeni* have been examined from as far north as Osler, Saskatchewan; these are typical of *haydeni* in color and measurements, but show an inclination toward the subspecies *cinereus* in having relatively longer and narrower rostra than specimens from the type region. The same is true of specimens from Laramie Peak and Fort Steele, Wyo., Portland, N. Dak., and most localities in eastern Montana. Others from southwestern Manitoba are essentially like typical *haydeni* in external characters but may show cranially a strong tendency toward *S. c. cinereus*. A large series from Aweme, Manitoba, is particularly puzzling and interesting. Nearly all the skins in this series are like typical *haydeni* in color and measurements, there being only a few that are like typical *cinereus* in color and only a few that have measurements of that subspecies. The skulls are extremely variable, ranging from a half dozen of those of the extreme style of *haydeni* (small and flat, with short and relatively broad rostrum) to several of the extreme style of *S. c. cinereus* (larger and decidedly higher, with long and narrow rostrum), with a few displaying intermediate skull characters. The contrast between the extremes in this series, if only the extremes from this locality were considered, is so great as to suggest different species. Certain specimens from the Turtle Mountains, N. Dak., are intermediate and could with about equal propriety be referred to either *haydeni* or true *cinereus* were they not surrounded geographically by *haydeni*. Alcoholic specimens, from which the skulls have been removed for study, from Fort Sisseton, S. Dak., and a skin with skull from Browns Valley, Minn., can also about as well be referred to one form as the other.

Specimens examined.—Total number 206, as follows:

Alberta: Islay, 2.[44]
Iowa: Sac City (2 miles west), 1; Wall Lake, 1.
Manitoba: Aweme, 64[45]; Carberry, 6; Killarney, 1.
Minnesota: Browns Valley, 1; Kittson County, 1; Madison, 1[46]; Moorhead, 6.

[44] J. D. Soper coll., Edmonton, Alberta.
[45] Royal Ontario Mus. Zool., 6; Stuart Criddle coll., Treesbank, Manitoba, 54.
[46] Acad. Nat. Sci. Philadelphia.

Montana: Crow Agency, 1; Ekalaka (5 miles southeast), 3; Fort Custer, 7; Medicine Bow, 1.
Nebraska: Bassett, Rock County, 4[47]; Kennedy, 1; Niobrara River (10 miles south of Cody), 1; Perch, Rock County, 10[47]; Two-mile Lake, Cherry County, 1.
North Dakota: Blackmer, 2; Bottineau, 1; Cannon Ball, 1; Fairmount (Sioux River), 1; Fargo, 2; Fish Lake (Birchwood), 2; Fort Buford (type locality), 1; Grand Forks, 1; Kenmare, 2; Lostwood (6 miles north), 9; Oakes, 2; Portland, 7; St. John (Fish Lake, 8 miles north of west), 1; Selfridge, 1; Steele, 1; Turtle Mountains (Birchwood), 2; Walhalla, 2; Williston (south of river), 1.
Saskatchewan: Indian Head, 12[48]; Osler, 3.[49]
South Dakota: Beadle County, 1; Custer, 3[50]; Custer (16 miles west), 2; Deadwood, 2; Dumont (Black Hills National Forest, altitude 6,100 feet), 5; Elk Mountain (20 miles north), 1; Fort Pierre, 2; Fort Sisseton, 8; Vermilion, 1.
Wyoming: Bear Lodge Mountains (Warren Peak, altitude 6,000 feet), 4; Fort Steele, 1; Laramie Peak (north slope, altitude 8,000 feet), 1; Laramie Peak (north slope, altitude 8,800 feet), 1; Rattlesnake Creek (Black Hills, altitude 6,000 feet), 1; Sherman, 1; Springhill, 1; Sundance, 3; Wolf (Eaton's Ranch), 1.

SOREX CINEREUS STREATORI Merriam

Streator Cinereous Shrew

(Pl. 2, d)

Sorex personatus streatori Merriam, North Amer. Fauna No. 10, p. 62, December 31, 1892.
Sorex cinereus streatori Jackson, Journ. Mamm. 6: 56, February, 1925.

Type specimen.—No. 73537, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected July 9, 1895, by C. P. Streator.

Type locality.—Yakutat, Alaska.

Geographic range.—Pacific coast region of North America from the southeastern part of Kenai Peninsula, Alaska, south to central Washington west of the Cascades. (Fig. 3.)

Diagnostic characters.—Darkest of the species; largest of the west American subspecies, with longest tail and largest hind foot. In color most nearly like *Sorex c. cinereus* but darker, particularly on ventral parts; larger, with longer tail and larger hind foot; skull longer than that of the subspecies *cinereus*, with longer and usually heavier rostrum, heavier dentition, the molariform teeth usually more deeply emarginate posteriorly. Decidedly larger in all respects than *S. c. hollisteri;* much darker, the underparts buffy rather than whitish; skull much larger and heavier, with distinctly larger rostrum. About the size of *S. c. miscix*, but very much darker in all pelages; skull much like that of *miscix* but teeth greater in extero-interior diameter.

Color.—Winter pelage: Upper parts scarcely different from corresponding pelage of *S. c. cinereus*, underparts decidedly more buffy. Upper parts grayish fuscous or chaetura drab, sometimes tending toward hair brown, extending well down on sides where it becomes slightly more drabbish, blending gradually with color of underparts drabbish avellaneous; tail fuscous above, avellaneous below nearly to tip. *Summer pelage:* Much darker and more brownish than in winter. Darker than *S. c. cinereus* in corresponding pelage. Upper parts fuscous-black or fuscous, extending well onto the sides and gradually blending with colors of underparts; underparts heavily tinged with buffy brown or wood brown, sometimes with pinkish buff, rarely indicating more or less light grayish olive; tail about as in winter.

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[47] Amer. Mus. Nat. Hist.
[48] Acad. Nat. Sci. Philadelphia, 3; Nat. Mus. Canada, 9.
[49] Mus. Comp. Zool.
[50] Amer. Mus. Nat. Hist., 1.

Skull.—Large for the *cinereus* group (condylobasal length 16 millimeters or over), with rather large rostrum. Longer than that of *S. c. cinereus*, with longer and usually heavier rostrum, longer tooth row, heavier dentition, the molariform teeth usually more deeply and acutely emarginate posteriorly. Larger and heavier than that of *S. c. hollisteri*, with decidedly larger rostrum, and heavier dentition. Much like that of *S. c. miscix* but teeth greater in extero-interior diameter.

Measurements.—Type specimen (adult male): Total length, 107; tail vertebrae, 50; hind foot, 12.5. Average of four other adult males from type locality: Total length, 105.5 (102–111); tail vertebrae, 45 (42–48); hind foot, 12.8 (12–13). Average of three adult males from Sitka, Alaska: Total length, 104 (102–107); tail vertebrae, 45.8 (45–47); hind foot, 13.3 (13–13.5). *Skull:* Type specimen (adult male; teeth moderately worn): Condylobasal length, 16.7; palatal length, 6.3; cranial breadth, 7.6; interorbital breadth, 3.2; maxillary breadth, 4.2; maxillary tooth row, 6.0. Average of four skulls of adult males (teeth moderately worn) from type locality: Condylobasal length, 16.3 (16.0–16.6); palatal length, 6.3 (6.2–6.4); cranial breadth, 7.7 (7.5–7.8); interorbital breadth, 3.2 (3.2–3.2); maxillary breadth, 4.1 (4.0–4.2); maxillary tooth row, 5.9 (5.8–6.0). Average of three skulls of adult males (teeth slightly worn) from Sitka, Alaska: Condylobasal length, 16.6 (16.4–16.8); palatal length, 6.3 (6.2–6.4); cranial breadth, 7.7 (7.5–7.9); interorbital breadth, 3.2 (3.1–3.2); maxillary breadth, 4.2 (4.1–4.3); maxillary tooth row, 6.0 (6.0–6.0).

Remarks.—Streator's cinereous shrew is confined to certain islands and a narrow strip of territory along the Pacific coast from the south side of Prince William Sound, Alaska, to the south side of the Strait of Juan de Fuca, Wash. In consideration of the extensive north and south range of the form it retains its characters throughout this area with remarkable uniformity. A short distance inland it intergrades with *S. c. cinereus*, as it does throughout extreme southern British Columbia, where specimens of *S. c. cinereus* from as far east as Glacier show tendencies toward *S. c. streatori* in color, size, and cranial characteristics.

Specimens examined.—Total number, 365, as follows:

Alaska: Anan Creek (mainland), 1[51]; Bradfield Canal, 11[52]; Chenega Island (Prince William Sound, 6[52]; Chichagof Island (Tenakee Inlet), 21; Chickamin River (Behm Canal), 1[52]; Cordova (Prince William Sound), 16[52]; Cordova Bay (head of, Prince William Sound), 7[52]; Ellamar (Prince William Sound), 6[52]; Elrington Island (Prince William Sound), 19[52]; Etolin Island, 2[52]; Fools Inlet (Wrangell Island), 2[52]; Fort Wrangell, 5[53]; Freshwater Bay (Chichagof Island), 1[52]; Glacier Bay, 1[52]; Glacier Bay (Bartlett Cove), 9[52]; Glacier Bay (Coppermine Cove), 2[52]; Grafton Island (Prince William Sound), 2[52]; Haines, 5; Hasselborg Lake (Admiralty Island), 1[52]; Hawkins Island (east side of Canoe Passage, Prince William Sound), 3; Hawkins Island (west side of Canoe Passage, Prince William Sound), 3[52]; Helm Bay, 1[52]; Hinchinbrook Island (Northeast Bay, Prince William Sound), 16[52]; Hoodoo Island (Prince William Sound), 17[52]; Hoonah (Chichagof Island), 7[52]; Horn Cliff (Beach), 1; Idaho Inlet (Chichagof Island), 1[52]; Inian Islands, 1[51]; Juneau, 11; Kelp Bay (Baranof Island), 1[51]; Kupreanof Island, 6; La Touche (La Touche Island, Prince William Sound), 19[52]; Loring, 5; Mitkof Island, 1[52]; Mitkof Island (Petersburg), 5; Orca, 1; Peril Strait (Baranof Island), 6[52]; Port Conclusion (Baranof Island), 3[51]; Port Frederic (Chichagof Island), 3[52]; Port Nell Juan (head of, Prince William Sound), 12[52]; Port Snettisham, 2[52]; Quadra Cannery, 2[51]; Quadra Lake, 4[54]; Red Bluff Bay (Baranof Island), 5[52]; Redoubt Lake (Baranof Island), 1[51]; Revillagigedo, 1[52]; Rodman Bay (Baranof Island), 5[52]; Sitka, 19[55]; Skagway, 6; Taku River, 3[52]; Thomas Bay, 6[52]; Valdez Narrows (Prince William Sound), 8; Wrangell, 33[56]; Yakutat (type locality), 6.

[51] D. R. Dickey coll., Pasadena, Calif.
[52] Mus. Vert. Zool.
[53] Amer. Mus. Nat. Hist.
[54] D. R. Dickey coll., 3.
[55] Amer. Mus. Nat. Hist., 2.
[56] C. G. Cantwell. coll., Palms, Calif., 3; D. R. Dickey coll., 19.

British Columbia: Howe Sound (Gibsons Landing), 1; Metlakatla, 2[57]; Mount Baker Range (49th parallel, altitude 6,000 feet), 4[58]; Observatory Inlet (Hastings Arm), 1[59]; Port Simpson, 3; River Inlet (head of Inlet), 4; Sumas, 1.[58]

Washington: Cedarville, 1; Glacier (altitude 900 feet), 1; Neah Bay, 1; Quiniault River (head North Fork, altitude 4,000 feet, Jefferson County), 1; Skohomish River (Mason County), 1[60]; Whatcom Pass (36 miles east of Glacier, altitude 5,200 feet, Whatcom County), 2.[61]

SOREX CINEREUS HOLLISTERI Jackson

Hollister Cinereous Shrew

(Pl. 2, e)

Sorex personatus arcticus Merriam, Proc. Washington Acad. Sci. 2: 17, March 14, 1900. (Not *Sorex arcticus* Kerr, 1792.)

Sorex cinereus hollisteri Jackson, Journ. Mamm. 6: 55, February, 1925.

Type specimen.—No. 99305, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected September 14, 1899, by W. H. Osgood.

Type locality.—St. Michael, Alaska.

Geographic range.—Western Alaska from Franklin Point south to the head of Cook Inlet (Anchorage). (Fig. 3.)

Diagnostic characters.—Similar externally to *Sorex c. cinereus* but averaging very slightly smaller with shorter tail; color paler, particularly in summer; underparts in both winter and summer pelage more nearly whitish; skull about the size of that of *S. c. cinereus* or slightly smaller, with actually and relatively narrower rostrum and usually with higher brain case. Much paler than *S. c. streatori* both dorsally and ventrally; smaller, with shorter tail, shorter hind foot, and smaller skull.

Color.—*Winter pelage:* Similar to *S. c. cinereus* but averaging slightly paler and apparently more flecked with whitish-tipped hairs above, and more distinctly whitish ventrally. *Summer pelage:* Much paler and more brownish than in winter. Decidedly paler than *S. c. cinereus* in corresponding pelage. Upper parts drab, sometimes almost olive-brown, usually shading into wood brown or avellaneous on the sides; underparts smoke gray or pale smoke gray, frequently tinged with pinkish buff; tail buffy brown or olive-brown, sometimes almost clove brown above, avellaneous or light drab below nearly to tip.

Skull.—Averaging somewhat smaller than that of *S. c. cinereus*, with actually and relatively narrower, more attenuate rostrum and usually with higher brain case. Smaller than that of *S. c. streatori*, with decidedly smaller and narrower rostrum, and weaker dentition.

Measurements.—Type specimen (adult female): Total length, 108; tail vertebrae, 39; hind foot, 12. Average of five adult females from type locality: Total length, 98 (92–104); tail vertebrae, 35.6 (32–38); hind foot, 11.9 (11–12.5). Average of six adult males from Kings Cove, Alaska Peninsula, Alaska: Total length, 93.2 (90–97); tail vertebrae, 38.2 (36–41); hind foot, 11.7 (11–12). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 15.5; palatal length, 6.0; cranial breadth, 7.6; interorbital breadth, 2.9; maxillary breadth, 3.8; maxillary tooth row, 5.4. Average of five skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 15.7 (15.4–15.9); palatal length, 6.0 (5.9–6.1); cranial breadth, 7.6 (7.4–7.8); interorbital breadth, 3.0 (2.9–3.1); maxillary breadth, 4.0 (3.9–4.1); maxillary tooth row, 5.5 (5.4–5.6). Average of six skulls of adult males (teeth slightly worn) from Kings Cove, Alaska Peninsula, Alaska: Condylobasal length, 15.3 (15.2–15.5); palatal length, 5.9 (5.8–6.0); cranial breadth, 7.5 (7.2–7.8); interorbital breadth, 3.0 (2.9–3.1); maxillary breadth, 3.8 (3.7–3.9); maxillary tooth row, 5.4 (5.3–5.5).

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[57] Nat. Mus. Canada, 1.
[58] Mus. Comp. Zool.
[59] Nat. Mus. Canada.
[60] Univ. Mich.
[61] State Coll. Wash., 1.

Remarks.—In its extreme form, represented by specimens from the Alaska Peninsula, *S. c. hollisteri* is a well-defined subspecies. It is confined to the coast region of Alaska from Alaska Peninsula northward, specimens from localities but little interior from the coast (vicinity of Lake Clark) showing an approach toward *S. c. cinereus*, with which it intergrades in central Alaska. A single skin without skull from St. Lawrence Island, Alaska, is provisionally referred to *hollisteri*.

Specimens examined.—Total number, 283, as follows:

Alaska: Akchookuk Lake, 2; Anchorage (Chester Creek), 1; Becharof Lake (Alaska Peninsula), 2; Bethel, 24[62]; Bettles, 11; Bristol Bay, 2; Chalitna River (head of), 9; Chignik, 11; Cold Bay (Alaska Peninsula), 1; Doonnockchogaweet Mountain, 1; Fairbanks, 1; Flat, 1; Frosty Peak (east base, Alaska Peninsula), 17; Good News Bay, 2; Hooper Bay, 1; Kakhtul River, 8; Katmai, 2; Kanatak (Portage Bay, Alaska Peninsula), 1; Kings Cove (Alaska Peninsula), 54; Kokechik River, 1; Kokwok, 5; Kokwok River (45 miles up), 1; Kokwok River (80 miles up), 16; Koyukuk River (Hacket Creek), 1; Kruzgamepa Hot Springs (north-northeast of Nome, long. 165 west, lat. 65 north), 1[63]; Lake Aleknagik, 5; Lake Clark, 7; Lake Clark (head Nogheling River), 1; Lake Clark (lower end of lake), 1; Lake Iliamna (Iliamna Village), 1; Lake Weelooluk, 1; Moller Bay (Alaska Peninsula), 4[64]; Nome, 1; Norton Bay, 1; Nulato, 22; Nunivak Island, 1; Nushagak, 15; Nushagak River, 1; Nushagak River (Lewis Point), 4; Point Protection, 2; Richardson (Tanana River), 7; St. Lawrence Island, 1[65]; St. Michael (type locality), 27; St. Michael Island, 2; Sawtooth Mountains, 1; Stuyahok Landing, 1; Wainwright, 1[66].

SOREX FONTINALIS Hollister

Maryland Shrew

(Pls. 2, f; 4, v; 5, t; 7, b)

Sorex fontinalis Hollister, Proc. U. S. Nat. Mus. 40: 378, April 17, 1911.

Type specimen.—No. 85439, U. S. Nat. Mus., ♀ adult (teeth moderately worn), skin and skull; collected November 6, 1898, by Gerrit S. Miller, jr.

Type locality.—Cold Spring Swamp, near Beltsville, Prince Georges County, Md.

Geographic range.—Known only from south-central and southeastern Maryland. (Fig. 3.)

Diagnostic characters.—Size small; smaller than *Sorex c. cinereus*, with shorter tail. Skull smaller than that of *S. c. cinereus*, with relatively narrow brain case, shorter rostrum, and shorter unicuspid row.

Color.—Winter pelage: Upper parts fuscous or olive-brown, becoming lighter on the sides, about drab; underparts smoke gray washed with pinkish buff; tail bicolor, fuscous above, buffy beneath nearly to tip. *Summer pelage:* Upper parts paler and much more brownish (less gray) than in winter, about snuff brown; flanks slightly paler than back; underparts and tail about as in winter pelage.

Time of molting.—Specimens collected November 6 to March 8 are in winter pelage. A male from Hyattsville, Md., was in complete summer fur May 3, 1900, while another male collected the same day is in winter pelage but shows indications of the beginning of molt on the rump.

Skull.—Smaller than that of *S. c. cinereus*, with much smaller, narrower brain case, shorter and relatively wider rostrum. Teeth about the size and

[62] Acad. Nat. Sci. Philadelphia, 2; D. R. Dickey coll., Pasadena, Calif., 1.
[63] Mus. Comp. Zool.
[64] Amer. Mus. Nat. Hist.
[65] Acad. Nat. Sci. Philadelphia.
[66] Colo. Must. Nat. Hist.

proportions of those of *S. c. cinereus*, unicuspid tooth row shorter with teeth more crowded. In general proportions somewhat like that of *S. lyelli* or *S. preblei;* smaller than that of *S. lyelli*, more flattened, narrower interorbitally and with smaller molariform teeth; larger than the skull of *S. preblei*, with longer maxillary tooth row.

Measurements.—Type specimen (adult female): Total length, 90; tail vertebrae, 31; hind foot, 10. Two adult males from Hyattsville, Md.: Total length, 86, 98; tail vertebrae, 33, 37; hind foot, 11, 11. *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 14.9; palatal length, 5.5; cranial breadth, 7.0; interorbital breadth, 2.9; maxillary breadth, 4.0; maxillary tooth row, 5.4. Skulls of two adult males (teeth slightly worn) from Hyattsville, Md.: Condylobasal length, 14.9, 14.9; palatal length, 5.7, 5.7; cranial breadth, 7.2, 7.1; interorbital breadth, 3.0, 3.0; maxillary breadth, 4.2, 4.1; maxillary tooth row, 5.3, 5.5.

Remarks.—Intergradation between *S. fontinalis* and *S. cinereus* is not indicated in any of the specimens examined. It is true that there is a gradual decrease in the size of *S. cinereus* and a tendency for its rostrum to shorten from the northern part of its range southward, but the difference between small southern specimens of *S. c. cinereus* and specimens of *S. fontinalis* is sharp and distinct. It is possible that when specimens are available from the region between the type locality and the mountains of Maryland and Pennsylvania, or from northeastern Maryland and Delaware, intergradation between the two forms may be shown; until then *fontinalis* must be given full specific rank.

Specimens examined.—Total number, 18, as follows:

Maryland: Beltsville (Cold Spring Swamp, near) (type locality), 2; Cabin John, 1; Cambridge, 1[67]; Hollywood, 1; Hyattsville, 6[68]; Landover, 1; Laurel, 4; Sandy Spring, 1; Tuxedo, 1.

SOREX LYELLI MERRIAM

MOUNT LYELL SHREW

(PLS. 2, G; 5, U; 7, C)

Sorex tenellus lyelli Merriam, Proc. Biol. Soc. Washington 15: 75, March 22, 1902.

Type specimen.—No. 109530, U. S. Nat. Mus., Biological Survey collection; ♂ young adult (teeth unworn), skin and skull; collected August 29, 1901, by Walter K. Fisher.

Type locality.—Mount Lyell, Tuolumne County, Calif.

Geographic range.—Crest of the central Sierra Nevadas in California. (Fig. 3.)

Diagnostic characters.—Size small, smaller than most subspecies of *Sorex cinereus*, about the size of *S. c. hollisteri* or *S. c. haydeni*, larger and paler than *S. fontinalis* or *S. preblei*. Skull flatter than in *S. cinereus* and relatively broader interorbitally. Skull in general proportions somewhat like that of *S. fontinalis* or *S. preblei;* somewhat larger than that of *S. fontinalis*, apparently less flattened and broader interorbitally; distinctly larger than that of *S. preblei*, with longer maxillary tooth row.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts hair brown to drab, sometimes almost olive-brown, paler on the sides; underparts pale olive-gray or pale smoke grap faintly tinged with pale olive-buff or tilleul buff; tail buffy brown, olive-brown, or between buffy brown and hair brown above, light drabbish below, darkening toward tip.

Skull.—Differs from that of any of the subspecies of *S. cinereus* in being flatter through the brain case and wider interorbitally. About the size of that of *S. c. hollisteri*, noticeably flatter, palatal length less, rostrum shorter and broader, and interorbital breadth greater. About the size of that of *S. c.*

[67] Donald R. Dickey coll., Pasadena, Calif. [68] Univ. Wis. Zool. Mus., 1.

haydeni or slightly larger, more flattened, broader interorbitally, rostrum relatively narrower, and maxillary tooth row longer. In general proportions most nearly like that of *S. fontinalis*, somewhat larger and apparently less flattened, broader interorbitally, and with heavier molariform teeth. Considerably larger than the skull of *S. preblei*, with relatively narrower rostrum, and longer tooth row.

Measurements.—Type specimen (young adult male); total length, 103; tail vertebrae, 41; hind foot, 12. Adult female from Vogelsang Lake, altitude 10,350 feet, Yosemite Park, Calif.: Total length, 102; tail vertebrae, 39; hind foot, 11. *Skull.*—Type specimen (young adult male; teeth unworn): Condylobasal length, 15.4; palatal length, 5.6; cranial breadth, 7.3; interorbital breadth, 3.1; maxillary breadth, 4.1; maxillary tooth row, 5.5. Skull of adult female (teeth moderately worn) from Vogelsang Lake, altitude 10,350 feet, Yosemite Park, Calif.: Condylobasal length, 15.2; palatal length, 5.8; cranial breadth, 7.5; interorbital breadth, 3.3; maxillary breadth, 4.2; maxillary tooth row, 5.5.

Remarks.—In the original description this form was placed as a subspecies of *S. tenellus* (Merriam, 1902, p. 75). It really has no close connection with *S. tenellus*, although it shows some superficial similarities, particularly in its having a rather flat skull. This flatness, however, is not nearly so pronounced as in the species *tenellus*, and in the type specimen, which was a young adult, seems to be somewhat accentuated, the brain case of its comparatively weak skull appearing to have become a trifle contracted and flattened medially during the cleaning process. This species, which represents *S. cinereus* in the Sierra Nevada, is rare in collections, only five specimens being available from a region where hundreds of shrews have been trapped.

Specimens examined.—Total number, 5, as follows:

California: Lyell Canyon (head of, Yosemite Park, altitude 9,800 feet), 1[69]; Mammoth, Mono County, 1[70]; Mount Lyell (type locality), 1; Vogelsang Lake (altitude 10,350 feet), Yosemite Park, 1[69]; Williams Butte (1 mile south, altitude 6,900 feet, Mono County, 1.[69]

SOREX PREBLEI Jackson

Preble Shrew

(Pls. 2, H; 5, V)

Sorex preblei Jackson, Journ. Washington Acad. Sci. 12: 263, June 4, 1922.

Type specimen.—No. 208032, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected July 3, 1915, by Edward A. Preble. Original number, 5972.

Type locality.—Jordan Valley, altitude 4,200 feet, Malheur County, Oreg.

Geographic range.—Known only from eastern Oregon. (Fig. 3.)

Diagnostic characters.—Smallest of the western forms of the *cinereus* group; color paler and more grayish than in *Sorex c. cinereus*, possibly a shade darker and more grayish than in *S. lyelli;* hind foot small. Skull considerably flattened, small (smallest of the *cinereus* group), with relatively short rostrum.

Color.—*Worn winter pelage:* Upper parts between hair brown and mouse gray, the sides and flanks scarcely paler; underparts pale smoke gray, slightly tinged with tilleul buff; tail above olive brown basally, darkening to clove brown toward tip, avellaneous below, darkening apically. *Summer pelage* (type specimen): Upper parts darker and more brownish than in winter, between hair brown and olive brown, paling on the sides; underparts pale smoke gray, very faintly tinged with cartridge buff; tail as in winter pelage.

[69] Mus. Vert. Zool. [70] D. R. Dickey coll., Pasadena, Calif.

Skull.—Small, rather flat, with relatively broad rostrum and short tooth row. More nearly like that of *S. lyelli* or *S. fontinalis* than like that of *S. cinereus*, but smaller than either, with shorter maxillary tooth row.

Measurements.—Type specimen (adult male): Total length, 95; tail vertebrae, 36; hind foot, 11. Adult male from Sled Springs, 25 miles north of Enterprise, Oreg.: Total length, 85; tail vertebrae, 35; hind foot, 11. *Skull.*—Type specimen (adult male; teeth moderately worn): Condylobasal length, 14.6; palatal length, 5.4; cranial breadth, 7.1; interorbital breadth, 3.1; maxillary breadth, 4.2; maxillary tooth row, 5.1. Skull of adult male (teeth slightly worn) from Sled Springs, 25 miles north of Enterprise, Oreg.: Condylobasal length, 14.2; palatal length, 5.6; cranial breadth, 7.2; interorbital breadth, 3.1; maxillary breadth, 4.1; maxillary tooth row, 5.2.

Remarks.—With the possible exception of *S. nanus*, *S. preblei* is the smallest of the western American members of the genus. It is easily distinguished from *S. nanus* by its higher and broader brain case and different dentition. It is most nearly like *S. lyelli* and *S. fontinalis*, from which it can be differentiated by characters above mentioned. In fact, additional specimens may prove its intergradation with *S. lyelli*, but on the basis of material at hand it is necessary to consider the two specifically distinct.

The specimen from Diamond, Oreg., is a young female that lacks the entire rostrum and teeth and is provisionally referred to *S. preblei*.

Specimens examined.—Total number, 3, as follows:

Oregon: Diamond (altitude 4,300 feet), 1; Enterprise (25 miles north at Sled Springs, altitude 4,600 feet), 1; Jordan Valley (altitude 4,200 feet), Malheur County (type locality), 1.

TABLE 1.—*Cranial measurements of adult specimens of* Sorex cinereus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. c. cinereus:										
North Carolina—Roan Mountain (6,000 feet).	54479	♂	15.5	5.9	7.6	3.2	4.1	5.4	Moderate.	
Do	54480	♂	15.4	5.9	7.3	2.9	4.2	5.4	...do	
Do	54482	♂	15.1	5.8	7.5	3.1	4.2	5.3	...do	
Do	54487	♂	15.9	5.6	7.6	3.2	4.0	5.5	...do	
Northwest Territories—Fort Resolution.	110828	♀	16.0	6.0	8.0	3.1	4.1	5.5	Slight	
Do	110833	♀	16.0	6.0	7.8	2.9	4.0	5.4	...do	
Do	110834	♀	16.1	6.0	8.0	3.1	4.0	5.5	...do	
Do	110835	♀	15.9	6.0	7.6	3.0	3.9	5.6	...do	
Do	116061	♀	15.9	6.0	7.6	3.0	4.0	5.6	...do	
Pennsylvania—Drury Run, Clinton County.	57870	♂	15.6	5.9	7.6	3.1	4.1	5.5	Moderate.	
Do	57872	♀	16.0	6.0	7.6	2.9	4.0	5.5	Slight	
Rhode Island—Washington County.	120876	♀	15.4	6.0	7.6	2.9	4.0	5.4	...do	
Do	120881	♀	15.7	6.0	7.6	3.0	4.0	5.6	...do	
Do	120884	♀	15.7	6.0	7.7	3.1	4.2	5.5	...do	
Do	120885	♀	16.2	6.0	7.6	3.0	4.3	5.6	...do	
Wisconsin—Mamie Lake, Vilas County.	226969	♀	15.5	5.8	7.5	3.0	4.0	5.3	...do	
Do	226970	♀	16.0	6.0	7.6	3.1	3.9	5.5	...do	
Do	227238	♀	15.8	6.0	7.6	3.0	4.1	5.5	...do	
Do	227243	♀	15.7	5.9	7.7	3.1	4.0	5.5	...do	
Do	227249	♀	15.9	6.1	7.8	3.0	4.1	5.7	...do	
Wyoming—Pahaska, mouth Grinnell Creek, Park County.	169852	♂	15.5	6.0	7.7	3.0	4.0	5.4	...do	
Do	169859	♂	15.4	6.0	7.4	3.0	4.0	5.5	...do	
Do	169860	♂	15.5	6.0	7.6	3.1	4.1	5.3	...do	

TABLE 1.—*Cranial measurements of adult specimens of* Sorex cinereus *group*—Continued

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. c. haydeni:										
North Dakota—										
Lostwood	208220	♀	15.3	5.5	7.5	3.0	4.3	5.2	Slight	
Do	208223	♀	15.0	5.5	7.5	3.0	4.4	5.0	do	
Williston	202240	♀	15.0	5.6	7.3	3.0	4.2	5.2	do	Essentially type locality.
S. c. streatori:										
Alaska—										
Yakutat	73537	♂	16.7	6.3	7.6	3.2	4.2	6.0	Moderate	Type specimen.
Do	73535	♀♂	16.1	6.2	7.5	3.2	4.0	5.8	do	Type locality.
Do	73540	♀♂	16.6	6.4	7.8	3.2	4.1	5.9	do	Do.
Do	73546	♀♂	16.6	6.2	7.8	3.2	4.1	6.0	do	Do.
Do	73548	♀♂	16.0	6.3	7.6	3.2	4.2	5.9	do	Do.
Sitka	73794	♀♂	16.4	6.2	7.5	3.1	4.1	6.0	Slight	
Do	73799	♀♂	16.8	6.4	7.7	3.2	4.2	6.0	do	
Do	73800	♂	16.5	6.3	7.9	3.2	4.3	6.0	do	
S. c. hollisteri:										
Alaska—										
St. Michael	99305	♀	15.5	6.0	7.6	2.9	3.8	5.4	do	Type specimen.
Do	99293	♀	15.7	6.1	7.7	2.9	3.9	5.5	do	Type locality.
Do	99294	♀	15.9	5.9	7.7	3.1	4.1	5.4	do	Do.
Do	99295	♀	15.4	6.0	7.4	2.9	3.9	5.5	do	Do.
Do	99298	♀	15.9	6.0	7.8	3.1	4.0	5.6	do	Do.
Do	99303	♀	15.7	6.0	7.5	3.0	4.0	5.6	do	Do.
Kings Cove, Alaska Peninsula.	177308	♂	15.3	6.0	7.2	2.9	3.9	5.4	do	
Do	177312	♂	15.3	5.9	7.6	3.0	3.7	5.5	do	
Do	177315	♀♂	15.2	5.9	7.5	2.9	3.8	5.3	do	
Do	177316	♀♂	15.2	5.8	7.8	3.1	3.8	5.4	do	
Do	177317	♀♂	15.5	5.9	7.4	3.0	3.8	5.4	do	
Do	177320	♂	15.5	5.9	7.4	2.9	3.9	5.3	do	
S. c. miscix:										
Labrador—										
Black Bay	[1] 8651	♂	16.9	6.6	8.1	3.2	4.0	6.0	Very slight	Type specimen.
Do	[1] 7936	♀	16.6	6.4	8.0	3.2	4.2	5.8	do	Type locality.
Do	[1] 7937	♀	16.6	6.7	8.1	3.1	4.1	5.8	do	Do.
Do	[1] 7939	♀	16.8	6.7	8.0	3.2	4.1	5.9	do	Do.
Do	[1] 7941	♀	16.5	6.5	8.3	3.1	4.1	5.7	do	Do.
Sorex lyelli:										
California—										
Mount Lyell	109530	♂	15.4	5.6	7.3	3.1	4.1	5.5	Unworn	Type specimen; young adult.
Vogelsang Lake, 10,350 feet, Yosemite Park.	[2] 23001	♀	15.2	5.8	7.5	3.3	4.2	5.5	Moderate	
Sorex fontinalis:										
Maryland—										
Beltsville	85439	♀	14.9	5.5	7.0	2.9	4.0	5.4	do	Type specimen.
Hyattsville	76593	♂	14.9	5.7	7.2	3.0	4.2	5.3	Slight	
Do	76709	♂	14.9	5.7	7.1	3.0	4.1	5.5	do	
Sorex preblei:										
Oregon—										
Jordan Valley, 4,200 feet, Malheur County.	208032	♂	14.6	5.4	7.1	3.1	4.2	5.1	Moderate	Type specimen.
Sled Springs, 4,000 feet, 25 miles north of Enterprise, Wallowa County.	231711	♂	14.2	5.6	7.2	3.1	4.1	5.2	Slight	

[1] Mus. Comp. Zool. [2] Mus. Vert. Zool.

SOREX FUMEUS GROUP

The *fumeus* group includes a single species—*Sorex fumeus*. All necessary group comparisons are made under the species.

Geographic range.—Nova Scotia, New Brunswick, southeastern Quebec, south-central Ontario, south through New York, north-

western New Jersey, Pennsylvania, and western Maryland, to south-central Ohio and the mountains of northern Georgia; also southeastern Wisconsin (Racine). (Fig. 4.)

Diagnostic characters.—Size medium; tail medium in length, bicolor, scantily haired; color dull, in effect essentially concolor, except tail. Skull medium in size, relatively broad with short, broad interorbital region and mesopterygoid space; brain case moderately flattened; infraorbital foramen large and situated well posteriorly; lachrymal foramen situated over space between first and second molars; dentition moderate; molariform teeth rather deeply emarginate posteriorly; unicuspid teeth broader (extero-interior diameter) than long

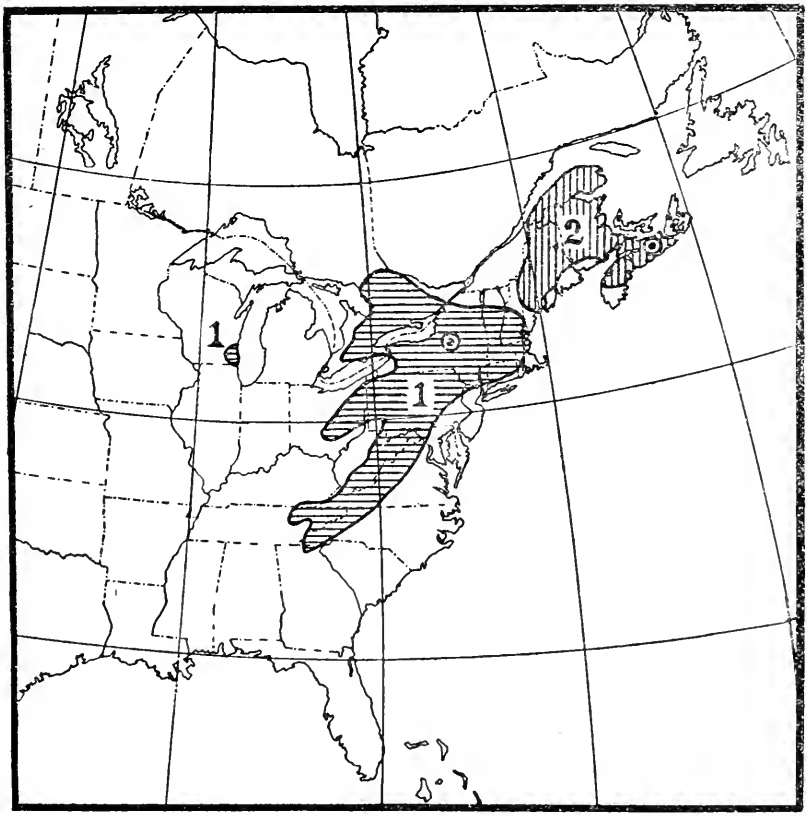

FIG. 4.—Geographic range of the subspecies of *Sorex fumeus*
1. *S. f. fumeus.* 2. *S. f. umbrosus.*

(antero-posterior diameter), the third larger than the fourth; internal ridge extending from apex of unicuspid to about one-half distance toward internal edge of cingulum, moderately pigmented near apex. The fumeus group can be distinguished externally from any forms of the *arcticus* or *pribilofensis* groups by its distinctly unicolor (except tail) appearance. In general aspect the skull of *fumeus* resembles in proportions somewhat that of *pribilofensis* but is much larger in all respects, with the preorbital region less swollen and the infraorbital foramen situated relatively farther back, the second upper premolar not lacking the distinct cusplike process on interior edge of basal shelf, and the unicuspid teeth without the internal heavily pigmented ridge from apex to edge of cingulum completely developed. Compared with the skull of any of the

arcticus group that of *fumeus* is flatter throughout, with considerably less deep, relatively narrower, and less angular brain case, less attenuate rostrum, narrower interorbitally, infraorbital foramen larger and relatively slightly farther back on rostrum, antero-posterior diameter of unicuspids relatively less, molariform teeth more deeply emarginate posteriorly, and cusps of i^1 narrower than in *arcticus*, the secondary cusp relatively smaller. Externally sometimes superficially like members of the *cinereus* group, but larger, particularly feet, and tail longer; skull decidedly larger and heavier than any of the *cinereus* group, with distinctly heavier rostrum and dentition, and with unicuspids lacking the pigmented ridge extending from apex of tooth to interior edge of cingulum (ridge is incomplete and only partly pigmented, near apex of tooth, in *S. fumeus*). Color in winter pelage like *S. dispar* in summer pelage, but tail shorter and less hairy, and skull much heavier and broader in all proportions; mesopterygoid space broader; upper incisors larger, unicuspids heavier and of different relative sizes (in *dispar* the third and fourth are about subequal). Decidedly larger in all proportions than any of the *longirostris* group and differing in dentition. Similar in color to certain specimens of the *trowbridgii* group and not dissimilar in certan cranial features; differs from any of *trowbridgii* group in that unicuspids are relatively much wider (extero-interior diameter), wider than long (antero-posterior diameter), and third unicuspid is larger than fourth. Larger than any of the *merriami* group and never whitish on the ventral parts; skull radically different, much larger than that of *S. merriami*, more truncate posteriorly, relatively narrower interorbitally, much less swollen orbitally, rostrum relatively longer, more attenuate, and relatively narrower, particularly through infraorbital region; infraorbital foramina larger and situated farther back; dentition different.

SOREX FUMEUS Miller

[Synonymy under subspecies]

Geographic range.—That of the *fumeus* group. (Fig. 4.)

Diagnostic characters.—Those of the *fumeus* group.

Subspecies and geographic variation.—The species *fumeus* includes two subspecies: The typical form, *fumeus*, and *umbrosus*. The color of the species is fairly constant throughout its range, a tendency toward a reduction of reddish of the upper parts reaching its climax in the subspecies *umbrosus* in Nova Scotia. Geographical variation in the skulls is completely swamped by the extensive individual and local variation.

Time of molting.—In the southern part of the range of *Sorex fumeus* the spring molt may begin as early as the middle of April, though most specimens at that time are still in full winter pelage. The transition in the south apparently occurs generally during May, for the majority of June specimens are in summer pelage. A male from Roan Mountain, N. C., shows first indications of the molt April 19, 1893, while another from the same locality is in worn winter pelage May 3. A male from Mount Rogers, Va., has the molt about half completed June 22, 1903, while a second one collected at the same place and time is in complete winter pelage. Middle May specimens from Maryland and most middle and late June specimens from New York and Vermont are in complete summer fur, although a breeding female from Lake George, N. Y., has not fully completed the molt July 10. Two specimens, a male and a female, from Halifax, Nova Scotia, are in process of molt July 18, 1894. A male from River du Loup, Quebec, has acquired practically all the summer fur July 16, 1900.

The winter pelage of *S. fumeus* is usually obtained in full by the last week in October or first week in November. Occasionally specimens are in complete winter pelage early in October (Roan Mountain, N. C., October 11, 1892; Topsham, Me., October 3, 1915; Digby, Nova Scotia, October 10, 1893), but the transition seems to occur more frequently about that time or the middle of the month. A female from Black Mountain, W. Va., is in summer pelage October 29, 1900, but three others collected between October 28 and November 1, the same year, are in full winter pelage. A female from Digby, Nova Scotia, in worn summer pelage had not begun to molt October 25, 1893; another female from the same place has the winter fur coming in under the summer fur over the entire upper parts and abdomen October 22.

SOREX FUMEUS FUMEUS Miller

Smoky Shrew

(Pls. 2, 1; 4, w; 5, w; 7, d; 11, b; 12, b)

Sorex fumeus Miller, North Amer. Fauna No. 10, p. 50, December 31, 1895.
Sorex fumeus fumeus Jackson, Proc. Biol. Soc. Washington 30: 149, July 27, 1917.

Type specimen.—No. 7.7.7.2582, British Museum (No. 2582, collection of Gerrit S. Miller, jr.); ♀ adult, skin and skull; collected September 24, 1893, by Gerrit S. Miller, jr.

Type locality.—Peterboro, Madison County, N. Y.

Geographic range.—New Hampshire, Vermont, Connecticut, Rhode Island, and northern New York, south through northwestern New Jersey, Pennsylvania, and western Maryland, to south-central Ohio and northwestern Georgia; also recorded from Ontario (North Bay) and southeastern Wisconsin (Racine). (Fig. 4.)

Diagnostic characters.—Characters given under the species *Sorex fumeus* will separate *S. f. fumeus* from all shrews except *S. f. umbrosus*. It averages slightly smaller than *umbrosus*, and is distinctly more reddish brown (less grayish) in summer pelage.

Color.—Winter pelage: Distinctly grayish. Upper parts in general effect either mouse gray or deep mouse gray, occasionally almost dark mouse gray. Underparts a trifle paler than the upper parts, usually mouse gray, frequently silvery in certain lights. Tail indistinctly bicolor, fuscous above, chamois or honey yellow beneath nearly to tip; feet chamois, the outer edge dusky. *Summer pelage:* Decidedly more brownish than winter pelage. Upper parts about olive-brown or slightly darker; underparts somewhat paler than upper parts, usually drab or wood brown, showing more or less intermixture of deep neutral gray of base of hairs; tail and feet as in winter.

Skull.—Medium in size, relatively short and broad, with short rostrum and relatively short and broad interorbital region; brain case moderately flattened; infraorbital foramen large and placed well back; dentition moderate, molariform teeth rather deeply emarginate posteriorly; third unicuspid larger than fourth. Skull decidedly larger and relatively broader than that of *S. c. cinereus*, with much heavier rostrum and dentition; about equal in length to that of *S. dispar* but decidedly broader and heavier throughout, with wider rostrum and heavier dentition; somewhat smaller than that of *S. cinereus*, flatter throughout, with less depth of rostrum and brain case, relatively wider and shorter interorbitally, and with smaller unicuspidate teeth. Not essentially different from that of *S. f. umbrosus*.

Measurements.—Two adult males from type locality: Total length, 124, 120; tail vertebrae, 45, 45; hind foot, 13, 13.4. Adult female from Renova, Pa.: Total length, 111; tail vertebrae, 45; hind foot, 13. Average of 3 adult females from Cranberry Glades, Pocahontas County, W. Va.: Total length, 117.7 (115–120); tail vertebrae, 47.7 (47–48); hind foot, 14.3 (14–15). *Skull:* Average of 3 skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 18.1 (18.0–18.3); palatal length, 6.8 (6.8–6.9); cranial breadth, 8.9 (8.7–9.0); interorbital breadth, 3.8 (3.7–3.9); maxillary breadth, 5.3 (5.2–5.4); maxillary tooth row, 6.2 (6.2–6.3). Skulls of two adult males (teeth slightly worn) from Travellers Repose, W. Va.: Condylobasal length, 18–6, 18.3; palatal length, 7.2, 7.1; cranial breadth, 8.8, 8.9; interorbital breadth, 4.0, 3.8; maxillary breadth, 5.3, 5.4; maxillary tooth row, 6.6, 6.6. Average of 4 skulls of adult females (teeth slightly worn) from Roan Mountain, N. C.: Condylobasal length, 18.8 (18.0–18.6); palatal length, 7.0 (6.8–7.2); cranial breadth, 8.9 (8.7–9.0); interorbital breadth, 3.9 (3.8–4.0); maxillary breadth, 5.2 (5.2–5.3); maxillary tooth row, 6.4 (6.2–6.5).

Remarks.—Two specimens of *S. f. fumeus* were in the United States National Museum as long ago as 1855. Both of these have the brain cases broken away and absent, but both have the rostra and teeth in

fairly good condition. One of them from Carlisle, Pa., was misidentified by Baird (1857, p. 22) with *S. forsteri* Richardson, a synonym of *S. c. cinereus;* the other, from Racine, Wis., he identified as *S. richardsoni* (Baird, 1857, p. 24). The Wisconsin specimen, here referred to the subspecies *fumeus*, is the only one known from that region; it is in worn summer pelage, very faded, and, with its broken skull, is unsuitable for critical subspecific comparison. Still later, Dobson (1890, pl. 23, fig. 5) misidentified a specimen from Lake George, N. Y., as *S. platyrhinus* (DeKay), a synonym of *S. c. cinereus.*

The majority of specimens of *S. f. fumeus* now in collections have come from the Appalachian Mountains, where the form seems to be not uncommon in certain localities. In color, the subspecies is constant throughout most of its range, but there is a pronounced variation in the skulls, particularly in the degree of flatness of the brain case. In some cases this appears to be local; in others all degrees of flatness of the cranium are present at a given locality; nowhere can a definite geographic range be assigned to these variations. The skulls from Travellers Repose, W. Va., and Renovo, Pa., have as shallow and flat brain cases as any, but specimens from intervening localities in Maryland, from north in New York, and south in North Carolina have skulls with high brain cases. Moreover, some of the skulls from as near Travellers Repose as Black Mountain, and Cranberry Glades, Pocahontas County, W. Va., have high brain cases; and in the large series from Roan Mountain, N. C., are found skulls both with comparatively high brain cases and low ones, and also intermediates with varying degrees of depth.

In the extreme northeastern part of its range, *S. f. fumeus* approaches *S. f. umbrosus* in color. A majority of the specimens from Vermont, New Hampshire, and western Massachusetts shows this tendency, and even one from Tupper Lake in the Adirondacks, N. Y., and another from the Catskills in the same State, are almost as gray as typical *umbrosus.* Specimens from Peterboro, N. Y., the type locality of the subspecies *fumeus*, however, are as reddish-brown as those from the southern part of the range of the subspecies. The writer has been unable to examine a specimen, now in the British Museum, recorded from North Bay, Ontario (Miller, 1897, p. 35); the locality has been provisionally included on the map (p. 61) in the range of *S. f. fumeus.*

Specimens examined.—Total number, 161, as follows:

Connecticut: Monroe, 1.
Georgia: Brasstown Bald (altitude 4,700 feet), 1.
Maryland: Bittinger, 3; Fiuzel, 6.
Massachusetts: Mount Greylock, 6.[71]
New Hampshire: Antrim, 1[72]; Dublin, 1[72]; Intervale, 1[73]; Mossy Brook (Mount Monadnock), 1; Ossipee, 4; Waterville, 1; Webster, 1.[72]
New Jersey: Culvers Gap, Sussex County, 1[74]; Delaware Water Gap, 1[74]; Greenwood Lake (south end, Passaic County), 1.[74]
New York: Berlin (altitude 1,100 feet), 18; East Greenwich, 1; Hunter Mountain (Catskill Mountains), 3; Lake George, 6; Peterboro (type locality), 6; Piseco, 1; Tupper Lake, 1.[72]
North Carolina: Roan Mountain, 5; Roan Mountain (altitude 6,000 feet), 12; Roan Mountain (altitude 6,300 feet), 2; Roan Mountain (Magnetic City), 1.

[71] Manton Copeland coll., Brunswick, Me.
[72] Mus. Comp. Zool.
[73] Univ. Mich. Mus.
[74] Acad. Nat. Sci., Philadelphia.

Ohio: Alma, 1[73]; Carrollton, 2[73]; Hopetown, 1[73]; Overton, 1.[73]
Pennsylvania: Bushkill Creek (7 miles east of Cresco, Monroe County), 1[74]; Carlisle, 1; Chester County, 1; Eagles Mere, 3[74]; Fleming, 1; Ganoga Glen, Sullivan County, 3[74]; Ganoga Lake (North Mountain), 2[74]; Krings Station, 1[74]; Lake Leigh (North Mountain), 2[74]; Mount Pocono, Monroe County, 2[74]; Renovo, 4; Round Island, 3[74]; Summit Mills, 2[74]; Sayre, 2.
Rhode Island: Chepachet, 1.
Tennessee: High Cliff, 1; Roan Mountain (top), Carter County, 2.[74]
Vermont: Mount Mansfield, 3; Rutland, 1.[75]; Woodstock, 2.[74].
Virginia: Mount Rogers (altitude 5,719 feet), Grayson County, 2; Paris, 1; Washington (Devils Stairs, altitude 2,000 feet), 1.
West Virginia: Black Mountain, 4[76]; Cranberry Glades (head Cranberry River), Pocahontas County, 10; Franklin, 1; Rowlesburg, 1; Travellers Repose, 5; White Sulphur, 2[77]; White Sulphur Springs, 1[74]; Winding Gulf, 3.
Wisconsin: Racine, 1.

SOREX FUMEUS UMBROSUS Jackson

Nova Scotian Smoky Shrew

S[orex] fumens (sic) Cox, Canadian Record Sci. 7: 118, 1896. (Nomen nudum, misprint for *S. fumeus.*)
Sorex fumeus umbrosus Jackson, Proc. Biol. Soc. Washington 30: 149, July 27, 1917.

Type specimen.—No. 150065, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected July 29, 1907, by W. H. Osgood. Original number 3140.

Type locality.—James River, Antigonish County, Nova Scotia.

Geographic range.—Nova Scotia, New Brunswick, southeastern Quebec, and Maine. (Fig. 4.)

Diagnostic characters.—Similar to *Sorex f. fumeus* but averaging slightly larger, and in summer pelage distinctly less reddish brown (more grayish brown) on upper parts.

Color.—Winter pelage: Similar to that of *S. f. fumeus. Summer pelage:* Brown of the upper parts noticeably less reddish than in the subspecies *fumeus.* Upper parts fuscous-black mixed with grayish; underparts drab mixed with deep neutral gray of base of hairs; tail bicolor, fuscous-black above, honey yellow, cinnamon-buff, or chamois below nearly to tip; feet chamois, the outer side dusky.

Skull.—Similar to that of *S. f. fumeus,* possibly averaging slightly larger.

Measurements.—Type specimen (adult male): Total length, 127; tail vertebrae, 52; hind foot, 14. Two adult males from type locality: Total length, 127, 126; tail vertebrae, 49, 45; hind foot, 14, 14.5. *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 19.0[78]; palatal length, 7.2; cranial breadth, 9.3; interorbital breadth, 3.9; maxillary breadth, 5.3; maxillary tooth row, 6.8. Skulls of two adult females (teeth very slightly worn) from type locality: Condylobasal length, 17.8, 18.5; palatal length, 7.2, 7.2; cranial breadth, 8.5, 9.1; interorbital breadth, 3.9, 3.9; maxillary breadth, 5.0, 5.1; maxillary tooth row, 6.5, 6.6.

Remarks.—Although not a strikingly differentiated form, specimens of *S. f. umbrosus* from Nova Scotia are in series readily separable from specimens of *S. f. fumeus* from central New York and the southern Appalachian Mountains. Intergradation between the

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[73] Manton Copeland coll., Brunswick, Me.
[74] Univ. Mich. Mus.
[75] Acad. Nat. Sci. Philadelphia.
[76] Amer. Mus. Nat. Hist.
[77] Field Mus. Nat. Hist.
[78] Field Mus. Nat. Hist., 1.
[78] In the original description of this subspecies the condylobasal length was misprinted as 24.0 (Jackson, 1917, p. 150).

two forms, however, is clearly indicated over the greater part of the New England States and western New Brunswick. Specimens from Maine are referable to *umbrosus;* while specimens from New Hampshire, Vermont, and western Massachusetts (Mount Greylock) can be referred to *S. f. fumeus*, although displaying an approach toward *umbrosus.* The small series from Hampton, southeastern New Brunswick, is typical of *umbrosus* in every respect, yet a specimen from Restigouche River, northwestern New Brunswick, shows a strong tendency toward the subspecies *fumeus.*

Specimens examined.—Total number, 62, as follows:

Maine: Brunswick, 4[79]; King and Bartlett Lake, 1[80]; Mud Pond, Penobscot County, 2[81]; North Belgrade, 1[79]; Topsham, 3.[82]
New Brunswick: Bathurst (15 miles from, Miramichi Road), 1[83]; Hampton, 3; Maugerville, 2[84]; Restigouche River, 1.[85]
Nova Scotia: Barrington Passage, 17[83]; Digby, 13[86]; Halifax, 3[87]; James River (type locality), 6; Little River, Digby Neck, 2; Newport, 1.[81]
Quebec: Gaspé Peninsula (Cascapedia River, Tracadie), 1[81]; Riviere du Loup, 1.[85]

TABLE 2.—*Cranial measurements of adult specimens of* Sorex fumeus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. f. fumeus:										
New York: Peterboro.	111122	♀	18.3	6.8	9.0	3.9	5.4	6.2	Slight	Type locality.
Do	111123	♀	18.1	6.8	8.7	3.7	5.2	6.3	do	Do.
Do	140945	♀	18.0	6.9	8.9	3.9	5.2	6.2	do	Do.
West Virginia: Travellers Repose.	87025	♂	18.6	7.2	8.8	4.0	5.3	6.6	do	
Do	87026	♂	18.3	7.1	8.9	3.8	5.4	6.6	do	
North Carolina: Roan Mountain.	47823	♀	18.0	6.8	8.7	3.7	5.2	6.2	do	
Do	47825	♀	18.5	7.2	9.0	3.9	5.2	6.5	do	
Do	47826	♀	18.1	6.9	9.0	4.0	5.3	6.3	do	
Do	55818	♀	18.6	7.0	8.9	3.8	5.2	6.5	do	
S. f. umbrosus:										
Nova Scotia: James River.	150065	♂	[1]19.0	7.2	9.3	3.9	5.3	6.8	Slight	Type specimen.
Do	150061	♀	17.8	7.2	8.5	3.9	5.0	6.5	Very slight	Type locality.
Do	150064	♀	18.5	7.2	9.1	3.9	5.1	6.6	do	Do.

[1] In the original description of this subspecies this measurement was misprinted as 24.0 (Jackson, 1917, p. 150).

SOREX ARCTICUS GROUP

The *arcticus* group includes three species: *Sorex arcticus*, *S. tundrensis*, and *S. hydrodromus.*

Geographic range.—Western Alaska from Bering Strait to Bristol Bay, east to mouth of Anderson River, Northwest Territories, southeast across Alberta, Saskatchewan, Manitoba, and western Ontario to northeastern South Dakota, and central Minnesota and Wisconsin; also Nova Scotia and New Brunswick. (Fig. 5.)

Diagnostic characters.—Medium size, with moderately short tail, and tricolor pattern; the back distinctly darker than the sides, which in turn are dis-

[79] Lee Mus. Biol., Bowdoin College.
[80] Acad. Nat. Sci. Philadelphia.
[81] Amer. Mus. Nat. Hist.
[82] Manton Copeland coll., Brunswick, Me. 2; Lee Mus. Biol., 1.
[83] Nat. Mus. Canada.
[84] Miramichi Nat. Hist. Soc. Chatham, New Brunswick.
[85] Field Mus. Nat. Hist.
[86] Univ. Mich., 1; Mus. Comp. Zool., 10.
[87] Mus. Comp. Zool.

tinctly darker than the ventral parts. Skull moderate in all dimensions; dentition moderately heavy; unicuspids rather heavy and swollen, the fourth smaller than the third; internal ridge extending from apex of unicuspid toward cingulum incomplete, weakly pigmented, and not ending in secondary cusplet. Larger than any of the *cinereus* group, with larger hind foot, distinctly larger skull, heavier dentition, the molariform teeth being relatively, as well as actually, broader (extero-interior diameter). Compared with any of the *fumeus* group, *S. arcticus* is distinctly tricolored, the skull is higher, rostrum more attenuate, wider interorbitally, antero-posterior diameter of unicuspids relatively greater, molariform teeth less emarginate posteriorly, and cusps of i^1 broader, the secondary cusp relatively larger. Larger and darker than *S. pribilofensis* with higher, more angular brain case, longer, more attenuate rostrum, and with internal ridge on unicuspid scarcely pigmented. Larger than *S. merriami*, darker, particularly the underparts; rostrum longer and higher and interorbital region less inflated than in *S. merriami*, the interorbital region being relatively very much narrower.

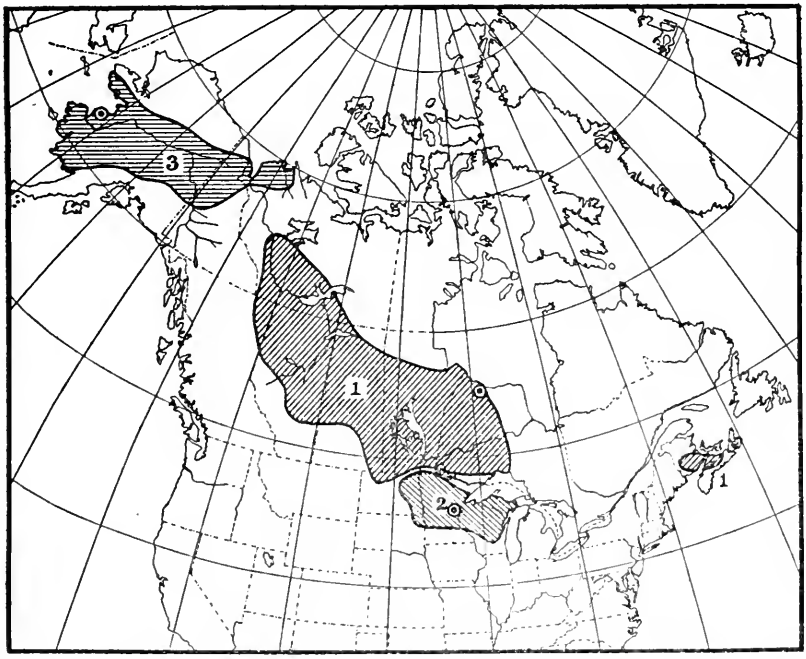

FIG. 5.—Geographic range of subspecies of *Sorex arcticus* and of the species *S. tundrensis*

1. *S. arcticus arcticus.* 2. *S. a. laricorum.* 3. *S. tundrensis.*

Remarks.—The *arcticus* group resembles superficially the *fumeus* group, from which, however, it is differentiated by marked cranial characters, not only of proportions and shape of skull, but dentally, particularly in the shape of the first upper incisor. It frequently occurs with *S. cinereus*, but can readily be distinguished externally from that species by the size of the feet and the pronounced tricolor pattern.

SOREX ARCTICUS KERR

[Synonymy under subspecies]

Geographic range.—West-central Northwest Territories (Fort Norman), southeasterly across Alberta, Saskatchewan, Manitoba, and

western Ontario to northeastern South Dakota, and central Minnesota and Wisconsin; also Nova Scotia and New Brunswick. (Fig. 5.)

Diagnostic characters.—Size medium (hind foot about 14 millimeters); color rich brownish, tricolor, dark, the dorsal parts in winter almost black; skull medium in size, with brain case moderate in depth (*Sorex a. laricorum*) to high (*S. a. arcticus*), rostrum long and high, dentition moderately heavy. In all pelages *S. arcticus* is distinctly darker than *S. tundrensis*, and in winter pelage has the color of the sides more contrasted from that of the underparts; *S. arcticus* is somewhat larger than *S. tundrensis*, with longer tail; skull larger than that of *S. tundrensis*, with higher, longer, and broader rostrum, longer mesopterygoid space, post-glenoid processes usually more developed, palate longer, teeth larger and broader.

Subspecies and geographic variation.—The species *arcticus* is divided into two subspecies, *arcticus* and *laricorum*. The species as a whole retains its characteristics with considerable precision over its range, the only geographic variation being toward the south, where it tends to become paler, and this, associated with a lowering of the brain case, shortening of the antero-posterior diameter of the supraoccipital, and broadening of the interorbital region, is recognized subspecifically in *laricorum*.

Time of molting.—The transition from winter to summer fur seems to occur for the most part in June. In a series of nine specimens from Norway House, Manitoba, collected June 18 to 23, 1900, are five females in complete summer pelage and three females and one male in winter pelage. None of these is in actual process of molting, although the condition of the skin and pelage of the male would seem to indicate that it would soon begin the new growth of hair. The specimen from Fort Norman, Northwest Territories, is in winter pelage June 14, 1904, while a female from Fort Smith is in full summer fur June 21, 1901. A male from Slave River, 10 miles below the mouth of Peace River, Alberta, collected June 10, 1901, shows clearly the summer pelage coming in under the worn winter fur over the entire animal. A breeding female in delayed spring molt from Island Lake, Alberta, has summer pelage on the face, crown, and chin, the rest of the animal still retaining the winter fur August 12, 1895.

Evidence indicates that the fall molt in *S. arcticus* takes place most often during the latter part of September and first of October. In the series of 25 skins from South Edmonton, Alberta, collected between September 8 and 23, 1894, are 5 that show the beginning stages of the fall molt; 3 of these, a male and 2 females, were taken September 23; another, a male, September 8; and the fifth, a female, on the 15th. The skins of 4 or 5 others of this series, collected September 10 to 15, seem to indicate, by the condition of the skin of the backs, preparation for molting. The series of 32 skins from St. Albert, Alberta, was collected between October 30 and November 3, 1895; all are in full winter pelage except a female taken November 3, which has just begun molting on the posterior third of the back. A male from Athabaska Landing, Alberta, has the molt well begun September 14, 1903.

SOREX ARCTICUS ARCTICUS Kerr

American Saddle-backed Shrew

(Pls. 2, j; 4, x; 7, e; 11, c; 12, c)

Sorex arcticus Kerr, Animal Kingdom, p. 206, 1792 (not *Sorex personatus arcticus* Merriam, 1900).

Sorex richardsonii Bachman, Journ. Acad. Nat. Sci. Philadelphia 7: part 2, p. 383, 1837.[88]

S[orex] richardsoni Sundevall, Kongl. [Svenska] Vetenskapsacad. Handl. 1842, p. 182, 1843.

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[88] *Type specimen.*—No. 55.12.24.92, British Museum (A. 139 of Zool. Soc. London Museum; 527 of Zool. Soc. London Ms. list; and 160 of Zool. Soc. London List, 1838), in original stuffed condition but taken off stand, skull incomplete. The writer is indebted to Oldfield Thomas for this information. This is the specimen described by Richardson as *Sorex parvus* and is therefore the type of *Sorex richardsonii* Bachman, since this name was distinctly given to Richardson's animal. Mr. Thomas has kindly furnished the following measurements of the specimen: Hind foot, without claws, 13.2 millimeters; hind foot, with claws, 14.5; length of upper tooth series, 8.7.

Sorex sphagnicola Coues, Bul. U. S. Geol. and Geog. Surv. 3: 650, May 15, 1877. Type locality: Fort Liard, Northwest Territories.

Sorex belli Merriam, Proc. Biol. Soc. Washington 7: 25, April 13, 1892. (Based on Dobson Ms., 1885. Type locality: Shamattawa River, tributary of Hayes River, Hudson Bay, Manitoba.) Nomen nudum.

Sorex sphagnicolus Merriam, Proc. Biol. Soc. Washington 7: 25, April, 1892.

Sorex arcticus arcticus Jackson, Proc. Biol. Soc. Washington 38: 127, November 13, 1925.

Type specimen.—None known to exist.

Type locality.—Settlement on Severn River, Hudson Bay, now known as Fort Severn, mouth of Severn River, Ontario, Canada.

Geographic range.—West-central Northwest Territories (Fort Norman), southeasterly across Alberta, Saskatchewan, Manitoba, to northwestern North Dakota and the north shore of Lake Superior, Ontario; also Nova Scotia and New Brunswick. (Fig. 5.)

Diagnostic characters.—Rather larger than *Sorex tundrensis*, darker and much richer colored, skull larger with heavier rostrum. Somewhat darker on back and sides in winter pelage than *S. a. laricorum* with skull higher, and deeper through brain case, supraoccipital greater in antero-posterior diameter, and interorbital region somewhat more constricted.

Color.—Tricolor in all pelages, distinctly so in winter, less in summer. *Winter pelage:* Upper parts a ribbon of rich dark fuscous-black or blackish brown extending from the nose to the base of the tail, becoming slightly paler on the face and nose; sides sharply contrasted with back, snuff brown to wood brown, which extends onto sides of face; underparts paler and more grayish than sides, the line of color demarcation usually not so sharply defined as that between the back and sides, smoke gray more or less tinged with light drab, avellaneous, or pinkish buff, in late winter becoming densely tinged with drab, wood brown, or avellaneous; tail indistinctly bicolor, fuscous or fuscous-black above, avellaneous to buffy brown below, darkening toward tip, the terminal fourth nearly as dark below as above; feet above dark buffy brown, darker on wrists and ankles. *Summer pelage:* Paler above, darker and more brownish below than in winter pelage, therefore less pronounced tricolor pattern. Upper parts fuscous, sometimes almost mummy brown; sides olive-brown or slightly paler, sometimes tending toward cinnamon-brown; underparts usually drab, sometimes avellaneous. Feet and tail as in winter.

Skull.—Medium in size; brain case high and arched, not flattened; rostrum large, moderately elongate, high, attenuate. Compared with the skull of *S. a. laricorum* that of *S. a. arcticus* is noticeably higher, more arched and less flattened, with antero-posterior diameter of supraoccipital greater; interorbital region usually more constricted, and palate averaging shorter.

Measurements.—Average of 4 adult males from South Edmonton, Alberta: Total length, 112 (108–115); tail vertebrae, 40 (38–42); hind foot, 14 (14–14). Average of 4 adult females from South Edmonton, Alberta: Total length, 113 (111–115); tail vertebrae, 40 (39–42); hind foot, 13.5 (13–14). *Skull:* Average of 4 skulls of adult males (teeth slightly worn) from South Edmonton, Alberta: Condylobasal length, 18.6 (18.5–18.7); palatal length, 7.2 (7.2–7.2); cranial breadth, 9.3 (9.2–9.4); interorbital breadth, 3.5 (3.4–3.6); maxillary breadth, 5.1 (5.0–5.2); maxillary tooth row, 6.6 (6.5–6.6). Average of 4 skulls of adult females (teeth slightly worn) from South Edmonton, Alberta: Condylobasal length, 19.0 (18.7–19.1); palatal length, 7.4 (7.3–7.5); cranial breadth, 9.3 (9.2–9.4); interorbital breadth, 3.7 (3.7–3.7); maxillary breadth, 5.1 (5.0–5.2); maxillary tooth row, 6.7 (6.5–6.8). Skulls of 2 adult females (teeth slightly worn) from Wingard, Saskatchewan: Condylobasal length, 18.9, 18.6; palatal length, 7.4, 7.2; cranial breadth, 9.2, 9.3; interorbital breadth, 3.5, 3.5; maxillary breadth, 5.1, 5.0; maxillary tooth row, 6.6, 6.4.

Remarks.—A specimen of the American saddle-backed shrew, one of the most beautiful American insectivores, was mentioned as early as 1772, when Forster referred one from the settlement on Severn River, Hudson Bay, to *Sorex araneus* Linn., remarking that the specimen was much blacker on the back than the European animal (Forster, 1772, p. 380), a color difference between *S. arcticus* and

S. araneus which, in the aggregate, actually exists. So similar are the two species, however, that it is not surprising that Forster called his specimen *S. araneus*. A few years later Pennant gave a description of the same specimen, basing his account on that of Forster and referring the specimen with question to the Foetid shrew [i. e., *S. araneus* Linn.]. (Pennant, 1784, p. 139.) Eight years later, and 20 years after the animal was first described, it was redescribed by Kerr, who based his description mainly on that of Pennant and gave the species the tenable name of *S. arcticus*. (Kerr, 1792, p. 206.)

In 1829, Richardson fairly accurately described a specimen of *S. arcticus*, but considered it probably to be *Sorex parvus* Say (Richardson, 1829, p. 8), an entirely different animal, now placed in the separate genus Cryptotis. This description became the basis of Bachman's description of *Sorex richardsonii* (Bachman, 1837, p. 383), a name that has been generally used for the species during recent years. Dobson misidentified *S. arcticus* with *S. vulgaris* Linnaeus (Dobson, 1890, pl. 23, figs. 4), itself a synonym of *S. araneus* Linn.

The type specimen of *S. sphagnicola* Coues, in the United States National Museum, is an imperfect skin consisting of the head, nape, hinder third of the body, the hind feet, and tail, and is not accompanied by the skull. It is in summer pelage and apparently was molting, and matches almost perfectly certain specimens of *S. a. arcticus* in similar condition of pelage. The name *sphagnicola*, therefore, should be retained in synonymy under *S. a. arcticus*, with which, under the name *richardsonii*, it has already been identified. (Preble, 1908, p. 246.)

The most northerly point from which a specimen of *S. a. arcticus* has been examined is Fort Norman, Northwest Territories; this specimen and others from the region of Great Slave Lake agree in all essentials with specimens from the vicinity of Edmonton, Alberta, and Norway House, Manitoba. One skull from Fort Simpson, Northwest Territories, has a shallower brain case than that of average *S. a. arcticus*, in this respect appearing something like that of *S. a. laricorum*. In southern Manitoba (Red River Settlement) and western North Dakota an approach toward *laricorum* is evident in a tendency for the brain case to be shallower, although the single specimen from Kenmare, N. Dak., is almost a perfect match cranially with typical *S. a. arcticus*. The imperfect specimens examined from New Brunswick and Nova Scotia are provisionally referred to *S. a. arcticus* rather than to *laricorum*.

Specimens examined.—Total number, 124, as follows:

Alberta: Athabaska Delta (east branch, 1 mile west of Jack Fish Lake), 1 [89]; Athabaska Delta (east branch, 9 miles north of Jack Fish Lake), 2 [90]; Athabaska Landing (5 miles above), 2; Athabaska River (Pelican Rapid), 1; Blindmans and Red Deer Rivers, 3 [89]; Dunvegan (about 75 miles north, Fort St. John Trail, Peace River), 1 [91]; Fort Chipewyan (6 miles northwest) 1; Island Lake (15 miles west Lake St. Ann), 3; St. Albert, 32; Slave River (10 miles below Peace River), 1; Slave River (25 miles below Peace River), 1; South Edmonton, 24.

Manitoba: Aweme, 1 [92]; Lake Manitoba (south end), 1; Lake Winnipeg, 1; Norway House, 9; Red River Settlement, 3; Robinson Portage, 1; Shamattawa River (tributary of Hayes River), 1 [93]; Swampy Lake (near outlet), 1.

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[89] Mus. Comp. Zool.
[90] Mus. Comp. Zool., 1.
[91] Mus. Vert. Zool.
[92] Royal Ontario Mus. Zool.
[93] Nat. Mus. Canada.

New Brunswick: Maugerville, 2.[94]
North Dakota: Lostwood (6 miles north), 1; Kenmare, 1.
Northwest Territories: Fort Norman, 4[95]; Fort Rae, 1; Fort Rae (25 miles south, Trout Rock), 4; Fort Resolution, 4; Fort Simpson, 5; Fort Smith, 1; Great Slave Lake (Big Island), 1; Great Slave Lake (Buffalo River), 1.
Nova Scotia: Truro (1¾ miles east-southeast), 1.[96]
Ontario: Macdiarmid (Lake Nipigon), 2.[92]
Saskatchewan: Indian Head, 1[93]; Portage La Loche, 1; Wingard, 4.

SOREX ARCTICUS LARICORUM Jackson

Southern Saddle-backed Shrew

(Pls. 2, K; 5, Y)

Sorex pachyurus Baird (nec [*S.*] *pachyurus* Kuster, 1835, qui *Pachyura etrusca* Savi), Report Pacific R. R. Survey 8: part 1, Mammals, p. 20, 1857. Type locality: Pembina, N. Dak. (not Minnesota, as stated by Baird).

Sorex arcticus laricorum Jackson, Proc. Biol. Soc. Washington 38: 127, November 13, 1925.

Type specimen.—No. 186837, U. S. Nat. Mus., Merriam collection (No. $\frac{2019}{2552}$); ♂ adult (teeth slightly worn), skin and skull; collected February 19, 1886, by Vernon Bailey. Original number, 75.

Type locality.—Elk River, Sherburne County, Minn.

Geographic range.—Eastern North Dakota, northeastern South Dakota, northern and central Minnesota, and northern Wisconsin and Michigan. (Fig. 5.)

Diagnostic characters.—Similar to *Sorex a. arcticus*, possibly averaging paler on upper parts and sides in winter pelage; skull decidedly flatter and shallower than that of the subspecies *arcticus*, less constricted interorbitally, palate somewhat longer.

Color.—*Winter pelage:* Essentially like that of *S. a. arcticus* but averaging somewhat paler. *Summer pelage:* Indistinguishable from that of the subspecies *arcticus*.

Skull.—Size about that of *S. a. arcticus* but general appearance distinctly flatter; brain case decidedly shallower and more flattened, the antero-posterior diameter of supraoccipital less; palate somewhat longer (antero-posterior diameter), and interorbital breadth greater.

Measurements.—Type specimen, adult male, measured from dry skin by writer: Total length, 117; tail vertebrae, 42; hind foot, 14. Two adult males from Rhinelander, Wis. Total length, 115, 117; tail vertebrae, 40, 39; hind foot, 14, 14. *Skull.*—Skull of type specimen (adult male, teeth slightly worn): Condylobasal length, 19.0; palatal length, 7.6; cranial breadth, 9.3; interorbital breadth, 3.8; maxillary breadth, 5.3; maxillary tooth row, 6.8. Average of 6 skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 18.9 (18.6–19.1); palatal length, 7.7 (7.5–7.8); cranial breadth, 9.3 (9.1–9.5); interorbital breadth, 3.8 (3.7–3.9); maxillary breadth, 5.2 (5.1–5.3); maxillary tooth row, 6.7 (6.6–6.9). Skull of type specimen of *S. pachyurus* Baird, adult (teeth slightly worn), sex unknown, from Pembina, N. Dak.: Condylobasal length, 18.9; palatal length, 7.7; cranial breadth, 9.3; interorbital breadth, 3.8; maxillary breadth, 5.3; maxillary tooth row, 6.7.

Remarks.—Baird's description of *Sorex pachyurus* was based upon two specimens from Pembina, N. Dak.; a third specimen from Fort Ripley, Minn., was referred with some hesitation to the species (Baird, 1857, p. 22). Specimen No. 1674, now a skeleton (No. 38820),

[92] Royal Ontario Mus. Zool.
[93] Nat. Mus. Canada.
[94] Miramichi Nat. Hist. Soc. Chatham, New Brunswick.
[95] Amer. Mus. Nat. Hist., 3.
[96] Provincial Mus., Halifax, Nova Scotia.

at that time an alcoholic, is considered the type specimen (Lyon and Osgood, 1909, p. 247) since it is figured (Baird, 1857, pl. 27). The two specimens were in winter pelage; Baird was led astray in comparing them with a summer specimen of *S. fumeus*, which he believed to be *S. arcticus*, from Racine, Wis., and did not associate them with true *arcticus*. Unfortunately the name *S. pachyurus* Baird is not available, since it is antedated more than 20 years by *S. pachyurus* Kuster (1835, p. 77), a synonym of *Pachyura etrusca* Savi, a shrew of southern Europe. The form of *arcticus* found in eastern North Dakota, and in Minnesota, Wisconsin, and Michigan, is named *laricorum* in reference to one of its prevailing habitats, tamarack and spruce swamps.

Intergradation between *S. a. arcticus* and *S. a. laricorum* is indicated in specimens from Manitoba and western North Dakota. Specimens from Wisconsin and Michigan referred to *laricorum* are not exactly typical in every respect; they compare favorably in length of palate and interorbital breadth but have higher brain cases, in some cases as high as in *S. a. arcticus*.

Specimens examined.—Total number, 95, as follows:

Manitoba: Aweme, 2[97]; Carberry, 1.
Michigan: Chippewa County, 1[98]; Gogebic Lake, Ontonagon County, 6[98]; Mud Lake, Gogebic County, 5.[98]
Minnesota: Bridgman, 1; Elk River (type locality), 47; Fort Ripley, 1; Fort Snelling, 1; Minneapolis, 3; Winnibigoshish, 1.
North Dakota: Fort Totten, 1; Pembina (type locality of *S. pachyurus* Baird), 4; Stump Lake, 1; Valley City, 1.[99]
South Dakota: Fort Sisseton, 1; Fort Wadsworth, 1.
Wisconsin: Conover, 1[1]; Lake St. Germain, Vilas County, 4; Mamie Lake, Vilas County, 3; Mercer, 1; Pelican Lake, Oneida County, 1[1]; Rhinelander, 3[2]; Sayner, 1[1]; Solon Springs, 2[1]; Withee, 1.

SOREX TUNDRENSIS Merriam

Tundra Saddle-backed Shrew

(Pls. 2, L; 4, Y; 5, Z; 7, F; 12, D)

Sorex tundrensis Merriam, Proc. Washington Acad. Sci. 2: 16, March 14, 1900.

Type specimen.—No. 99286, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected September 13, 1899, by W. H. Osgood.

Type locality.—St. Michael, Alaska.

Geographic range.—Western and central Alaska from Bering Strait and Bristol Bay eastward, northern Yukon, and northwestern Northwest Territories. (Fig. 5.)

Diagnostic characters.—Size medium; color pattern tricolor (in winter, general effect almost bicolor, the sides only indistinctly different from underparts), the brown back sharply contrasting with the pale grayish underparts; skull medium in size and depth, with moderately developed rostrum and dentition. Slightly smaller than *Sorex arcticus*, with shorter tail; decidedly paler in all pelages than *S. arcticus*, the underparts in summer grayish instead of brownish, and in winter the grayish not brown and the back never tending toward black. Skull a trifle smaller than that of *S. arcticus*, with a decidedly smaller and lower rostrum, shorter mesopterygoid space, postglenoid processes usually smaller, shorter palate, and smaller teeth.

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[97] Stuart Criddle coll., Treesbank, Manitoba.
[98] Univ. Michigan Mus.
[99] Morris J. Kernall coll., Valley City, N. Dak.
[1] Field Mus. Nat. Hist.
[2] Univ. Wisconsin Zool. Mus.

Color.—Winter pelage: Essentially bicolor in general effect, the back brown, sides grayish faintly tinged with brownish and barely different from the pale grayish underparts. Entire upper parts from nose, crown, nape, to base of tail a broad ribbon of brown, between Prout's brown and cinnamon-brown, sometimes tending toward snuff brown; underparts and sides pale smoke gray more or less tinged with light buff, sometimes with warm buff, the sides and flanks usually somewhat more heavily tinged than the underparts but not sharply differentiated; tail bicolor, above between snuff brown and Saccardo's umber, sometimes tending toward sayal brown, darkening at tip; below usually pale ochraceous-buff, sometimes light ochraceous-buff, nearly to tip, which is brownish; feet usually drab, slightly darker on the outer side and paler on the inner. *Summer pelage:* More variable than winter pelage. Distinctly tricolor in general effect; the back dark brown, the sides pale brown, the underparts grayish. Upper parts from nose and face to rump and base of tail usually sepia or Prout's brown, sometimes mummy brown particularly in fresh unfaded pelage; cheeks, face below ears, and sides to thighs, drab to wood brown; underparts smoke gray usually tinged with cream-buff, in general effect sometimes almost olive-buff; tail and feet as in winter.

Time of molting.—The transition from winter to summer pelage occurs usually during April or early May. Out of 13 specimens collected during April and the last week of March, 1903, by Charles Sheldon at the head of the Toklat River, Alaska, 7 show indications of molt, the other 6 being in full winter pelage. A skin from 80 miles up Kokwok River, Alaska, has obtained the summer fur on the posterior third of the back, May 6, 1912. Other specimens from Nushagak and Mount Sischoo, Alaska, collected, respectively, May 24, 1911, and June 6, 1912, are in fresh summer pelage.

The winter pelage is generally obtained during September. In a series of 17 skins collected at the type locality between September 1 and 23, 1899, the following conditions of pelage are found: Two collected September 1, and 1 each on the second and third, show no signs of molting; 3 others, collected respectively on the 1st, 2d, and 12th, show the skin of the rumps to be in a condition preparatory for molting; 6 others taken September 1, 2, 6, 11, 15, and 20, have the new fur under the old over most of the back; 2 others collected on the 15th have winter pelage over the posterior halves of their backs, and the other 2 captured September 13 and 23, have the entire upper parts, thighs, and most of the sides, in winter pelage. Two specimens from the mountains near Eagle, Alaska, are beginning to molt August 9 and September 1, 1903, but 31 others collected at the same place during August are all in summer fur. October specimens from the head of the Toklat River, Alaska, are in winter pelage.

Skull.—Medium in size and depth; rostrum medium in size, dentition moderate; third unicuspid larger than fourth. Skull slightly smaller than that of *S. arcticus;* rostrum smaller and lower, particularly basally; lower orbitally; shorter mesopterygoid space; postglenoid processes averaging smaller; shorter palate; and smaller, narrower, more densely pigmented teeth.

Measurements.—Type specimen (adult male): Total length, 108; tail vertebrae, 32; hind foot, 13. Average of 3 adult females from type locality: Total length, 105.7 (101–108); tail vertebrae, 31.7 (30–33); hind foot, 13 (13–13). Average of 6 adult males from head of Seward Creek, mountains near Eagle, Alaska: Total length, 105.8 (101–112); tail vertebrae, 35 (32–38); hind foot, 13.7 (12.5–14). *Skull:* Type specimen (adult male, teeth slightly worn): Condylobasal length, 18.3; palatal length, 7.1; cranial breadth, 9.1; interorbital breadth, 3.7; maxillary breadth, 4.9; maxillary tooth row, 6.3. Average of 3 adult females (teeth slightly worn) from type locality: Condylobasal length, 18.2 (18.0–18.4); palatal length, 7.1 (7.0–7.2); cranial breadth, 9.1 (9.0–9.2); interorbital breadth, 3.6 (3.5–3.7); maxillary breadth, 4.9 (4.8–5.0); maxillary tooth row, 6.3 (6.2–6.4). Average of 6 skulls of adult males (teeth slightly worn) from head of Seward Creek, mountains near Eagle, Alaska: Condylobasal length, 18.1 (17.8–18.5); palatal length, 7.0 (6.7–7.2); cranial breadth, 9.1 (9.0–9.3); interorbital breadth, 3.8 (3.7–3.9); maxillary breadth, 5.0 (4.8–5.1); maxillary tooth row, 6.3 (6.1–6.4).

Remarks.—There is no marked geographic variation in *S. tundrensis.* Certain specimens from the interior of Alaska have larger skulls than any now available from the type region near the Bering coast, but the smallest skulls from the type region can be matched almost perfectly with skulls from the same interior localities pro-

ducing large skulls, and the averages are unusually constant. Likewise, certain skins from the upper Yukon (vicinity of Circle and Charlie Creek), Alaska, have decidedly darker backs than any in the type series, but it is undoubtedly due to the fresh condition of their summer pelage. The series taken in August at the head of Seward Creek, in the mountains near Eagle, Alaska, also an interior locality on the upper Yukon drainage, is indistinguishable from topotypes in corresponding pelage. A skin in fresh summer pelage (May 24) from Nushagak, Alaska, essentially on the Bering coast, has the darkest upper parts of any specimen examined.

In none of the specimens of *S. tundrensis* has anything been observed that can be construed to be an approach toward *S. arcticus*. Although *S. tundrensis* occurs at Fort Anderson, Northwest Territories, and *S. a. arcticus* at Fort Norman, only a comparatively short distance away, the two forms retain their characters and do not differ appreciably from specimens from their respective type regions.

Specimens examined.—Total number, 183, as follows:

Alaska: Bethel, 2; Bettles, 5; Charlie Creek, Yukon River, 3; Circle, 1; Circle (20 miles above, on Yukon River), 2; Doonnockchogaweet Mountains, 1; Eagle (mountains near), 35; Fort Yukon, 4; Good News Bay, 4; Hooper Bay, 4; Kanuluk, 2; Kokwok River (80 miles up), 5; Kruzgamepa Hot Springs, 1[3]; Kuskokwim River, 1; Kuskokwim River (Crooked Creek, 200 miles above Bethel), 1[4]; Lake Aleknagik, 1; Lake Weelooluk, 1; Mount McKinley (Bear Creek), 1; Mount Sischoo, 1; Nome River, 1; Nulato, 20; Nushagak, 1; Nushagak River (Lewis Point), 1; Richardson, 4; St. Michael (type locality), 32; Savage River, 1; Sawtooth Mountains, 2; Stuyahok Landing, 1; Tanana, 1; Toklat River (head of), 21.

Northwest Territories: Anderson River (lower region, between Fort Anderson and Liverpool Bay), 17; Peel River, 4; Toker Point (south of), 1.[5]

Yukon: Fortymile, 1.

SOREX HYDRODROMUS Dobson

Unalaska Saddle-backed Shrew

Sorex hydrodromus Dobson, Annals and Mag. Nat. Hist. (6th series) 4: 373, November, 1889.

[*Neosorex*] *hydrodomus* (sic) Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 379, March, 1901.

Neosorex hydrodromus Miller, Proc. Boston Soc. Nat. Hist. 31: 119, August, 1903.

Type locality.—Unalaska Island, Aleutian Islands, Alaska.

Type specimen.—Not seen by the writer. No. 85, collection of the Zoological Museum of the Academy of Sciences of the Union of Socialistic Soviet Republics.

Geographic range.—Known only from type locality.

General characters.—From original description: "Scarcely larger than *S. minutus*, and therefore much smaller than *S. palustris*, which it also differs from in dentition, but resembles in the fringed condition of the digits of the manus and pes. The tail is nearly as long as the body and is clothed rather thinly with moderately long hairs, which do not form a fringe; in the form of the muzzle and ears there is nothing peculiar or different from that of *S. minutus;* the feet, however, differ remarkably in the possession of fringes to the digits both of the manus and pes, as well as or even better developed than in *Crossopus fodiens;* a thick comb-like fringe of stiff hairs also extends along the outer and inner margins of both manus and pes, being especially dense and well developed along the outer margins." (Dobson, 1889, p. 373.)

[3] Mus. Comp. Zool. [4] D. R. Dickey coll., Pasadena, Calif. [5] Amer. Mus. Nat. Hist.

Color.—From original description: "Fur reddish brown above, yellowish brown beneath; chin, throat, and chest with greyish-tipped hairs; the base of the hairs both above and beneath dark bluish grey." (Dobson, 1889, p. 373.)

Skull.—From original description: "The teeth closely resemble those of *S. vulgaris;* as in that species the third incisor is the largest and longest of the unicuspidate teeth; the first maxillary tooth is very nearly equal to the second incisor and quite intermediate in size between the third incisor and the second maxillary tooth; the third maxillary tooth is even more internal than in *S. vulgaris*, in this respect resembling the American representatives of that species. and its long axis is at right angles to the direction of the jaw, its inner and posterior convex margin fitting into the concavity on the inner and anterior side of the fourth maxillary tooth. The mandibular teeth closely resemble those of *S. vulgaris.*" (Dobson, 1889, p. 373.) (Fig. 6.)

Measurements.—From original description: "Length: Head and body, 53 millim.; tail, 46; eye from end of muzzle, 9½; ear, length, 6½; elbow to end of middle digit, without claw, 13; manus, 6; pes, 13; distance between tips of first upper incisor and last premolar, 3½." (Dobson, 1889, p. 373.)

Remarks.—Dobson remarks in regard to his *S. hydrodromus:*

This species is evidently aquatic, like *Crossopus fodiens*, the fringe of the manus and pes being even better developed than in that species; but in all generic characters it agrees with those of the genus *Sorex*. While agreeing with *Sorex palustris* from the adjoining continent of America in external characters, it differs from it in the proportions of its teeth, resembling in this respect the section of which *S. vulgaris* is typical, while *S. palustris* agrees with those represented by *S. vagrans.* (Dobson, 1889, p. 374.)

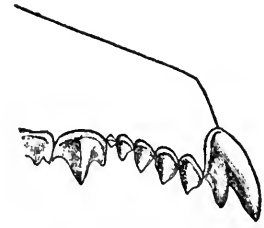

FIG. 6.—Rostrum of *Sorex hydrodromus*. Enlarged seven diameters. After Dobson, 1889, p. 373

Unfortunately the writer has been unable to examine a specimen of this shrew. Merriam, who also never saw the species, placed it with acknowledged uncertainty in the subgenus Neosorex (Merriam, 1895, p. 94–95), probably being led to do so by Dobson's account of the "thick comb-like fringe of stiff hairs along the outer and inner margins of both manus and pes." Elliot (1901a, p. 379) and Miller and Rehn (1903, p. 119) recognized Neosorex as a genus and included therein the species *hydrodromus*, apparently following Merriam's lead. Except for the description of the fringed feet, there is nothing in the original account to associate closely *S. hydrodromus* with Neosorex, and Dobson clearly intimated the distinct difference between the two forms when he stated:

No better proof could be afforded of the uselessness of retaining Neosorex as a distinct genus for the American species characterized by the possession of swimming-fringes in the digits, while the tail is simple, as in Sorex. These species are in fact aquatic forms of the genus Sorex. (Dobson, 1889, p. 374.)

The original description, as quoted almost entire in the present account of the species, and the illustration of the upper teeth fit *S. tundrensis* almost precisely and make it necessary to place *S. hydrodromus* in the *arcticus* group. The known geographic ranges of *S. tundrensis* and the subgenus Neosorex also support this contention. Until specimens from the type locality are available, the exact status of the form will remain in doubt. The description so closely fits *S. tundrensis* that the possibility of *S. hydrodromus* Dobson preoccupying *S. tundrensis* Merriam is strongly suggested, and at best *S.*

tundrensis may prove only subspecifically distinct from *S. hydrodromus.*

TABLE 3.—*Cranial measurements of adult specimens of* Sorex arcticus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. a. arcticus:										
Alberta—South Edmonton.	69150	♂	18.5	7.2	9.4	3.5	5.0	6.5	Slight	
Do	69161	♂	18.5	7.2	9.3	3.4	5.1	6.6	do	
Do	69163	♂	18.7	7.2	9.3	3.6	5.2	6.6	do	
Do	69171	♂	18.6	7.2	9.2	3.5	5.1	6.5	do	
Do	69151	♀	19.1	7.5	9.3	3.7	5.2	6.8	do	
Do	69158	♀	19.0	7.3	9.4	3.7	5.0	6.5	do	
Do	69159	♀	18.7	7.4	9.4	3.7	5.0	6.6	do	
Do	69173	♀	19.1	7.3	9.2	3.7	5.1	6.7	do	
Saskatchewan—Wingard.	73180	♀	18.9	7.4	9.2	3.5	5.1	6.6	do	
Do	73181	♀	18.6	7.2	9.3	3.5	5.0	6.4	do	
S. a. laricorum:										
Minnesota—Elk River.	186837	♂	19.0	7.6	9.3	3.8	5.3	6.8	do	Type specimen.
Do	186843	♂	19.0	7.7	9.4	3.9	5.3	6.8	do	Type locality.
Do	186845	♂	18.7	7.5	9.5	3.7	5.1	6.6	do	Do.
Do	186849	♂	18.6	7.6	9.1	3.8	5.3	6.6	do	Do.
Do	186852	♂	19.1	7.8	9.2	3.8	5.2	6.9	do	Do.
Do	186855	♂	19.1	7.8	9.4	3.9	5.3	6.8	do	Do.
Do	186856	♂	18.8	7.6	9.3	3.7	5.2	6.7	do	Do.
North Dakota—Pembina.	38820	------	18.9	7.7	9.3	3.8	5.3	6.7	do	Type specimen of *S. pachyurus* Baird.
S. tundrensis:										
Alaska—St. Michael.	99286	♂	18.3	7.1	9.1	3.7	4.9	6.3	do	Type specimen.
Do	99276	♀	18.0	7.0	9.2	3.5	4.8	6.2	do	Type locality.
Do	99277	♀	18.4	7.2	9.1	3.6	4.8	6.4	do	Do.
Do	99279	♀	18.1	7.1	9.0	3.7	5.0	6.2	do	Do.
Alaska—Mountains near Eagle.	131000	♂	18.0	7.1	9.1	3.9	5.1	6.2	do	
Do	131006	♂	18.3	7.0	9.1	3.7	5.1	6.3	do	
Do	131011	♂	18.5	7.2	9.3	3.8	5.1	6.4	do	
Do	131018	♂	18.0	7.1	9.2	3.7	4.8	6.1	do	
Do	131032	♂	17.9	6.9	9.0	3.8	5.0	6.3	do	
Do	131034	♂	17.8	6.7	9.0	3.8	5.0	6.2	do	

SOREX PRIBILOFENSIS GROUP

The *pribilofensis* group includes a single species: *Sorex pribilofensis.* All necessary group comparisons are made under the species.

SOREX PRIBILOFENSIS MERRIAM

PRIBILOF SHREW

(PLS. 2, M; 4, Z; 5, A′; 7, H; 11, D; 12, E)

Sorex pribilofensis Merriam, North Amer. Fauna No. 10, p. 87, December 31, 1895.

Type specimen.—No. 30911, U. S. Nat. Mus., Biological Survey collection; ♀ adult, alcoholic with skull not removed; collected July 29, 1891, by C. Hart Merriam.

Type locality.—St. Paul Island, Pribilof Group (in Bering Sea), Alaska.

Geographic range.—Known only from type locality.

Diagnostic characters.—Size small; tail rather short, hairy; color pattern somewhat like *S. tundrensis,* in summer pelage tricolor, in winter distinctly bicolor. Skull short and broad, interorbital region broad, mesopterygoid space

short, rostrum heavy; dentition moderately heavy, the third unicuspid larger than the fourth. Compared with any of the *cinereus* group, *S. pribilofensis* has a relatively shorter tail, a more tricolor pattern in summer pelage, and in winter pelage has the dark color of the upper parts much more reduced to a longitudinal ribbon; the skull of *S. pribilofensis* is relatively much broader and shorter than that of *S. cinereus*, distinctly broader interorbitally, with a decidedly heavier rostrum, broader palate, and heavier dentition; molars relatively broader (extero-interiorly) than in *S. cinereus*, the unicuspids larger, with internal ridge from apex to edge of cingulum as in the species *cinereus* (but more heavily pigmented than in *S. c. cinereus*). Similar in external proportions and general color pattern to members of the *arcticus group* but smaller, and paler in winter pelage; skull shorter and broader interorbitally than that of any members of the *arcticus* group, with flatter, more rotund (less angular) brain case, shorter, less attenuate rostrum, and with internal pigmented ridge on unicuspid extending from apex to cingulum (in *arcticus* group this ridge is short and on the internal part of the cingulum only and is scarcely pigmented).

Color.—Winter pelage: Distinctly bicolor, the color of the underparts encroaching upon the back and meeting in a sharp line. Top of nose, crown, ears, nape, back, and rump to base of tail a sharply defined longitudinal ribbon of drabbish hair brown; entire underparts, lips, cheeks, sides of head below eyes and ears, flanks, and sides of body well up toward back pale olive gray, usually very faintly tinged with pale olive buff. Tail bicolor; drab above, pale pinkish buff beneath nearly to tip. *Summer pelage:* Tricolor, the back sharply defined from sides, which are less clearly defined from the ventral parts. Top of head and back to base of tail a distinct longitudinal strip of brownish (between hair brown and olive brown); sides of head and body paler, drab to between wood brown and avellaneous; underparts smoke gray, sometimes slightly tinged or stained with olive buff; tail as in winter, less hairy.

Time of molting.—The evidence at hand seems to show that the transition from winter to summer pelage usually occurs in June or early in July. Out of 24 specimens collected in June, July, and early in August, all except 7 are in complete summer pelage. A female collected June 26, 1895, still retains the entire worn winter pelage. A male, June 22, 1890, has acquired about half of the summer fur, and 2 others, collected July 5, 1914, are in about the same status. A female, August 14, 1895, has the last remnants of the winter fur, while 2 males, collected one day earlier, are approximately one-half molted.

The fall change occurs about the middle of October. Eleven of twenty-five specimens collected between October 22 and 26, 1914, are in complete winter pelage; 11 are in process of molting; 3 are still in summer pelage.

Skull.—Short and broad, particularly interorbitally; rostrum moderately short, heavy; mesopterygoid space short; brain case moderately flattened, not angular; dentition moderately heavy; molariform teeth about as broad (extero-internal diameter) as long (antero-posterior diameter); cusplike processes of basal shelves of molariform teeth reduced; interior edge of basal shelf of second upper premolar without distinct cusplike process; unicuspid teeth relatively large and broad (extero-interior diameter), decreasing gradually in size posteriorly, the third larger than the fourth, the fifth relatively large, but much smaller than the fourth; unicuspid teeth each with internal heavily pigmented ridge from apex to edge of cingulum.

Measurements.—Average of 8 adult males from type locality: Total length, 96.2 (92–103); tail vertebrae, 34.7 (32–37); hind foot, 13.8 (13–14.5). *Skull:* Average of 10 skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 15.8 (15.4–16.0); palatal length, 5.7 (5.6–5.8); cranial breadth, 7.8 (7.7–8.0); interorbital breadth, 3.7 (3.6–3.8); maxillary breadth, 4.8 (4.7–4.9); maxillary tooth row, 5.5 (5.4–5.6).

Remarks.—The interesting little Pribilof shrew as far as known is confined to St. Paul Island, in Bering Sea, where it is not uncommon. It is strikingly different from any other American Sorex, showing some affinity toward the *cinereus* group in the possession of pigmented ridges on the internal sides of the unicuspid teeth, but, on the whole, it is probably more closely related to the *arcticus* group.

Specimens examined.—One hundred and twenty-one[6] from the type locality.

[6] Mus. Comp. Zool., 1.

TABLE 4.—*Cranial measurements of adult specimens of* Sorex pribilofensis *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. pribilofensis:										
Alaska—St. Paul Island.	206181	♂	16.0	5.7	7.9	3.7	4.8	5.5	Slight	Type locality.
Do	206182	♂	15.8	5.7	7.9	3.7	4.8	5.4	do	Do.
Do	206183	♂	15.9	5.7	7.9	3.6	4.8	5.4	do	Do.
Do	63232	♂	15.8	5.7	7.8	3.7	4.8	5.5	do	Do.
Do	63233	♂	15.9	5.7	7.9	3.7	4.8	5.4	do	Do.
Do	63234	♂	16.0	5.7	8.0	3.8	4.9	5.6	do	Do.
Do	63235	♂	15.5	5.6	7.9	3.6	4.7	5.4	do	Do.
Do	217965	♂	15.9	5.7	7.7	3.6	4.7	5.5	do	Do.
Do	217969	♂	16.0	5.8	7.7	3.7	4.8	5.6	do	Do.
Do	217975	♂	15.4	5.7	7.7	3.8	4.9	5.4	do	Do.

SOREX MERRIAMI GROUP

The *merriami* group includes two species: *Sorex merriami* and *S. leucogenys*.

Geographic range.—Known only from arid regions of southeastern Montana, southwestern North Dakota, southeastern Washington, north-central Oregon, Nevada, and southwestern Utah. (Fig. 7.)

Diagnostic characters.—In size somewhat larger than *S. cinereus*, pale (grayish drab above), with distinctly whitish underparts and feet. Skull relatively short and broad, flattened through the brain case, relatively high and swollen interorbitally, with a short, broad rostrum, which compared with that of other members of the genus found within its geographic range, is abruptly truncate anteriorly (nares region). The third upper unicuspidate tooth of most of the west American shrews is smaller than the fourth. Exceptions to this are found in *S. cinereus* and *S. arcticus*, both species that may possibly occur within certain parts of the geographic range of shrews of the *merriami* group, and, like them, have the third upper unicuspid larger than or, infrequently in *S. cinereus* equal to the fourth. Members of the *merriami* group, however, have the unicuspids relatively narrow and elongate (in lateral aspect), and tending to be more crowded together than in *S. cinereus* or *S. arcticus*.

Remarks.—Although the number of specimens available that represent the *merriami* group is small and insufficient for satisfactory evidence as to distribution and variation, nevertheless it shows that the species *merriami* and *leucogenys* are very closely related forms differing markedly from any other shrews. The members of this group appear to inhabit arid or semidesert regions, much in contrast with the habitat preference of most species of long-tailed shrews.

SOREX MERRIAMI DOBSON

MERRIAM SHREW

(PLS. 2, N; 4, A'; 6, A; 7, I; 11, E; 12, F)

Sorex merriami Dobson, Monograph of the Insectivora, systematic and anatomical, part 3, fasc. 1, pl. 23, fig. 6, May, 1890.

Type specimen.—No. 186441, U. S. Nat. Mus., Merriam collection (old No. $\frac{1001}{4861}$); ♀ adult (teeth slightly worn), alcoholic with skull removed; collected December 26, 1884, by Charles E. Bendire.

Type locality.—Fort Custer, Bighorn County, Mont.

Geographic range.—Known only from five localities in southwestern North Dakota, southeastern Montana, northern Nevada, north-central Oregon, and southeastern Washington. (Fig. 7.)

Diagnostic characters.—Size small, larger than *Sorex cinereus*, smaller than *S. arcticus;* color pale, underparts and feet distinctly whitish; tail medium in length, decidedly bicolor, whitish below to tip. Skull relatively short and broad, flattened through the brain case, high and swollen orbitally, with short, broad rostrum. Dentition heavy; unicuspid row relatively short, the fourth

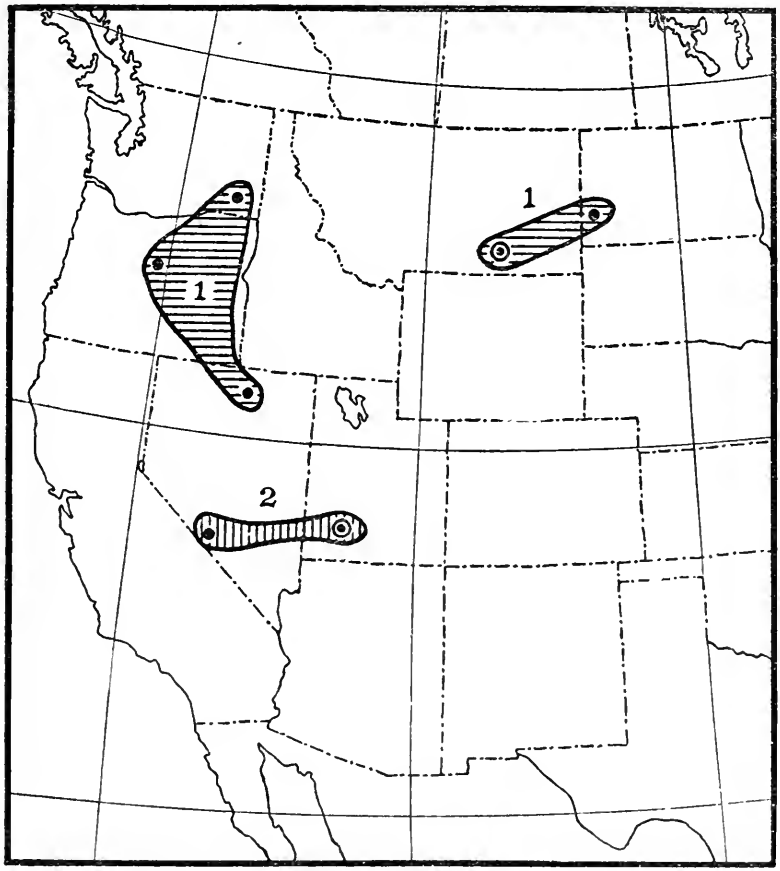

FIG. 7.—Geographic range of species of *Sorex merriami* group

1. *S. merriami.* 2. *S. leucogenys.*

unicuspid smaller than third. Skull somewhat smaller than that of *S. leucogenys*, with flatter brain case and anterior halves of unicuspid tooth rows more approximated and more nearly parallel.

Color.—Winter pelage:[7] Upper parts drab, becoming paler on the flanks; underparts, chin, lips, and feet, distinctly whitish, the feet tinged with light buff; tail bicolor, wood brown above, whitish beneath to tip. *Summer pelage:*[8] Upper parts grayish drab becoming light drab on the flanks; underparts nearly white, very faintly tinged with pale olive-buff; tail and feet as in winter.

[7] Based on alcoholic specimen from Elko County, Nev.
[8] Based on imperfect skin from Medora, N. Dak.

Skull.—Short and broad, flattened through brain case, high and swollen orbitally; rostrum short and broad, particularly broad through region of infraorbital foramina, which open relatively well forward; mesopterygoid space short, the sides relatively heavy. Teeth large, the molars as broad (exterointernally) as long (antero-posteriorly), deeply emarginate posteriorly; teeth densely pigmented; unicuspid tooth row short, the fourth unicuspid smaller than the third; unicuspids placed relatively vertical to antero-posterior axis of alveolar borders; antero-posterior diameter of each unicuspid considerably less than supero-inferior diameter; unicuspids without heavily pigmented internal ridge from apex to edge of cingulum; first upper incisors small.

Measurements.—Type specimen (adult female) (measured from alcoholic specimen after removal of skull): Total length, 90; tail vertebrae, 35; hind foot, 11.5. *Skull.*—Type specimen (adult female; teeth slightly worn): Condylobasal length, 15.8; palatal length, 6.3; cranial breadth, 8.0; interorbital breadth, 4.0; maxillary breadth, 5.0; maxillary tooth row, 5.6. Skull of adult (teeth slightly worn), sex unknown, from Golconda (100 miles northeast of), Nevada: Condylobasal length, 16.2; palatal length, 6.4; cranial breadth 7.9; interorbital breadth, 3.8; maxillary breadth, 5.1; maxillary tooth row, 5.8.

Remarks.—Regarding the type specimen of *S. merriami*, Merriam has written:

> The type and only known specimen of this remarkable shrew was presented to me by Maj. Charles E. Bendire, who collected it at the post garden, on the Little Big Horn River, about a mile and a half above Fort Custer, Mont., December 26, 1884. I sent it, with all my other shrews to Dr. George E. Dobson, who was then engaged on a monographic revision of the Soricidae. Unfortunately, owing to Dr. Dobson's continued ill health, all that has ever been published of this monograph is a fasciculus of plates, showing the jaws and teeth of certain species, with a page of explanation facing each plate (Monog. Insectivora, Part III, fasc 1, May, 1890). The present species is named and its peculiar dentition shown in Pl. XXIII, fig. 6, of this work. But the remarkable shape of the palate and peculiarities of the skull as a whole are not shown. The skull was removed from the alcoholic specimen by Dr. Dobson, and I have sometimes wondered whether by any possible accident it could have been transposed with that of some Asiatic species, it is so very unlike all known American shrews. When the specimen was returned the alcoholic bore my original label and number (1001), but the skull was numbered differently (1886; its proper number is 4861). Dr. Dobson afterwards wrote me that his number was an error, and that the skull belonged to my alcoholic No. 1001. [Merriam, 1895, p. 88–89.]

Since the time Merriam published the foregoing remarks, four additional specimens of this rare shrew have come to light. Unfortunately, none of these is a perfect specimen. On June 23, 1896, Vernon Bailey found a dead shrew in a creek valley, 7 miles southeast of Antelope, Oreg. From this specimen, a mere fragment of skin and body that has been in alcohol, the partly crushed skull has been removed. It agrees well with that of the type of *S. merriami*, except that it seems a trifle higher through the brain case.

The remains of a small shrew were found among the rocks on a high butte near Medora, N. Dak., on June 13, 1913, by S. G. Jewett. Some animal had killed the shrew and eaten its head, so that only the skin of the hind half of the body, the hind feet, and tail are available for study. The color of the animal and the habitat where it was found indicate that the specimen is with little doubt *S. merriami*.

The third specimen was obtained by Edmund Heller, November 26, 1914, at Desert Ranch, Elko County, Nev., where it had been caught by a house cat. The skull of this specimen is slightly larger and with somewhat higher brain case than that of the type of *S. merriami*, but it is decidedly more nearly like this form than *S. leucogenys*.

The last specimen to make its appearance, a skin accompanied by a broken skull, was collected by George G. Cantwell, November 18, 1919, at the entrance to an old badger digging on top of a "high bunch grass hill," at Starbuck (altitude 645 feet), Columbia County, Wash. It shows no appreciable differences from the type specimen of *S. merriami.*

Specimens examined.—Total number, 5, as follows:

Montana: Fort Custer (type locality), 1.
Nevada: Desert Ranch, 100 miles northeast of Golconda, Elko County, 1.
North Dakota: Medora, 1.
Oregon: Antelope (7 miles southeast), 1.
Washington: Starbuck (altitude 654 feet), 1.

SOREX LEUCOGENYS Osgood

White-cheeked Shrew

(Pls. 2, o; 4, b'; 6, b; 7, j)

Sorex leucogenys Osgood, Proc. Biol. Soc. Washington 22: 52, April 17, 1909.

Type specimen.—No. 157952, U. S. Nat. Mus., Biological Survey collection; ♀ adult, skin and skull; collected August 12, 1908, by W. H. Osgood.

Type locality.—Mouth of the canyon of Beaver River, about 3 miles east of Beaver, Beaver County, Utah.

Geographic range.—Known only from type locality and Esmeralda County, Nev. (Fig. 7.)

Diagnostic characters.—Essentially like *Sorex merriami* in color, but slightly larger; skull larger than that of *S. merriami*, higher through the brain case, and with anterior halves of unicuspid tooth rows less approximated and less nearly parallel.

Color.—Winter pelage: Unknown. *Summer pelage:* Similar to *S. merriami.* Upper parts pale hair brown or grayish drab becoming light drab on the flanks; underparts nearly white, faintly tinged with pale olive-buff; chin, lips, and sides of face below eyes pale olive-buff; feet whitish, tinged with light buff; tail distinctly bicolor, drab above, whitish below, tipped with whitish.

Skull.—Larger than that of *S. merriami*, with relatively and actually broader and higher brain case, which rises more abruptly in frontal region, the unicuspid tooth rows tending to approach each other at the anterior ends with more regularity (in straight line) and with anterior halves less approximated and more diverging posteriorly.

Measurements.—Type specimen (adult female): Total length, 107; tail vertebrae, 38; hind foot, 12.5. Adult female from Mount Magruder, Nev.: Total length, 105; tail vertebrae, 40; hind foot, 12. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 16.5; palatal length, 6.5; cranial breadth, 8.3; interorbital breadth, 3.8; maxillary breadth, 5.1; maxillary tooth row, 5.8. Skull of adult female (teeth slightly worn) from Indian Spring, Mount Magruder, Nev.: Condylobasal length, 16.9; palatal length, 6.7; cranial breadth, 8.4; interorbital breadth, 4.0; maxillary breadth, 5.4; maxillary tooth row, 6.0.

Remarks.—The type specimen of *S. leucogenys* was trapped on a dry Upper Sonoran slope about 200 yards from running water. The Indian Spring specimen is paler than the type specimen, which may be due chiefly to the differences in the make-up of the skins, the former being stuffed considerably fuller than the latter. Its skull has the high brain case and other characters of the type specimen of *S. leucogenys* and is even slightly accentuated in size. The White Mountains specimen differs from the type only in slightly heavier molariform teeth and in a somewhat less reddish coloration, which is undoubtedly

due to seasonal variation. The external measurements as taken by the collector are less than of the type of *S. leucogenys*, but the skull does not show a corresponding differentiation; if anything it is larger. Although the skull of *S. merriami* from northern Nevada is slightly larger than the type skull of that species and has a trifle higher brain case, the approach toward *S. leucogenys* does not clearly indicate intergradation between the two forms.

Specimens examined.—Three as follows:

Nevada: Chiatovich Creek, altitude 8,200 feet, White Mountains, Esmeralda County, 1[9]; Indian Spring, altitude 7,700 feet, Mount Magruder, Esmeralda County, 1.[10]

Utah: Beaver (3 miles east of), Beaver County (type locality), 1.

TABLE 5.—*Cranial measurements of adult specimens of* Sorex merriami *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. merriami:										
Montana—Fort Custer.	186441	♀	15.8	6.3	8.0	4.0	5.0	5.6	Slight	Type specimen.
Nevada—100 miles northeast of Golconda.	210121	------	16.2	6.4	7.9	3.8	5.1	5.8	---do------	
S. leucogenys:										
Utah—Beaver River	157952	♀	16.5	6.5	8.3	3.8	5.1	5.8	---do------	Type specimen.
Nevada—Mount Magruder.	[1] K572	♀	16.9	6.7	8.4	4.0	5.4	6.0	---do------	

[1] Collection of Donald R. Dickey, Pasadena, Calif.

SOREX SCLATERI GROUP

The *sclateri* group includes a single species—*Sorex sclateri*. All necessary group comparisons are made under the species.

SOREX SCLATERI MERRIAM

SCLATER SHREW

(PLS. 2, P; 4, C'; 6, C; 8, A)

Sorex sclateri Merriam, Proc. Biol. Soc. Washington 11: 288, July 15, 1897.

Type specimen.—No. 75872, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected October 23, 1895, by E. W. Nelson and E. A. Goldman.

Type locality.—Tumbala, altitude 5,000 feet, Chiapas, Mexico.

Geographic range.—Known only from the type locality.

Diagnostic characters.—Size relatively large; tail long, hind foot large; color dark, both dorsally and ventrally; skull large, relatively long and narrow, interorbital region rather elongate, interpterygoid space long, dentition moderately heavy, weakly pigmented, the third unicuspid larger than the fourth. Similar in external appearance to *S. veraepacis*, possibly darker ventrally; skull decidedly narrower than of *S. veraepacis*, the brain case less angular and more flattened, the interorbital region more elongate, and the relative size of the third and fourth unicuspids reversed.

[9] Mus. Vert. Zool. [10] D. R. Dickey coll., Pasadena, Calif.

Color.—Winter pelage: Upper parts dark clove brown or dark bister, or almost blackish clove brown; underparts scarcely paler than upper parts, clove brown or between clove brown and bister; tail clove brown above, slightly paler below. *Summer pelage:* Unknown.

Time of molting.—A male collected October 22, 1895, has acquired the new fur except on the occiput, nape, and rump, which are in process of molting. The three other specimens, collected October 23, 24, and 25, appear to be in fresh pelage.

Skull.—Large, relatively long and narrow; the interorbital and post-palatal regions noticeably relatively elongate; brain case narrow, flattened, gently rotund laterally (not angular) in superior aspect; dentition moderately heavy, weakly pigmented, the third unicuspidate tooth slightly larger than the fourth.

Measurements.—Type specimen (adult female): Total length, 126; tail vertebrae, 52; hind foot, 16. Adult male from type locality: Total length, 125; tail vertebrae, 52; hind foot, 16. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 19.9; palatal length, 8.0; cranial breadth, 9.2; interorbital breadth, 4.4; maxillary breadth, 5.9; maxillary tooth row, 7.4. Skull of adult male (teeth slightly worn) from type locality: Condylobasal length, 19.6; palatal length, 7.7; cranial breadth, 9.2; interorbital breadth, 4.4; maxillary breadth, 5.6+; maxillary tooth row, 7.2.

Remarks.—Although *S. sclateri* is very similar to *S. veraepacis* in superficial external appearance, averaging scarcely a shade darker and more brownish in color, it shows pronounced differences in cranial characters, and the two species are apparently not closely related. Only four specimens of the Sclater shrew are available for study, but in these four the characters diagnostic of the species are very uniform.

Specimens examined.—Four, from the type locality.

SOREX LONGIROSTRIS GROUP

The *longirostris* group includes a single species.—*Sorex longirostris.* All necessary group comparisons are made under the species.

SOREX LONGIROSTRIS Bachman

[Synonymy under subspecies]

Geographic range.—Atlantic Plain and Piedmont region from northern Virginia and southern Maryland south to northern Florida (Alachua County) and central Alabama (Autauga County); eastern and southern Illinois and southwestern Indiana. (Fig. 8.)

Diagnostic characters.—Small; with short rostrum and crowded unicuspid tooth row; first and second unicuspids about equal in size, the third and fourth decidedly smaller than first and second, the third somewhat smaller than the fourth; fifth unicuspid very much smaller than fourth, almost minute; teeth inextensively pigmented. Differs from the *cinercus* group in its relatively shorter, broader rostrum, shorter and more crowded unicuspid row, third upper unicuspid smaller than the fourth, and antero-posterior diameter of unicuspid teeth less than extero-interior (lateral) diameter; extero-interior diameter of molariform teeth relatively much greater than in those of the *cinercus* group and first incisors, both upper and lower, relatively smaller. Much smaller than any of the *fumeus* or *arcticus* groups, and with different skull proportions and dentition. Sometimes similar to certain forms of the *ornatus* and *vagrans-obscurus* groups. Usually more reddish or darker in color than any of the *ornatus* group, skull higher through the brain case and less depressed interorbitally, first incisors weaker, unicuspid tooth row and mesopterygoid space shorter. Differs from members of the *vagrans-obscurus* group in a more flattened brain case, shorter unicuspid tooth row with the individual teeth relatively less in antero-posterior diameter, more extensively pigmented dentition, and relatively and actually shorter mesopterygoid space.

Subspecies and geographic variation.—The species *longirostris* includes the two subspecies *longirostris* and *fisheri*. Insufficient specimens are available to show clearly the variations of the species over its entire range, but the subspecies *longirostris* appears to be very constant in characters over its comparatively wide distribution, grading rather abruptly into the localized larger *fisheri* with its larger and relatively narrower skull.

Time of molting.—A male and a female of the subspecies *longirostris* taken April 16, 1907, at Reevesville, Ill., show fresh summer pelage over the entire ventral parts and head, the upper parts being in worn winter pelage; two males collected on April 16 and 18 of the same year at the same place are in worn winter pelage. The specimen of *fisheri* from Chapanoke, N. C., collected March

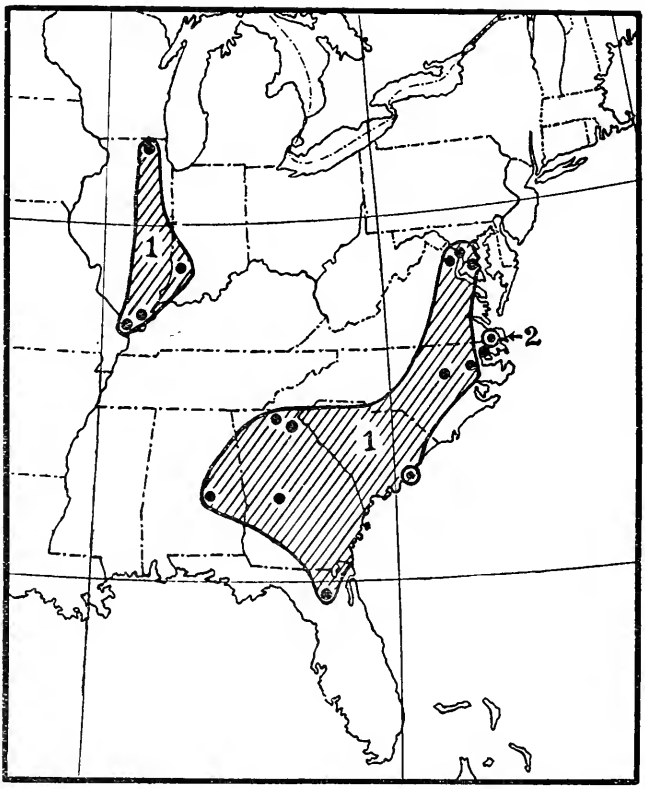

FIG. 8.—Geographic range of subspecies of *Sorex longirostris*

1. *S. l. longirostris*. 2. *S. l. fisheri*.

20, 1897, has the molt beginning on the midback. A male *fisheri* collected May 23, 1905, at the type locality shows the summer pelage coming in under the worn winter fur on the back, while another male taken at the same time and an unsexed individual collected June 5, 1895, at Dismal Swamp, have obtained the full summer pelage.

None of the specimens of *S. l. longirostris* examined is in process of changing from the summer to the winter pelage. Specimens of this form collected November 27 and 28, 1906, at Olive Branch, Ill., have apparently acquired the full winter coat. A specimen of *S. l. fisheri* caught October 21, 1895, has the new fur incoming under the old over most of the back, while the type specimen, a male collected October 11, has the winter fur on the rump, the fur on the remainder of the back and the abdomen being in the process of renewal.

Remarks.—The species *S. longirostris* is composed of only two forms, comprising a compact lot separable from all other groups by

the combined characters above enumerated. The shrews of this species differ from all other Sorex of eastern America in having the third unicuspid considerably smaller than the fourth, a characteristic common to most species of Sorex of western America, and absent from those of the intervening plains region. For this reason, combined with the apparent scarcity of individuals and the uniformity of characters within the species, one might be inclined to believe that it is a relict group of the preglacial fauna occupying the faunally old portion of the southeastern United States.

SOREX LONGIROSTRIS LONGIROSTRIS Bachman

Bachman Shrew

(Pls. 2, Q; 5, A; 6, D; 8, B; 11, F; 12, G)

Sorex longirostris Bachman, Journ. Acad. Nat. Sci. Philadelphia 7: part 2, p. 370, 1837.

O[tisorex] longirostris De Kay, Zool. New York, part 1, Mammalia, p. 23, 1842.

[*Musar[aneus] (Croc[idura])] bachmani* Pomel, Arch. Sci. Phys. et Nat. 9: 249, 1848.

Sorex wagneri Fitzinger, Sitzungsber. Kaiserl. Akad. Wissensch., math.-natürwissensch. Classe, Wien, bd. 57, abtheil 1, p. 512, 1868.

Type specimen.—Not known now to exist. Collected by Alexander Hume.

Type locality.—Hume Plantation, swamps of the Santee River [Cat Island, mouth of Santee River], S. C.

Geographic range.—Atlantic Plain and Piedmont region (except vicinity of Dismal Swamp, Va., inhabited by *S. l. fisheri*) from northern Virginia and southern Maryland, south to northern Florida (Alachua County) and central Alabama (Autauga County); eastern and southern Illinois and southwestern Indiana. (Fig. 8.)

Diagnostic characters.—Size small, with relatively short tail (about equal length of body without head); about the size of *S. fontinalis*, more reddish in color, with distinct cranial characters; skull relatively short and broad, with flattened brain case and short rostrum; unicuspids short (antero-posterior diameter) and broad (extero-interior diameter), the third smaller than the fourth. Separated from all other American shrews except *S. l. fisheri* by group characters. Smaller than *fisheri*, with decidedly smaller and relatively broader skull with shorter rostrum.

Color.—*Winter pelage:* Upper parts Prout's brown, or mummy brown, sometimes almost fuscous, shading gradually on the sides into cinnamon brown; underparts tinged strongly with smoke gray mixed with drab, and showing considerable deep neutral gray of base of hairs. Tail indistinctly bicolor, Prout's brown or mummy brown above, cinnamon brown or ochraceous tawny below. *Summer pelage:* Very slightly paler than in winter pelage, the underparts more drab or avellaneous. Tail as in winter.

Skull.—Small, with short rostrum, and broad, flattened brain case. Differs from that of *S. cinereus* and *S. fontinalis* in group characters. Much smaller than that of *S. l. fisheri* and relatively broader with shorter rostrum.

Measurements.—Adult male from Raleigh, N. C.: Total length, 87; tail vertebrae, 32; hind foot, 11.5. Adult male from Falls Church, Va.: Total length, 79; tail vertebrae, 33; hind foot, 11. Average of three adult males from Olive Branch, Ill.: Total length, 83.7 (79–90); tail vertebrae, 28.3 (27–30); hind foot, 10.3 (10–10.5). *Skull:* Skull of adult (sex unknown; teeth slightly worn) from Butler, Ga.: Condylobasal length, 14.6; palatal length, 5.1; cranial breadth, 7.3; interorbital breadth, 3.2; maxillary breadth, 4.2; maxillary tooth row, 5.0. Skull of adult male (teeth slightly worn) from Raleigh, N. C.: Condylobasal length, 14.1; palatal length, 5.1; cranial breadth, 7.2; interorbital breadth, 3.0; maxillary breadth, 4.2; maxillary tooth row, 5.0. Skull of adult male (teeth slightly worn) from Falls Church, Va.: Condylobasal length,

14.4; palatal length, 5.2; cranial breadth, 7.4; interorbital breadth, 3.2; maxillary breadth, 4.3; maxillary tooth row, 5.1. Imperfect skulls of two adults (sex unknown; teeth moderately worn) from Bicknell, Ind.: Palatal length, 5.1, 5.2; interorbital breadth, 3.2, 3.0; maxillary breadth, 4.6, 4.1; maxillary tooth row, 4.8, 4.8.

Remarks.—Apparently local in distribution, and either rare or difficult to trap, probably both, this little shrew is represented in collections by comparatively few specimens. The knowledge of its presence in a given locality has frequently been purely accidental. The first one brought to the attention of zoologists was found in a newly dug ditch in the Santee Marshes of South Carolina and upon it was based the original description. Bachman also describes another specimen, which was found in the gullet of a hooded merganser (*Lophodytes cucullatus*) (Bachman, 1837, p. 372), and a specimen in the United States Bureau of Biological Survey collection was taken from the stomach of a barred owl (*Strix varia alleni*) shot near Autaugaville, Ala. Another had evidently fallen over the cliffs to the shore of Chesapeake Bay, Md., where it was found dead by Marcus Ward Lyon, jr.

Although the specimens examined come from widely separated localities, represented in most cases by a single individual, there is little variation in the color or cranial characters. Indiana and Illinois specimens seem to average a trifle less reddish in color than specimens from the Atlantic States, and they may possibly have on the average shorter unicuspid rows and smaller molariform teeth, but the differences are slight and inconstant, and, on the basis of the specimens examined, not marked enough for subspecific separation. The skulls from Raleigh, N. C., seem to average very slightly higher through the brain case than those from Georgia, but the difference is nonessential. The skull from Chesapeake Beach, Md., is relatively somewhat narrower than typical specimens, which probably indicates a tendency toward *S. l. fisheri*, though there is no approach in size. The specimen from Falls Church, Va., is almost identical with the Georgia ones, which are assumed to be typical. Unfortunately, efforts to procure specimens of Sorex from the type locality of *S. l. longirostris* have proved futile. There seems little doubt, however, of the status of the form.

The status of *Amphisorex lesueurii* Duvernoy, the description of which has been misidentified as that of *S. longirostris*, is discussed under *S. c. cinereus* (p. 43–44).

Specimens examined.—Total number, 24, as follows:

Alabama: Bear Swamp, 4 miles northeast of Autaugaville, 1.
District of Columbia: Washington, 1.
Florida: Newnans Lake, near Gainesville, Alachua County, 1.[11]
Georgia: Butler, 1; Young Harris, 1.
Illinois: Olive Branch, 3[12]; Pistakee Lake, Henry County, 1[13]; Reevesville, 4.[12]
Indiana: Bicknell, 3.
Maryland: Chesapeake Beach, Calvert County, 3; Hall, Prince Georges County, 1.
North Carolina: Raleigh, 3.
Virginia: Falls Church, 1.

[11] Harley B. Sherman coll., Gainesville, Fla.
[12] Field Mus. Nat. Hist.
[13] Ill. State Lab. Nat. Hist.

SOREX LONGIROSTRIS FISHERI Merriam

Fisher Shrew

(Pls. 2, B; 5, B)

Sorex fisheri Merriam, North Amer. Fauna No. 10, p. 86, December 31, 1895.

Type specimen.—No. 75166, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth very slightly worn), skin and skull; collected October 11, 1895, by A. K. Fisher.

Type locality.—Lake Drummond, Dismal Swamp, Va.

Geographic range.—Known only from Dismal Swamp, Va., and adjacent part (Chapanoke) of North Carolina. (Fig. 8.)

Diagnostic characters.—Similar to *Sorex l. longirostris* but much larger with color usually duller above and more tinged with drab or wood brown on the underparts; skull distinctly larger in all dimensions than that of the subspecies *longirostris*, relatively somewhat narrower.

Color.—Winter pelage: Upper parts and sides fuscous; underparts moderately tinged with drab or wood brown, showing mixture of deep neutral gray of base of hairs. Tail bicolor, fuscous above, drab below nearly to tip. *Summer pelage:* Somewhat brighter than winter pelage. Upper parts Prout's brown, mummy brown, or near fuscous, becoming slightly paler on the sides; underparts drab or wood brown, rarely showing any trace of the deep neutral gray of base of hairs. Tail as in winter.

Skull.—Much larger than that of *S. l. longirostris*, relatively narrower with longer rostrum. About the size of that of large individuals of *S. c. cinereus*, but easily distinguished by its flatness of brain case, wide rostrum, and other group characters.

Measurements.—Type specimen (adult male): Total length, 108; tail vertebrae, 39; hind foot, 12. Two adult females from type locality: Total length, 102, 98; tail vertebrae, 40, 34; hind foot, 13, 11.5. *Skull:* Skulls of two adult males (teeth slightly worn), type specimen and topotype: Condylobasal length, 15.9, 15.9; palatal length, 5.6, 5.4; cranial breadth, 7.8, 7.7; interorbital breadth, 3.5, 3.5; maxillary breadth, 4.4, 4.5; maxillary tooth row, 5.4, 5.4. Skulls of two adult females (teeth slightly worn) from type locality: Condylobasal length, 16.4, 15.4; palatal length, 5.6, 5.5; cranial breadth, 8.2, 7.5; interorbital breadth, 3.6, 3.3; maxillary breadth, 4.8, 4.5; maxillary tooth row, 5.8, 5.3. Skull of adult male (teeth slightly worn) from Chapanoke, N. C.: Condylobasal length, 15.8; palatal length, 5.5; cranial breadth, 7.3; interorbital breadth, 3.4; maxillary breadth, 4.4; maxillary tooth row, 5.6.

Remarks.—The distribution of *S. l. fisheri* is evidently restricted to a small area in the Dismal Swamp region of southeastern Virginia and northeastern North Carolina. There is considerable variation in size among the skulls from the type locality, but the smallest skulls of *fisheri* are distinctly larger than the largest of *S. l. longirostris*. The single specimen of *fisheri* available from North Carolina barely suggests an approach toward *S. l. longirostris*.

Specimens examined.—Total number, 16, as follows:

North Carolina: Chapanoke, Perquimans County, 1.[14]
Virginia: Lake Drummond, Dismal Swamp (type locality), 15.

[14] Acad. Nat. Sci., Philadelphia.

TABLE 6.—*Cranial measurements of adult specimens of* Sorex longirostris *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. l. longirostris:										
Georgia—										
Butler	38425	------	14.6	5.1	7.3	3.2	4.2	5.0	Slight	
Young Harris	159415	------	13.9	5.0	7.2	3.1	4.2	5.0	---do	
North Carolina—Raleigh.	81972	♂	14.1	5.1	7.2	3.0	4.2	5.0	---do	
Virginia—Falls Church.	87190	♂	14.4	5.2	7.4	3.2	4.3	5.1	---do	
Maryland—Chesapeake Beach.	151738	♂	14.3	5.1	7.0	3.2	4.2	5.0	---do	
Indiana—Bicknell	168737	------	------	5.1	-----	3.2	4.6	4.8	Moderate	
Do	168834	------	------	5.2	-----	3.0	4.1	4.8	---do	
S. l. fisheri:										
Virginia—Lake Drummond.	75166	♂	15.9	5.6	7.8	3.5	4.4	5.4	Very slight	Type specimen.
Do	75168	♂	15.9	5.4	7.7	3.5	4.5	5.4	Slight	Type locality.
Do	75167	♀	16.4	5.6	8.2	3.6	4.8	5.8	---do	Do.
Do	140810	♀	15.4	5.5	7.5	3.3	4.5	5.3	---do	Do.
North Carolina—Chapanoke.	[1] 10573	♂	15.8	5.5	7.3	3.4	4.4	5.6	---do	

[1] Acad. Nat. Sci., Philadelphia.

SOREX DISPAR GROUP

The *dispar* group contains two species.—*Sorex dispar* and *S. gaspensis.*

Geographic range.—Gaspé Peninsula, Quebec; mountains of eastern New York, western Massachusetts, northeastern Pennsylvania, and southern West Virginia. (Fig. 9.)

Diagnostic characters.—Size, medium; color, dull grayish; back almost concolor with underparts; tail, long, moderately hairy; skull, smooth, nonangular, long and narrow, moderately flattened; rostrum, relatively long and narrow, depressed; infraorbital foramen with posterior border lying behind the plane of interspace between m^1 and m^2; dentition, moderate; unicuspids, relatively narrow (extero-interior diameter), the third about equal the fourth in size.

In color, members of the *dispar* group are not unlike *S. fumeus* in winter pelage but differ from any member of the *fumeus* or *arcticus* groups in relatively longer tail; long, narrow, depressed rostrum; narrow palate; in the position of the infraorbital foramen; weaker dentition, with pm^2 with posterior portion of cingulum less expanded internally, and narrower unicuspidate teeth. Compared with any of the *cinereus* group, either species of the *dispar* group is larger, with larger, more flattened skull and more depressed rostrum, which is even more accentuated in ratio of length to breadth than that of *S. cinereus;* molariform teeth relatively wider (extero-interior diameter) than in *cinereus* group, the interior ridge from the apex to cingulum of the unicuspidate teeth less developed, less pigmented. Somewhat like the western *S. trowbridgii* in color, but with tail not so clearly bicolor; and radically different cranially and ventrally.

Remarks.—The *dispar* group has a limited distribution in the eastern United States and Canada, and individuals belonging thereto are apparently rare, since less than 30 are known to exist in collections. The group is clearly differentiated from any other Sorex in the extreme posterior position of the infraorbital foramen.

SOREX DISPAR Batchelder

Gray Long-tailed Shrew

(Pls. 2, s; 4, d'; 6, e; 8, c; 11, g; 12, h)

Sorex macrurus Batchelder (nec *S. macrourus* Lehmann, 1822, qui *Neomys fodiens*), Proc. Biol. Soc. Washington 10:133, December 8, 1896.
Sorex dispar Batchelder (substitute for *S. macrurus* Batchelder), Proc. Biol. Soc. Washington 24:97, May 15, 1911.

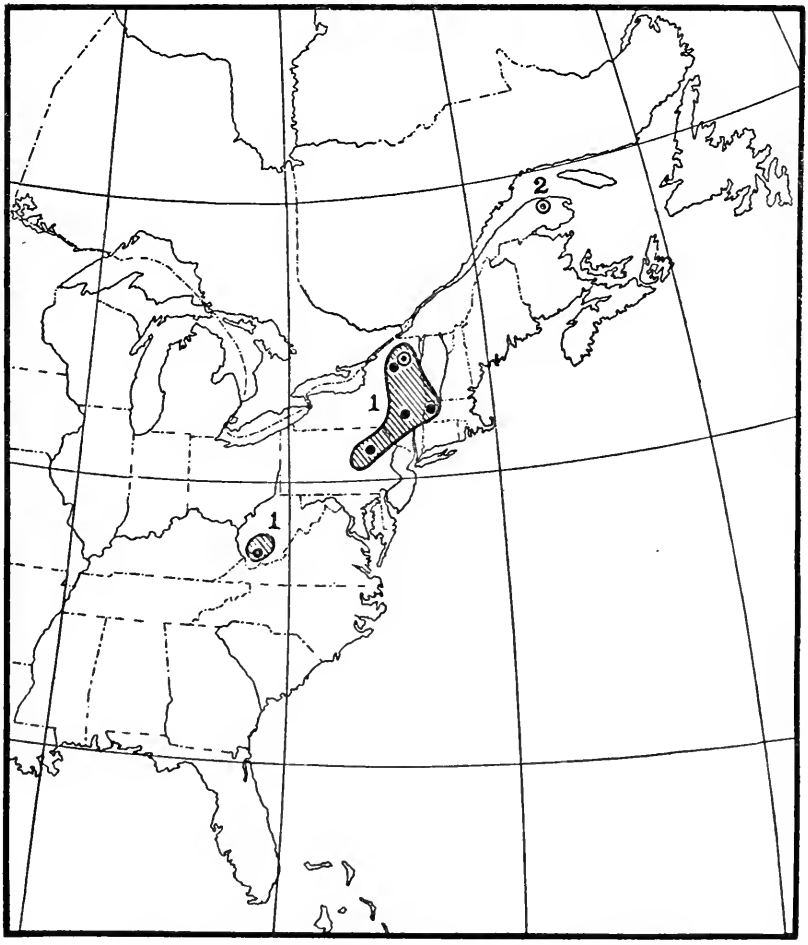

Fig. 9.—Geographic range of species of *Sorex dispar* group

1. *S. dispar.* 2. *S. gaspensis.*

Type specimen.—No. 1384, collection of C. F. Batchelder, Cambridge, Mass.; ♂ adult (teeth unworn), skin and skull, left maxillary process broken away; collected September 9, 1895, by C. F. Batchelder.

Type locality.—Beedes (sometimes called Keene Heights), Essex County, N. Y.

Geographic range.—Mountains of eastern New York, western Massachusetts, northeastern Pennsylvania, and southern West Virginia. (Fig. 9.)

Diagnostic characters.—Similar to *Sorex gaspensis* but distinctly larger, darker, and tending to be more brownish in color; hind foot actually larger than in *S. gaspensis* but in proportion to body length relatively smaller; skull noticeably larger than that of *S. gaspensis*, with corresponding heavier dentition.

Color.—Winter pelage: Unknown. *Summer pelage:* Dull, grayish, scarcely paler ventrally than on back. Upper parts dark mouse gray to deep mouse gray with a perceptible tinge of chaetura black or chaetura drab, in some lights appearing more or less finely flecked with whitish; underparts about same tone of color as upper parts, scarcely, if any, paler; tail fuscous-black above, usually paler beneath, particularly basally, chaetura drab or hair brown, sometimes almost as dark as above (fuscous-black), occasionally, when much worn, honey yellow or cinnamon-buff. Upper surfaces of feet more or less clothed with fuscous hairs, particularly on outer edge.

Time of molting.—Of the specimens of *S. dispar* examined, only one is in process of molting. A male collected September 4, 1896, on Hunter Mountain, in the Catskills, N. Y., shows indications of the incoming of the winter pelage under the worn summer pelage on the rump. Another male from the same place, collected a day previous, is in worn summer pelage with no signs of molting.

Skull.—Medium in size; smooth, not angular, moderately flattened; relatively long and narrow, brain case narrow, rather low; orbital region elongated (antero-posteriorly); rostrum relatively long and narrow, depressed; mesopterygoid space elongate; molariform dentition moderately heavy; first incisors small; unicuspidate teeth relatively narrow (extero-interior diameter), the first and second about subequal, the third and fourth smaller than the first and second, the third about equal the fourth or possibly slightly smaller, the fifth relatively large but considerably smaller than third; unicuspids with cingulum weakly developed.

Measurements.—Type specimen (adult male): Total length, 130; tail vertebrae, 60; hind foot, 15. Two adult males from Hunter Mountain, Catskill Mountains, N. Y.: Total length, 124, 121; tail vertebrae, 55, 56; hind foot, 15, 14. Two adult females from Hunter Mountain, Catskill Mountains, N. Y.: Total length, 122, 125; tail vertebrae, 56, 58; hind foot, 14.5, 15. Adult male from 4 miles southwest of Pemberton, W. Va.: Total length, 131; tail vertebrae, 62; hind foot, 14. *Skull:* Type specimen (adult male, teeth unworn): Condylobasal length, 18.2; palatal length, 7.0; cranial breadth, 8.1; interorbital breadth, 3.5; maxillary tooth row, 6.1. Skulls of two adult males (teeth slightly worn) from Hunter Mountain, Catskill Mountains, N. Y.: Condylobasal length, 18.0, 17.3; palatal length, 6.9, 6.6; breadth of cranium, 8.0, 7.9; interorbital breadth, 3.3, 3.3; maxillary breadth, 4.2, 4.2; maxillary tooth row, 6.2, 6.1. Skulls of two adult females (teeth slightly worn) from Hunter Mountain, Catskill Mountains, N. Y.: Condylobasal length, 17.6, 17.9; palatal length, 6.6, 6.8; cranial breadth, 8.0, 8.1; interorbital breadth, 3.3, 3.4; maxillary breadth, 4.2, 4.3; maxillary tooth row, 6.1, 6.1. Skull of adult male (teeth slightly worn) from 4 miles southwest of Pemberton, W. Va.: Condylobasal length, 18.0; palatal length, 6.9; cranial breadth, 8.0; interorbital breadth, 3.4; maxillary breadth, 4.5; maxillary tooth row, 6.3.

Remarks.—So different from any other species of American shrew is *S. dispar* that, once the animal is known, critical comparisons with other forms in the region inhabited by it are unnecessary. In color it is not unlike *S. fumeus* in winter pelage, but it can usually be distinguished by its longer tail (55 or more). Cranially, it differs from all other American shrews in its relatively long, narrow, flattened skull with long, narrow, depressed rostrum and peculiar dentition. It does not fit into any other group of shrews, showing in minor respects suggestions of the *cinereus*, *fumeus*, and *arcticus* groups, but differing radically from each of them in other characters.

Specimens examined.—Total number, 15, as follows:

Massachusetts: Mount Graylock, 3.[15]
New York: Beedes (sometimes known as Keene Heights), Essex County (type locality), 1;[16] Hunter Mountain, Catskill Mountains, 8; Mount Marcy (summit), 1.[16]
Pennsylvania: Lake Leigh (North Mountain), Sullivan County, 1.[17]
West Virginia: Winding Gulf (4 miles southwest of Pemberton), 1.

SOREX GASPENSIS ANTHONY AND GOODWIN

GASPÉ PENINSULA SHREW

Sorex gaspensis Anthony and Goodwin, Amer. Mus. Novitates, no. 109, p. 1, March 10, 1924.

Type specimen.—No. 64190, Amer. Mus. Nat. Hist., ♂ young adult (teeth unworn), skin and skull, the skull slightly crushed in pterygoid region; collected September 5, 1923, by G. G. Goodwin.

Type locality.—Mount Albert, altitude 2,000 feet, Gaspé Peninsula, Quebec.

Geographic range.—Known only from Gaspé Peninsula, Quebec. (Fig. 9.)

Diagnostic characters.—Similar to *S. dispar* but distinctly smaller, paler, and more grayish (less brownish) in color; hind foot small, actually considerably smaller than in *S. dispar*, but in proportion to body length relatively slightly larger; skull distinctly smaller than that of *S. dispar* with correspondingly weaker dentition.

Color.—Winter pelage: Unknown. *Summer pelage:* Distinctly paler and more grayish than that of *S. dispar*. Upper parts between deep mouse gray and deep neutral gray, or slightly paler; underparts scarcely paler than upper parts; tail essentially as in *S. dispar*, possibly less fuscous; feet a shade paler.

Time of molting.—A female collected September 7, 1923, shows the intrusion of the winter fur under the summer pelage over the posterior half of the back.

Skull.—Essentially similar in proportions to that of *S. dispar* but decidedly smaller in all dimensions, the mesopterygoid space apparently relatively shorter, teeth smaller, and dental pigmentation heavier.

Measurements.—Type specimen (young adult male): Total length, 102; tail vertebrae, 47; hind foot, 10.5.[18] Adult male and young adult female from type locality: Total length, 100, 95; tail vertebrae, 47, 47; hind foot, 12, 12. *Skull:* Type specimen (young adult male, teeth unworn): Condylobasal length, 16.3; palatal length, 6.4; cranial breadth, 7.4; interorbital breadth, 3.0; maxillary tooth row, 5.6. Skulls of adult male (teeth moderately worn) and young adult female (teeth very slightly worn) from type locality: Condylobasal length, 16.1, 15.8; palatal length, 6.5. 6.4; cranial breadth, 7.3, 7.9; interorbital breadth, 3.2, 3.0; maxillary breadth, 4.0, 3.7; maxillary tooth row, 5.5, 5.6.

Remarks.—Although the material at present available shows no specific connection between *S. gaspensis* and *S. dispar*, it is possible that additional specimens from the regions now separating the known geographic ranges of the two forms may show intergradation between them. The members of this group of shrews are local in distribution, and apparently scarce where found.

Specimens examined.—Three,[19] from the type locality.[19a]

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[15] Mapton Copeland coll., Brunswick, Me.
[16] C. F. Batchelder coll., Cambridge, Mass.
[17] Acad. Nat. Sci., Philadelphia.
[18] Evidently an error; measures 12 millimeters in the dry skin.
[19] Amer. Mus. Nat. Hist.
[19a] George G. Goodwin, of the American Museum of Natural History, writes under date of Nov. 22, 1927, in a letter to the author: "* * * this summer I took nine specimens of *Sorex gaspensis* in the Gaspé Peninsula, south of Shickshock Range. I found this shrew to be comparatively common in the Cascapedia Valley. The specimens average slightly larger than the three that I took at Mount Albert; hind foot in every case measuring 12.5 mm. One specimen had a total length of 115 mm., and 55 mm. for length of tail. They seem to have the same habits as the water shrew [i. e., *Sorex palustris gloveralleni*]."

TABLE 7.—*Cranial measurements of adult specimens of* Sorex dispar *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. dispar:										
New York—										
Beedes	[1]1384	♂	18.2	7.0	8.1	3.5	-----	6.1	Unworn	Type specimen.
Hunter Mountain.	83159	♀	17.6	6.6	8.0	3.3	4.2	6.1	Slight	
Do	83160	♀	17.9	6.8	8.1	3.4	4.3	6.1	do	
Do	83161	♂	18.0	6.9	8.0	3.3	4.2	6.2	do	
Do	83162	♂	17.3	6.6	7.9	3.3	4.2	6.1	do	
S. gaspensis:										
Quebec—Mount Albert.	[2]64189	♂	16.1	6.5	7.3	3.2	4.0	5.5	-----	Type locality.
Do	[2]64190	♂	16.3	6.4	7.4	3.0	-----	5.6	-----	Type specimen.
Do	[2]64191	♀	15.8	6.4	7.9	3.0	3.7	5.6	-----	Type locality.

[1] C. F. Batchelder, coll., Cambridge, Mass. [2] Amer. Mus. Nat. Hist.

SOREX TROWBRIDGII GROUP

The *trowbridgii* group includes a single species—*Sorex trowbridgii*. All necessary group comparisons are made under the species.

SOREX TROWBRIDGII BAIRD

[Synonymy under subspecies]

Geographic range.—Extreme southwestern British Columbia, western Washington and Oregon, extreme northern California, western California south to San Raphael Mountains, and eastern California south to Kaweah River; chiefly in Transition Zone. (Fig. 10.)

Diagnostic characters.—Size medium; tail moderately long, sharply bicolor, dark above, nearly white (or pale ochraceous-buff) below; underparts of body scarcely, if any, paler than back. Skull medium in size, moderately depressed, the third unicuspid smaller than fourth, ridge extending from apex of unicuspid toward interior edge of cingulum but slightly pigmented and rarely pigmented to cingulum, separated from cingulum by antero-posterior groove, and never ending in distinct cusplet. Compared with *S. obscurus*, the color of *S. trowbridgii* and subspecies is more sooty, and it differs from any of the *obscurus* group in the relatively narrower teeth, and in that the internal ridge from the apex of the unicuspid is different. Compared with any of the *ornatus* group, *S. trowbridgii* is larger, with distinctly larger skull, higher brain case, broader cranium, broader mesopterygoid space, and longer tooth row.

Subspecies and geographic variation.—The species *trowbridgii* is divided into four subspecies: *trowbridgii*, *humboldtensis*, *montereyensis*, and *mariposae*. Beginning at the northern edge of the range of the species (subspecies *trowbridgii*) and passing toward the south through the region inhabited by *humboldtensis* to that occupied by *montereyensis*, there is a gradually intensifying of the reddish element in the color and a shortening of the tail, particularly south of the type region of *humboldtensis*, and a broadening of the palate and rostrum, which is correlated with an increase in size of the molariform teeth. Toward the east and northeast of *montereyensis* the color of the animal becomes paler, recognized in the subspecies *mariposae*.

Time of molting.—The spring molt usually occurs during June or late in May but may start as early as the last of April. Thus 7 specimens collected at Chehalis, Wash., April 26 to April 30, 1918, are all in more or less worn winter pelage, while 8, collected April 30, show the beginning of the molt on the back. Two males from Neah Bay, Wash., have the molt barely started May 14 and 23, while 1 from Sumas, British Columbia, is considerably more advanced May 26. Three individuals from near Inverness, Calif., have the molt well

started May 27, and June 5 and 8, while 1 from near Cazadero, the same State, is in similar condition June 22. Specimens from Oregon show molt as follows: Swan Lake, June 13; Eugene, 2 females, June 18; Yaquina Bay, June 19; Vida, June 25; and Reston, July 7. Specimens showing late molt are 1 from Prattville, Calif., molt nearly completed, July 24; 1 from East Fork Kaweah River, Calif., complete except for posterior half of back, July 28; and 1 from Canyon Creek, Calif., which still shows barely a trace of the winter fur on the rump, August 11.

The fall molt in *S. trowbridgii* is usually completed by the first or second week of November and frequently by late in October. In rare instances it may begin as early as late in July, as in a male and female from Aptos, Calif., collected, respectively, on July 23 and 20, 1909, in each of which the fresh winter pelage is beginning to appear on the rump. Other evidence of early fall molt is found in 2 males from the south base of Santa Lucia Peak, Calif., August 26, 1902, and another from San Rafael Mountains, Calif., August 30, 1903. The majority of fall specimens in actual process of molt appear to have been collected during October and are represented by specimens from Lakeview, Oreg., October 2; Verdi, Nev., October 15 and 16; and from the following localities in California: Monterey, October 6; Pacheco Peak, October 17 and 18; Orick, October 20 and 21; Michigan Bluff, October 28. Five specimens from Point Reyes, Calif., collected November 3 to 5, are all in complete winter fur except 1 that still shows a trace of the summer fur on the head, and 2 females from Briceland are still in process of molting November 11. Only 3 specimens of the subspecies *trowbridgii* that show molt are available, all of which have the molt well advanced under the old fur; they were collected at the following localities in Washington; Mount Rainier, September 18; Lake Quinault, September 27; and Mount Stewart, October 2.

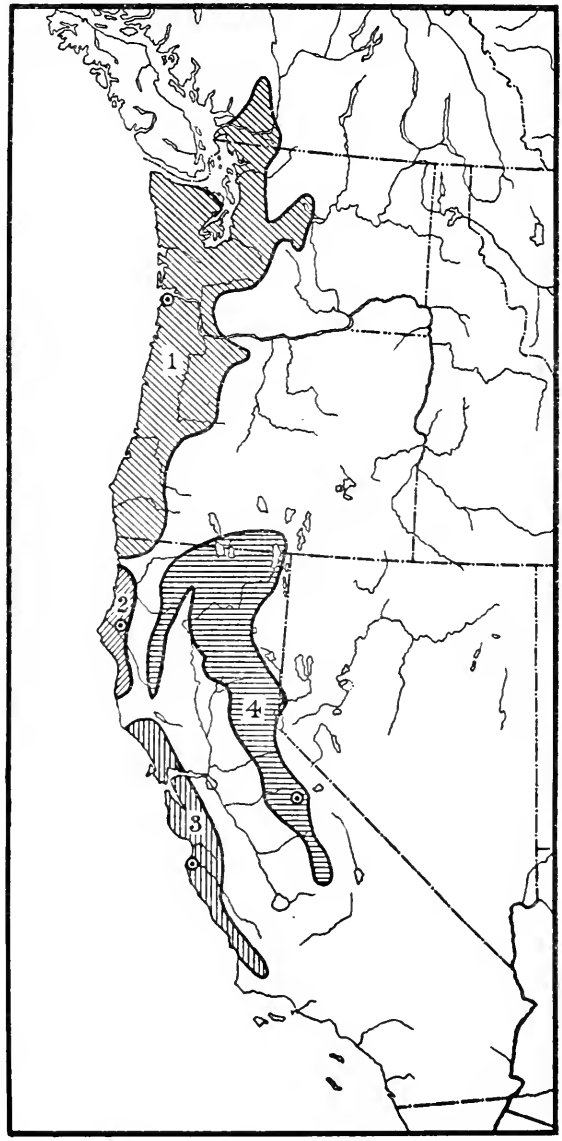

FIG. 10.—Geographic range of subspecies of *Sorex trowbridgii*

1. *S. t. trowbridgii.*
2. *S. t. humboldtensis.*
3. *S. t. montereyensis.*
4. *S. t. mariposae.*

Remarks.—The species *trowbridgii* forms a well-differentiated group separated from others by distinct dental characters in the unicuspidate teeth. Its distribution is limited to a comparatively short range from southwestern British Columbia south over the northern two-thirds of California, where it is confined largely to the Transition Zone. The species appears to be less confined to marshes and damp habitats than some others and is frequently found in dry woods.

SOREX TROWBRIDGII TROWBRIDGII Baird

TROWBRIDGE SHREW

(Pls. 2, t; 5, c; 6, f; 8, d; 11, h; 12, i)

Sorex trowbridgii Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 13, 1857.
Sorex trowbridgei True, Proc. U. S. Nat. Mus. 7: 606, 1885.
Sorex trowbridgii trowbridgii Jackson, Journ. Washington Acad. Sci. 12: 264, June 4, 1922.

Type specimen.—Cotypes No. $\frac{8\,1\,3}{3\,0\,8\,8}$, U. S. Nat. Mus.; sex unknown, adult (teeth moderately worn), poorly made skin and skull (cranium broken and right mandible missing); received from W. P. Trowbridge, United States Army; skin catalogued July, 1855, skull January, 1857. This (No. $\frac{8\,1\,3}{3\,0\,8\,8}$) is the only specimen of which Baird gives skull measurements in the original description. It is hereby selected as the lectotype of *Sorex trowbridgii*. No. 967, U. S. Nat. Mus., sex unknown, poorly made skin without skull[20]; collected June 10, 1855, by James Wayne, received from W. P. Trowbridge, United States Army, and entered in the museum catalogue November, 1855.

Type locality.—Astoria, mouth of Columbia River, Clatsop County, Oreg.

Geographic range.—Extreme southwestern British Columbia, western Washington and Oregon, and extreme northwestern California (south to mouth of Klamath River). (Fig. 10.)

Diagnostic characters.—Color rather dark and grayish; darker and more grayish than *S. t. montereyensis* or *S. t. mariposae*, with relatively longer tail. Skull comparatively narrow, with noticeably narrow rostrum and weak dentition. About the color of *S. t. humboldtensis*, ratio of total length to length of tail vertebrae about the same, averaging a bit smaller. Rostrum and dentition weaker than in *humboldtensis*.

Color.—Winter pelage: Upper parts deep mouse gray to almost dark mouse gray, slightly, if at all, tending toward brownish; underparts scarcely paler than upper parts, mouse gray to deep mouse gray, sometimes very slightly tinged with drabish; tail sharply bicolor, fuscous, to fuscous-black or chaetura black above, whitish below, sometimes near cartridge buff or light buff, to tip. *Summer pelage:* A trifle more brownish and possibly paler than in winter. Upper parts between deep mouse gray and chaetura drab to between mouse grap and hair brown; underparts essentially like back, scarcely if any paler; tail about as in winter.

Skull.—Comparatively narrow, particularly in rostral region; frontal region arising rather abruptly to moderately elevated brain case; dentition weak, particularly unicuspids and first upper molariform tooth. Rostrum narrower and dentition weaker than in any other form of *S. trowbridgii*.

Measurements.—Two adult females from type locality: Total length, 115, 130; tail vertebrae, 56, 59; hind foot, 13, 14. Average of 4 adults females from

[20] The skull has been removed from the skin, but is missing. It has not been entered in the museum catalogue, and Baird (1857) makes no mention of it.

Vida, Oreg.: Total length, 117 (113–120); tail vertebrae, 54.3 (52–57); hind foot, 13.5 (13–14). Average of 3 adult males from Sumas, British Columbia: Total length, 114.7 (112–117); tail vertebrae, 55.7 (55–57); hind foot, 13.8 (13.5–14). *Skull:* Lectotype (adult, sex unknown; teeth moderately worn): Condylobasal length, 17.5±; palatal length, 6.8; cranial breadth 8.6±; interorbital breadth, 3.8; maxillary breadth, 5.0; maxillary tooth row, 6.5. Two skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 17.6, 17.6; palatal length, 6.9, 6.9; cranial breadth, 8.6, 8.9; interorbital breadth, 3.8, 3.8; maxillary breadth, 4.9, 5.0; maxillary tooth row, 6.4, 6.6. Average of 4 skulls of adult females (teeth slightly worn) from Vida, Oreg.: Condylobasal length, 17.3 (17.1–17.5); palatal length, 6.8 (6.7–6.9); cranial breadth, 8.6 (8.3–8.9); interorbital breadth, 3.8 (3.6–3.9); maxillary breadth, 4.9 (4.8–5.0); maxillary tooth row, 6.4 (6.3–6.5). Average of 3 skulls of adult males (teeth slightly worn) from Sumas, British Columbia: Condylobasal length, 17.5 (17.4–17.6); palatal length, 6.9 (6.8–7.0); cranial breadth, 8.6 (8.5–8.8); interorbital breadth, 3.9 (3.8–4.0); maxillary breadth, 5.0 (4.9–5.0); maxillary tooth row, 6.5 (6.4–6.6).

Remarks.—Judging from the notes of various collectors of *S. t. trowbridgii*, the form is apparently more plentiful in log-strewn forests than in marshes and habitats favorable to certain other shrews, and although confined within a geographic range covered by what is generally known as the humid northwest coast region of the United States, the little mammal is as apt to be found on the drier forested hills as on the moist lowlands. Wherever found the form is easily identified, as shrews go, by the characters previously given, the long, sharply bicolor tail together with the size of the animal and the dark underparts of its body nearly concolor with its back being particularly good recognition marks.

Direct intergradation with *S. t. humboldtensis* is indicated in specimens of *S. t. trowbridgii* from Requa and Crescent City, Calif. Also one of the four skulls from Prospect, Oreg., shows a noticeable approach toward *humboldtensis* in breadth of rostrum and size of molars, but the three others are like those of typical *trowbridgii*. Specimens from Siskiyou, Oreg., and Stud Horse Canyon, in the Siskiyou Mountains, and Preston Peak, Calif., shows a tendency toward *S. t. mariposae*. A single specimen from Stehekin, at the head of Lake Chelan, Wash., appears a shade paler than average specimens of *S. t. trowbridgii*.

Specimens examined.—Total number, 219, as follows:

British Columbia: Cascade Mountains (altitude 1,000 feet), 1; Douglas, 1[21]; Hope, 4[22]; Second Summit (altitude 6,000 feet, Skagit River), 1[21]; Sumas, 36.[23]

California: Crescent City, 5[24]; Klamath River (Happy Camp), 1; Preston Peak (altitude 5,500 feet), 1; Requa, 1[25]; Siskiyou Mountains (altitude 6,500 feet, Stud Horse Canyon), 2.

Oregon: Astoria (type locality), 6; Blaine, 3[26]; Blue River, 1; Drew, 1; Empire, 1; Eugene, 2; Fish Hatchery (2 miles west of Vida), 2; Gold Beach, 4[25]; Marshfield, 1; Mercer, 1[27]; Netarts, 6[28]; Netarts Bay, 2[27]; Parkdale (2 miles west, altitude 1,500 feet), 3; Philomath (5 miles southwest), 4; Portland, 1; Prospect, 4[28]; Prospect (Rogue River), 1[28]; Reston, 1; Siskiyou, 3; Three Sisters (Alder Springs, altitude 4,300 feet), 1; Three Sisters (north slope, altitude 6,000 feet), 2; Vida, 9; Yaquina Bay, 2.

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[21] Nat. Mus. Canada.
[22] Mus. Comp. Zool.
[23] Acad. Nat. Sci. Philadelphia, 9; Field Mus. Nat. Hist., 2.
[24] D. R. Dickey coll., Pasadena, Calif., 1.
[25] Field Mus. Nat. Hist.
[26] D. R. Dickey coll., 1; Univ. Mich., 2.
[27] S. G. Jewett coll., Portland, Oreg.
[28] D. R. Dickey coll.

Washington: Aberdeen, 2; Ashford (Nisqually Valley), 1; Blaine, 2; Blewett Pass (2 miles south, altitude 3,000 feet, Kittitas County), 1; Blewett Pass (altitude 5,000 feet, Chelan County), 1[28]; Brookfield, 1; Cathlamet, 1; Cedarville, 1; Chehalis, 5; Chehalis (8 miles west), 3; Darrington (altitude 600 feet), 1; Destruction Island, 1; Duckabush, 1; Elwha, 1[29]; Elwha (altitude 425 feet), 2; Everett, 2[29]; Everett (4 miles south), 1; Glacier (altitude 900 feet), 1; Harstine Island, Mason County, 1; Hoodsport, 2; Index, 2; Index (north fork Skykomish River), 1[29]; Kapowsin, 1; Kirkland, 1[25]; Kirkland (3 miles east), 4; Lake Cushman, 1[30]; Lake Quinault, 1; Lake Whatcom, 1; Longmire (Mount Rainier, altitude 3,000 feet), 3[28]; Mount Rainier (Spray Park), 1[29]; Mount Rainier (Ohanapecosh Springs, altitude 2,000 feet), 4; Mount Rainier (Mesler's ranch, 1 mile west Rainier Park, altitude 2,000 feet), 1; Mount Rainier (Tahoma Creek, altitude 2,500 feet), 1: Mount Stewart (6 miles south, north fork Teanaway River, altitude 3,500 feet), 2; Mount Vernon, 12; Neah Bay, 8; North Bend (altitude 600 feet), 1; Olympic Mountains (3 miles southeast of Mount Elinor), 3; Point Defiance Park, Tacoma, 2[28]; Potlatch, 4[28]; Puget Sound, 2; Puyallup, 5[31]; Rockport (altitude 300 feet), 2; Seattle, 2[32]; Stehekin (head of Lake Chelan, altitude 1,079 feet), 1; Steilacoom, 3; Tacoma (5 miles east), 1[28]; Tacoma (6 miles south), 1; Tenino, 2; Tokeland (Shoalwater Bay), 1.

SOREX TROWBRIDGII HUMBOLDTENSIS Jackson

Humboldt Bay Shrew

Sorex trowbridgii humboldtensis Jackson, Journ. Washington Acad. Sci. 12: 264, June 4, 1922.

Type specimen.—No. 97271, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected June 11, 1899, by Walter K. Fisher. Original number, 914.

Type locality.—Carsons Camp, Mad River, Humboldt Bay, Humboldt County, Calif.

Geographic range.—Coastal region of northern California from mouth of Klamath River south to Point Arena. (Fig. 10.)

Diagnostic characters.—In general intermediate between *Sorex t. trowbridgii* and *S. t. montereyensis*. About the color of *S. t. trowbridgii*, tending to be larger, with tail proportionately to body length about as in the subspecies *trowbridgii*. Skull larger, and broader in all dimensions than that of *S. t. trowbridgii*, with heavier dentition. Averaging a shade darker and less brownish than *montereyensis*, with relatively and actually longer tail; skull with narrower rostrum and somewhat weaker dentition than in *montereyensis*.

Color.—*Winter pelage:* Essentially like that of *S. t. trowbridgii;* possibly averaging a shade darker. *Summer pelage:* Indistinguishable from that of *S. t. trowbridgii*.

Skull.—Intermediate in most respects between that of *S. t. trowbridgii* and that of *S. t. montereyensis*. Larger and broader than that of *S. t. trowbridgii*, with noticeably heavier rostrum and dentition. Rostrum narrower and dentition weaker than in *S. t. mariposae* or *montereyensis*.

Measurements.—Type specimen (adult male): Total length, 132; tail vertebrae, 62; hind foot, 14. Average of three adult males from Arcata, Humboldt County, Calif.: Total length, 131 (129–133); tail vertebrae, 60.3 (60–61); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.8; palatal length, 7.2; cranial breadth, 8.9; interorbital breadth, 4.1; maxillary breadth, 5.4; maxillary tooth row, 6.7. Average of three skulls of adult males (teeth moderately worn) from Arcata, Humboldt County, Calif.: Condylobasal length, 18.2 (18.2–18.3); palatal length, 7.2

[25] Field Mus. Nat. Hist.
[28] D. R. Dickey coll.
[29] State Coll. of Wash.
[30] Univ. Mich.
[31] D. R. Dickey coll., 1; G. G. Cantwell coll., Palms, Calif., 1.
[32] Field Mus. Nat. Hist., 1.

(7.1–7.2); cranial breadth, 9.0 (8.9–9.1); interorbital breadth, 4.0 (3.9–4.1); maxillary breadth, 5.3 (5.3–5.3); maxillary tooth row, 6.9 (6.9–6.9).

Remarks.—Although in reality intermediate between *S. t. trowbridgii* and *S. t. montereyensis*, the subspecies *humboldtensis* in its typical form averages larger than either. Externally it is more like *S. t. trowbridgii;* cranially it is apparently rather nearer *montereyensis.* Some of the specimens from near Mendocino City, Calif., here referred to *humboldtensis*, could be referred to *montereyensis* with almost equal propriety in so far as external characters are concerned; cranially, however, they are much nearer *humboldtensis.* Specimens from 7 miles north of Hardy, Mendocino County, Calif., have shorter tails than typical representatives of *humboldtensis*, but in color and cranial characters they are similar to this subspecies.

Specimens examined.—Total number, 80, as follows:

California: Alton Junction, 2; Arcata, 5[33]; Briceland, 2; Carlotta, 8[34]; Cuddeback, 1[35]; Dyerville, 2[34]; Dyerville (5 miles south), 3; Eureka, 11[36]; Fair Oaks, 3[37]; Hoopa Valley, 7; Mad River, Humboldt Bay (type locality), 10; Mendocino, 11[38]; Orick, 5[39]; Sherwood, 1[39]; Trinidad, 9.[39]

SOREX TROWBRIDGII MONTEREYENSIS Merriam

Monterey Shrew

(Pl. 2, u)

Sorex montereyensis Merriam, North Amer. Fauna No. 10, p. 79, December 31, 1895.

Sorex montereyensis montereyensis Grinnell, Univ. California Publ. Zool. 10: 188, March 20, 1913.

Sorex t[rowbridgii] montereyensis Jackson, Journ. Washington Acad. Sci. 12: 264, June 4, 1922.

Type specimen.—No. $\frac{32000}{44810}$, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull (basi-occipital region slightly broken); collected October 1, 1891, by Vernon Bailey.

Type locality.—Monterey, Monterey County, Calif.

Geographic range.—Coast region of California from Point Arena south to San Raphael Mountains. (Fig. 10.)

Diagnostic characters.—Tending to be more brownish than either *Sorex t. trowbridgii* or *S. t. humboldtensis*, with relatively and actually shorter tail; skull broader and heavier than that of either subspecies *trowbridgii* or *humboldtensis*, the postorbito-frontal region less constricted, dentition heavier. Slightly darker and more brownish than *S. t. mariposae*, with apparently average smaller skull with narrower cranium.

Color.—More brownish than *S. t. trowbridgii*, particularly in winter. *Winter pelage:* Upper parts chaetura drab or between chaetura drab and fuscous; underparts but slightly paler than upper parts, hair-brown or slightly paler; tail distinctly bicolor, less sharply so than in *S. t. trowbridgii*, above fuscous to mummy brown, below near pale orchraceous-buff nearly to tip. *Summer pelage:* Scarcely paler or more brownish than in winter. Upper parts fuscous, sometimes tending toward chaetura drab or olive-brown; underparts near hair brown; tail as in winter.

Skull.—Moderately broad and heavy; broader throughout and a trifle more flattened cranially than that of *S. t. trowbridgii* or *S. t. humboldtensis*, with

[33] Mus. Vert. Zool., 3.
[34] D. R. Dickey coll., Pasadena, Calif.
[35] Mus. Vert. Zool.
[36] Field Mus. Nat. Hist., 4; Mus. Vert. Zool., 6.
[37] Mus. Comp. Zool., 1; Mus. Vert. Zool., 2.
[38] Field Mus. Nat. Hist., 2; Mus. Vert. Zool., 6.
[39] D. R. Dickey coll., 1.

rostrum averaging distinctly broader and dentition heavier. Similar to that of *S. t. mariposae*, possibly averaging smaller with narrower cranium.

Measurements.—Type specimen (adult male): Total length, 120; tail vertabrae, 54; hind foot, 15. Average of five adult females from Monterey and Pacific Grove, Calif.: Total length, 123 (114–131); tail vertebrae, 51.8 (48–56); hind foot, 14.3 (13.5–15). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 18.0; palatal length, 7.3; cranial breadth, 9.1; interorbital breadth, 4.2; maxillary breadth, 5.6; maxillary tooth row, 7.0. Average of five skulls of adult females (teeth slightly worn) from Monterey and Pacific Grove, Calif.: Condylobasal length, 18.2 (18.0–18.4); palatal length, 7.3 (7.2–7.4); cranial breadth, 9.0 (8.7–9.2); interorbital breadth, 4.2 (4.0–4.3); maxillary breadth, 5.6 (5.4–5.7); maxillary tooth row, 6.9 (6.8–7.0).

Remarks.—Although for many years treated as specifically distinct from *S. trowbridgii*, the form *S. t. montereyensis* is clearly subspecifically connected with it through *humboldtensis*. Specimens of *montereyensis* from Nicasio, Point Reyes, and other points in Marin County, Calif., show in some respects an approach toward *humboldtensis* in that they seem to average somewhat darker than typical *montereyensis*, and a few of the skulls show narrower rostra; their dentition, however, is heavy, as in true *montereyensis*, in nearly every individual. Summer specimens from Mount Saint Helena, Calif., are inclined toward *S. t. mariposae* in color.

Specimens examined.—Total number, 284, as follows:

California: Aptos (5 miles south), 5; Bear Basin (head of Carmel River), 3; Bear Valley (head of Carmel River), 1; Bells Station, Santa Clara County, 1; Berkeley, 3[40]; Berkeley (Strawberry Creek), 1[41]; Berkeley (first canyon north of Strawberry Creek), 1[41]; Boulder Creek, 3; Cazadero (7 miles west, altitude 900 feet), 3[42]; Cone Peak, Monterey County, 1; Divide (altitude 800 feet, between Mill Valley and Muir Woods), Marin County, 1[42]; Freestone (altitude 300 feet), 1[42]; Freemont Peak, Gabilan Range, 2; The Geysers, Sonoma County, 1; Gilroy (near), 3[43]; Gualala, 5[42]; Gualala (Sonoma County side of Gualala River), 3[42]; Hardy (7 miles north, Mendocino County), 4[41]; Hayward, 1[42]; Inverness, 37[44]; Lagunitas, 4; La Honda, 2[45]; La Honda, San Mateo County, 13[46]; Marin County, 2; Mendocino, 4[42]; Menlo Park, 1[42]; Milpitas Ranch (south base Santa Lucia Peak), 2; Monterey (type locality), 16[47]; Morro, 2; Mount Hamilton, 1[45]; Mount St. Helena, 2; Mount Tamalpais, 1; Mount Tamalpais (altitude 2,000 feet), 1; Mount Veeder, 16; Nicasio, 68[48]; Oakland, 6[49]; Olema, 1; Pacheco Peak (summit), 3; Pacific Grove, 2; Palo Alto, 1[43]; Petaluma, 3[45]; Pine Valley (10 miles northwest Tassajara Springs), 1; Point Pinos (Pacific Grove P. O.), Monterey County, 1; Point Reyes, 24[50]; Portolo, San Mateo County, 17[51]; San Luis Obispo, 1; San Rafael Mountains (Peach Tree River), Santa Barbara County, 1; Stevens Creek, Santa Clara County, 2[42]; Tassajara Creek (6 miles below Tassajara Springs), 3; Telegraph Canyon (near Berkeley), 1[42]; Watsonville (10 miles north, altitude 2,000 feet), Santa Cruz County, 1[52]; Woodside (Santa Cruz Mountains, San Mateo County), 1.

SOREX TROWBRIDGII MARIPOSAE Grinnell

Yosemite Shrew

Sorex montereyensis mariposae Grinnell, Univ. Calif. Publ. Zool. 10:189, March 20, 1913.

Sorex trowbridgii mariposae Grinnell, Univ. Calif. Publ. Zool. 21:314, January 27, 1923.

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[40] Acad. Nat. Sci., Philadelphia.
[41] D. R. Dickey coll., Pasadena, Calif.
[42] Mus. Vert. Zool.
[43] Mus. Comp. Zool.
[44] D. R. Dickey coll., 6; Mus. Vert. Zool., 31.
[45] Field Mus. Nat. Hist.
[46] Amer. Mus. Nat. Hist.
[47] D. R. Dickey coll., 6; Mus. Vert. Zool., 6.
[48] Mus. Vert. Zool., 1; Mus. Comp. Zool., 4; Field Mus. Nat. Hist., 10; Amer. Mus. Nat. Hist., 13.
[49] Public Mus. Milwaukee.
[50] Field Mus. Nat. Hist., 5; Mus. Comp. Zool., 3; Mus. Vert. Zool., 3.
[51] D. R. Dickey coll., 2; Field Mus. Nat. Hist., 11; Mus. Comp. Zool., 4.
[52] Univ. of Mich.

Type specimen.—No. 12979, Mus. Vert. Zool., Univ. California; ♀ adult (teeth moderately worn), skin and skull; collected May 27, 1911, by J. and H. W. Grinnell.

Type locality.—Yosemite Valley, 4,000 feet altitude, Mariposa County, Calif.

Geographic range.—Extreme south-central Oregon, northern California south through the inner coast range, to about 39° 30′ N., and southeast of Sacramento Valley to Kaweah River; also extreme west-central Nevada near California line. (Fig. 10.)

Diagnostic characters.—Similar to *Sorex t. montereyensis* but slightly paler and more drabish (less brownish) in color, with apparently average larger skull with broader brain case.

Color.—Winter pelage: Upper parts between hair brown and mouse gray; underparts smoke gray tinged with light drab or drab gray, tail bicolor, hair brown to drab above, below pale ochraceous-buff to nearly pale pinkish cinnamon. *Summer pelage:* Upper parts hair brown; underparts light drab or slightly paler, sometimes near drab gray; tail bicolor, hair bown to drab above, near tilleul buff below.

Skull.—Similar to that of *S. t. montereyensis*, possibly averaging larger with broader cranium.

Measurements.—Type specimen (adult female): Total length, 121; tail vertebrae, 51; hind foot, 14. Average of three adult females from altitudes 4,700 feet to 6,400 feet, Yosemite Park, Mariposa County, Calif.: Total length, 117.7 (116–120); tail vertebrae, 50.3 (50–51); hind foot, 14.5 (14–15), *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 18.6; palatal length, 7.7; cranial breadth, 9.3; interorbital breadth, 4.2; maxillary breadth, 5.7; maxillary tooth row, 7.1. Average of three skulls of adult females (teeth slightly worn) from altitudes of 4,700 feet to 6,400 feet, Yosemite Park, Mariposa County, Calif.: Condylobasal length, 18.6 (18.4–18.8); palatal length 7.4 (7.3–7.5); cranial breadth 9.3 (9.2–9.4); interorbital breadth, 4.2 (4.1–4.3); maxillary breadth, 5.6 (5.5–5.7); maxillary tooth row, 7.0 (6.9–7.1).

Remarks.—The Yosemite form of *trowbridgii* closely resembles *S. t. montereyensis*, being but slightly paler and more drabish in color, and with slight cranial differences. It apparently intergrades with both *S. t. humboldtensis* and *montereyensis*. The four specimens from Liarly Ranch, 4 miles south of Mount Sanhedrin, Mendocino County, Calif., are provisionally referred to *S. t. mariposae*. Two of these specimens, collected in August, 1905, are more brownish than typical *mariposae* and in color show an approach toward *montereyensis*, to which they could about as well be referred; the other two, collected in August, 1913, are darker and more grayish than typical *mariposae* and in this respect approach *humboldtensis*, but the skulls show no tendency toward that form. A single specimen from South Yolla Bolly Mountain, Calif., is like *mariposae* in color, but cranially shows a distinct similarity to *humboldtensis*. Except that the skulls may run a trifle smaller and the dentition appears weaker, specimens from Swan Lake Valley and Lakeview, Oreg., do not differ from those of average typical *mariposae*.

Specimens examined.—Total number, 77, as follows:

California: American River (Middle Fork), 1; Beswick, 1; Canyon Creek (altitude 4,600 feet), 3; Carberry's Ranch, 1; Castle Lake (altitude 5,434 feet), 1 [53]; Chinquapin (near, altitude 6,200 to 6,400 feet), 3 [53]; Cisco (altitude 6,000 feet), 4 [53]; Downieville, 1; Dutch Flat (altitude 3,400 feet), 1 [53]; Eldorado County, 2; Emerald Bay, 1; Emerald Bay (Lake Tahoe), 1; Fyffe, 2 [54]; Fyffe (altitude 3,600 feet), 1 [53]; Gentrys Big Oak Flat Road (altitude 5,800 feet, Yosemite Park), 1 [53]; Giant Forest, Sequoia National Park, 1; Glen Alpine Springs, 1 [53]; Hayden

[53] Mus. Vert. Zool. [54] Mus. Comp. Zool.

Hill, 1; Indian Canyon (east fork, Mariposa County), 1[53]; Jackson Lake, Siskiyou County, 1[53]; Kaweah River (east fork), 1; Liarly's Ranch (8 miles east of Hearst, Mendocino County), 3[55]; Merced Grove Big Trees, Mariposa County (altitude 5,400 feet), 2[53]; Merced Lake (2 miles east), Yosemite Park, 1[53]; Michigan Bluff, 1; Mount Lassen (south base, Mill Creek, altitude 5,000 feet), 2; Mount Shasta (Mud Creek, timber-line), 1; Mount Shasta (Upper Mud Creek), 4; Mount Tallac, Eldorado County, 3[56]; Myers, Eldorado County, 1[57]; Parker Creek, Warner Mountains, 2[53]; Placerville, 1[53]; Prattville (12 miles northeast), 1; Sequoia National Park (Halsted Meadows), 5; Slipperyford, 1[58]; South Yolla Bolly Mountain, 2[55]; Squaw Creek Valley (Warmcastle Soda Springs), 1; Sweetwater Creek (altitude 3,800 feet, 2 miles east Feliciana Mountain), 2[53]; "The Spring" Yosemite Falls Trail, Yosemite Valley (altitude 4,700 feet), 2[53]; Tower House, Shasta County, 2[53]; Tower House (altitude 1,268 feet), Shasta County, 1[53]; Yosemite, 1; Yosemite Valley (altitude 4,000 feet, type locality), 3.[53]

Nevada: Verdi, 2.

Oregon: Lakeview, 1; Swan Lake Valley, 2.

TABLE 8.—*Cranial measurements of adult specimens of* Sorex trowbridgii *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. t. trowbridgii:										
Oregon—										
Astoria	3088	------	17.5±	6.8	8.6±	3.8	5.0	6.5	Moderate	Lectotype.
Do	24315	♀	17.6	6.9	8.5	3.8	4.9	6.4	Slight	Type locality.
Do	89021	♀	17.6	6.9	8.9	3.8	5.0	6.6	do	Do.
Vida	204440	♀	17.5	6.9	8.9	3.6	4.8	6.4	do	
Do	204473	♀	17.3	6.9	8.4	3.8	5.0	6.5	do	
Do	204475	♀	17.1	6.7	8.8	3.9	5.0	6.3	do	
Do	204476	♀	17.1	6.8	8.3	3.8	4.9	6.5	do	
British Columbia—										
Sumas	62999	♂	17.5	6.9	8.6	3.8	4.9	6.5	do	
Do	99748	♂	17.5	7.0	8.5	4.0	5.0	6.6	do	
Do	102688	♂	17.4	6.8	8.8	3.9	5.0	6.4	do	
S. t. humboldtensis:										
California—										
Carsons Camp, Mad River, Humboldt Bay.	97271	♂	17.8	7.2	8.9	4.1	5.4	6.7	do	Type specimen.
Arcata	97251	♂	18.3	7.2	9.1	3.9	5.3	6.9	Moderate	
Do	[1] 11813	♂	18.2	7.2	8.9	4.1	5.3	6.9	do	
Do	[1] 11814	♂	18.2	7.1	9.0	4.0	5.3	6.9	do	
S. t. montereyensis:										
California—										
Monterey	44810	♂	18.0	7.3	9.1	4.2	5.6	7.0	Slight	Do.
Do	44809	♀	18.3	7.3	8.7	4.2	5.5	6.8	do	Type locality.
Do	[1] 3467	♀	18.1	7.4	9.0	4.1	5.6	7.0	do	Do.
Do	[2] C125	♀	18.4	7.3	9.1	4.0	5.4	7.0	do	Do.
Pacific Grove	107920	♀	18.0	7.2	9.2	4.3	5.7	6.9	do	Do.
Do	159943	♀	18.1	7.3	9.0	4.2	5.5	6.8	do	
S. t. mariposae:										
California—										
Yosemite Valley, 4,000 feet.	[1] 12979	♀	18.6	7.7	9.3	4.2	5.7	7.1	Moderate	Type specimen.
Yosemite Valley, 4,700 feet.	[1] 21541	♀	18.8	7.5	9.4	4.2	5.6	7.1	Slight	Essentially type locality.
Merced Grove Big Trees, 5,400 feet.	[1] 22013	♀	18.4	7.4	9.3	4.3	5.7	7.0	do	
Near Chinquapin, 6,400 feet.	[1] 22015	♀	18.5	7.3	9.2	4.1	5.5	6.9	do	

[1] Mus. Vert. Zool. [2] Donald R. Dickey, coll., Pasadena, Calif.

[53] Mus. Vert. Zool. [55] Mus. Vert. Zool., 1. [56] Amer. Mus. Nat. Hist. 1; Mus. Comp. Zool., 2. [57] D. R. Dickey coll., Pasadena, Calif. [58] Acad. Nat. Sci. Philadelphia.

SOREX VAGRANS-OBSCURUS GROUP

The *vagrans-obscurus* group includes five species—*Sorex vagrans*, *S. durangae*, *S. obscurus*, *S. yaquinae*, and *S. pacificus*.

Geographic range.—Western North America from western (Seward Peninsula) and central Alaska, south through British Columbia and Alberta, east to central Montana and Colorado, south to southern California, southern New Mexico, and in the mountains through Arizona to the States of Michoacan, Puebla, and Vera Cruz, Mexico.

Diagnostic characters.—Size variable in the different species, small (*S. vagrans*) to large (*S. pacificus*), skull but moderately flattened, rostrum comparatively short and broad, third unicuspid distinctly smaller than fourth, the ridge extending internally from apex of unicuspid to border of cingulum well developed, usually heavily pigmented, and tending apically to form a distinct cusplet. Compared with the *trowbridgii* group, the teeth are relatively broader, and the internal ridge from the apex of the unicuspid different. Compared with any of the *ornatus* group, the skull is less flattened; the foramen magnum is placed relatively ventrad, encroaching less into supraoccipital and more into basioccipital; metacone of pm^3 comparatively low.

Remarks.—The members of the *vagrans-obscurus* group constitute several forms the exact relationships of which in some cases are complicated and difficult to solve. The relationship between *S. v. monticola* and *S. o. obscurus*, both of which occur in the Rocky Mountains, is particularly perplexing. Actual intergradation between these two apparently does not exist, although certain specimens are difficult to identify. As one passes eastward from the coast region of Washington there is noticeable an increase in size, in length of tail, and in size of skull and teeth of *S. vagrans*, which becomes recognizable in the subspecies *monticola*. Exactly the reverse occurs in the representative (*S. o. setosus*) of the species *obscurus* from the coast region eastward to its intergrading form, the subspecies *obscurus*. Intergradation of *S. o. obscurus* with *setosus*, and of *S. v. vagrans* with *monticola* is clearly demonstrated. The result is, that in the coast region of Washington and British Columbia, where representatives of the species *vagrans* and *obscurus* occur, they are contrastedly different, whereas throughout the Rocky Mountains, wherever the two species occur, they can be separated only by most careful study.

SOREX VAGRANS BAIRD

[Synonymy under subspecies]

Geographic range.—Extreme southern British Columbia, western Montana, south to central California, central Nevada, and in the Rocky Mountains through Arizona, the States of Michoacan, Puebla, and Vera Cruz, Mexico. (Fig. 11.)

Diagnostic characters.—Size small, tail comparatively short, hind foot small. The species *vagrans* needs critical comparison only with the species *obscurus* from which it differs not only in size but in cranial and dental characters as follows: Skull smaller, narrower, particularly interorbitally and through rostrum, palate shorter; superior border of foramen magnum tending to be more acute; teeth smaller, the protoconid of m_1 lower than in *Sorex obscurus*, relatively and actually narrower unicuspids, and smaller i^1. Compared with *S. durangae* the skull of *S. vagrans* is decidedly weaker and narrower, with the lachrymal region not swollen (as in *S. durangae*), and the rostrum and dentition distinctly weaker.

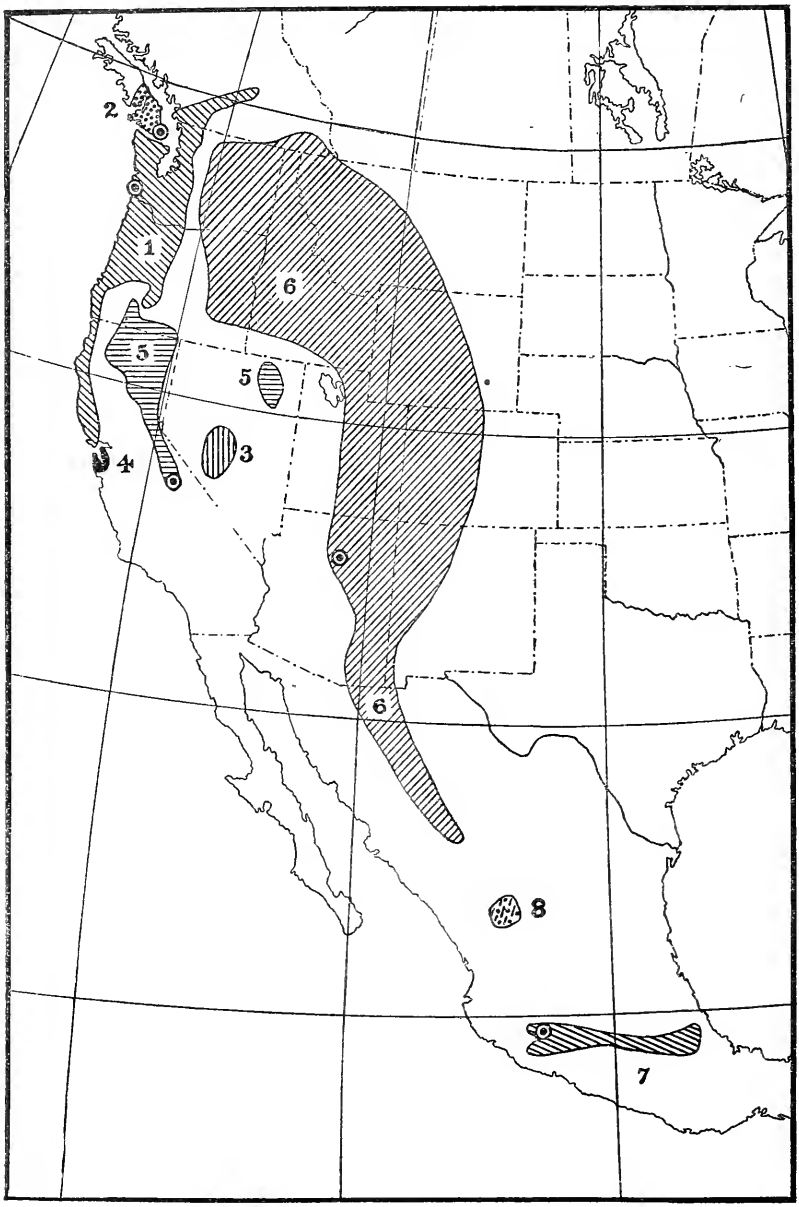

FIG. 11.—Geographic range of subspecies of *Sorex vagrans* and of the species *S. durangae*

1. *S. v. vagrans.*
2. *S. v. vancouverensis.*
3. *S. v. nevadensis.*
4. *S. v. halicoetes.*
5. *S. v. amoenus.*
6. *S. v. monticola.*
7. *S. v. orizabae.*
8. *S. durangae.*

Subspecies and geographic variation.—The species *vagrans* is divided into seven subspecies: *vagrans, vancouverensis, nevadensis, halicoetes, amoenus, monticola,* and *orizabae.* Starting with the typical form in the coast region of Washington, there is a slight darkening of color toward the northward, which on Vancouver Island, British Columbia, is recognizable in the subspecies *vancouverensis.* Southward there is also a tendency for the color to darken as well as a noticeable increase in size, which culminates in the darkest subspecies, *halicoetes.* Toward the southeast from the region of typical *vagrans* there is a slight tendency toward a darker form, the tail shortens a trifle, and the skull becomes somewhat smaller in *amoenus* and in *nevadensis,* which is also small and rather dark with a flatter skull. Eastward from the region of the subspecies *vagrans* there is a slight increase in size, a slight paling, and an increase in tail length recognizable in the form *monticola,* which to the extreme south in Mexico passes into the smaller, slightly darker form *orizabae,* with its comparatively narrow skull.

Time of molting.—The earliest indication of spring molt is in a female *S. v. vagrans* from Duckabush, Wash., January 31, 1919, which shows a darkened condition of the skin over the entire back and flanks, and to a less extent on the ventral parts. Another specimen from the same locality January 26 is in worn winter pelage. A female from Tokeland, Shoalwater Bay, Wash., retains winter pelage May 7, 1918, while another shows indications of beginning molt May 4. A male from Chehalis, Wash., has summer pelage coming in under the winter fur over the entire back, April 29, 1918. One from Kirkland, in the same State, has the mid-back in summer fur, rump in winter pelage, and shoulders and head in process of molt, May 13, 1911. Twenty-nine specimens of *S. v. vagrans* collected at Neah Bay, Wash., the last half of May, 1897, are for the most part in complete summer pelage. A male of *S. v. halicoetes* from Belmont, Calif., has the molt well started over the entire animal March 21, 1908, and another from Elmhurst, Calif., has the molt in about the same condition as the Belmont specimen on April 1, 1908. A female *halicoetes* from Palo Alto, Calif., has the molt barely begun on a small spot in the mid-back May 6. A male *S. v. amoenus* from Donner, Calif., has fresh summer fur on the head, shoulders, anterior back, flanks, and anterior two-thirds of the ventral parts, July 11, 1900, while a female from the same locality has the summer fur just coming in under the winter pelage over the entire back as late as July 17. Of a series of 14 specimens of *S. v. monticola* collected at Wallowa Lake, Oreg., between April 10 and 19, 1919, 7 retain the worn winter pelage, 6 are in summer fur, and 1 is in process of molting, the summer fur appearing under the winter over the entire back on April 10. A specimen from Stevensville, Mont., shows molt March 15, 1910. Specimens of *S. v. orizabae* from the type locality are in winter pelage April 22 to 25, 1893. One from Cofre de Perote, Vera Cruz, shows new fur coming in under the old on May 30.

The winter pelage is usually acquired during October. The earliest indications of fall molt are in a female of *S. v. vagrans* from Trout Lake, Wash., which has winter pelage appearing on the midback, occiput, and ventral parts, the remainder of the animal being in worn summer fur, August 28, 1918. A male collected August 29, 1897, at Soleduc River, altitude 4,000 feet in the Olympic Mountains, Wash., has the entire posterior half of the back, the right flank, nape, and ventral parts in winter pelage, the anterior part of the left side still retaining the summer fur. Other specimens of *S. v. vagrans* in process of fall molt have been collected at Lake Quinault, Wash., September 27, 1921; Steilacoom, Wash., October 5, 1891; Toledo, Wash., November 5, 1918; Tacoma, Wash., December 23, 1918; Yamsay Mountains, Oreg., September 6 and October 14, 1914; Upper Klamath Marsh, Oreg., September 11, 1914; Portland, Oreg., 3 females, October 13, 1914; Empire, Oreg., October 14, 21, and 22, 1909; Drain, Oreg., 3, November 22 and 23, 1894; Crescent City, Calif., three, October 13 and 14, 1905; and Point Reyes, Calif., October 27 and 29, 1904. Of 16 specimens of *S. v. amoenus* from Dana, Calif., collected between September 25 and October 1, 1904, 2 females and 4 males retain full summer fur, September 25 to 29; a female has complete winter fur September 30; and 5 males and 4 females collected between September 25 and October 1 are in various stages of molt, for the most part not far advanced. Specimens of *S. v. monticola* show molting at the following dates: Cornucopia, Oreg., September 3, 1915; Wallowa Lake, Oreg., September 14, 1897; Burns, Oreg., October 5, 6, and 8, 1916; and Anthony, Oreg., October 16, 18, and 28,, 1907. A female of *S. v. orizabae* from the north

slope of Volcan Toluca, D. F., Mexico, has acquired fresh winter pelage on the posterior half of the back, while another collected September 10 at the same locality retains the summer fur.

SOREX VAGRANS VAGRANS Baird

Vagrant Shrew

(Pls. 2, v; 5, d; 6, g; 8, e; 12, j)

Sorex vagrans Baird, Report Pacific R. R. Survey 8: pt. 1, Mammals, p. 15, 1857.
Sorex suckleyi Baird, Report Pacific R. R. Survey 8: pt. 1, Mammals, p. 18, 1857.
Type locality, Steilacoom, Pierce County, Wash.
Sorex vagrans vagrans Miller, U. S. Nat. Mus. Bul. 79, p. 14, December 31, 1912.

Type specimen.—No. 1675, U. S. Nat. Mus.; ♂ adult, alcoholic, entirely devoid of hair, skull not removed; received from J. G. Cooper, and entered in museum catalogue October 23, 1856.

Type locality.—Shoalwater Bay (known also as Willapa Bay), Pacific County, Wash.

Geographic range.—Extreme southwestern mainland of British Columbia, western Washington, western Oregon, and northwestern California south to San Francisco Bay. (Fig. 11.)

Diagnostic characters.—Size small, tail medium in length (about two-thirds as long as head and body), feet small. Similar to *Sorex v. amoenus*, but averaging paler and rather more brownish in color, with slightly longer tail. More blackish above in winter pelage and paler and less brownish beneath in all pelages than *S. v. vancouverensis*. Upper parts in winter pelage similar to those of *S. v. halicoetes*, the underparts decidedly paler and less brownish; skull weaker than that of *halicoetes*. A shade darker and more reddish than *S. v. monticola*, with smaller rostrum and weaker dentition.

Color.—Winter pelage: Upper parts usually near chaetura black, frequently tending toward fuscous-black, sometimes more or less indistinctly and finely flecked with whitish hair tips, occasionally showing greenish reflections in certain lights; ears more reddish than general tone of upper parts; sides and flanks usually paler than upper parts; chaetura drab to hair brown; underparts pale smoke gray or occasionally almost smoke gray, usually tinged with pale pinkish buff; tail scarcely bicolor, mummy brown above, somewhat paler below, particularly basally. *Summer pelage:* Paler and more reddish than in winter. Upper parts usually near mummy brown, sometimes tending toward sepia, rarely almost fuscous; sides and flanks sometimes almost concolor with back, usually slightly paler, about between Saccardo's umber and olive-brown; underparts smoke gray mixed and washed with between wood brown and avellaneous; tail about as in winter.

Skull.—Small, with rather high brain case, moderately short mesopterygoid space, short and narrow rostrum, and weak dentition. Rostrum weaker and more attenuate than that of *S. v. halicoetes*, dentition weaker, and length of maxillary tooth row less. Skull slightly smaller than that of *S. v. monticola*, with somewhat weaker rostrum and smaller molariform teeth. Skull less flattened than that of *S. v. nevadensis*, with rostrum relatively broader and less attenuate.

Measurements.—Average of four adult males from Aberdeen, Wash.: Total length, 103.8 (102–105); tail vertebrae, 42.5 (42–44); hind foot, 12 (12–12). *Skull:* Average of four skulls of adult males (teeth slightly worn) from Aberdeen, Wash.: Condylobasal length, 16.6 (16.4–16.8); palatal length, 6.5 (6.4–6.6); cranial breadth, 8.2 (7.9–8.3); interorbital breadth, 3.3 (3.2–3.4); maxillary breadth, 4.6 (4.5–4.8); maxillary tooth row, 5.6 (5.5–5.7).

Remarks.—This is the common small shrew of the lower altitudes of the coast region of Washington, Oregon, and northern California, where it is confined principally to the Transition Zone. The subspecies *vagrans* clearly shows intergradation with *S. v. monticola*, *S. v. amoenus*, and *S. v. halicoetes*. Specimens from Lapine and

Paulina Lake, Oreg., particularly, show an approach toward *amoenus*, one specimen (No. 204920, U. S. Nat. Mus., Biol. Surv. coll.) from the latter locality being practically indistinguishable from typical *amoenus*, but on the whole the series seems to be nearer *S. v. vagrans*. Certain specimens from certain places (Crescent City, Eureka, Arcata, Point Reyes) of the coast region of California are a trifle larger than typical specimens of *S. v. vagrans* and have somewhat larger skulls with heavier rostra. Skulls of this character, however, are not dominant among these specimens and probably indicate an approach toward *halicoetes*.

A specimen (No. 234302, U. S. Nat. Mus., Biol. Surv. coll.) collected by George G. Cantwell at Richardson, Lopez Island, San Juan County, Wash., February 21, 1920, is especially interesting and suggestive. On the label to this specimen Cantwell has written "Habitat, Salt Marsh"; on the labels of 5 other specimens, collected the previous day at the same locality, there is no mention of the habitat and they may or may not have been trapped in a salt marsh, but probably not. The skulls of all 6 specimens are essentially identical and agree with those of typical *Sorex v. vagrans*. The color of the "salt marsh" specimen, however, is decidedly darker than the other 5, particularly ventrally, and is indistinguishable in this respect, from specimens of typical *S. v. halicoetes*. One is surely warranted in suspecting that salt water may affect the color of the hair under certain conditions. Here lies an interesting problem for investigation.

Specimens examined.—Total number, 632, as follows:

British Columbia: Agassiz, 1[59]; Burrard Inlet, 1[59]; Cape Flattery, 1; Hope, 1[60]; Hope (Lake House), 8[60]; Hope (Roab's Ranch), 2[60]; Langley, 1; Lulu Island, 6[59]; Mount Baker Range, 1[59]; Nahun Plateau, 2[61]; Okanagan, 9[62]; Port Moody, 16; Saturna Island, 10[60]; Sumas, 39[63]; Westminster Junction, 4.[64]

California: Arcata, 2[63]; Carlotta, 1[66]; Carlotta (at mouth Eel River), 2[66]; Crescent City, 20; Cuddeback, 1[65]; Eureka, 3[67]; Eureka (5 miles north), 2[66]; Eureka (5 miles northeast), 1[66]; Ferndale, 5[65]; Humboldt Bay, 10; Inverness, 12[65]; Inverness (8 miles west), 1[65]; Loleta, 1[66]; Novato Point, Marin County, 1[65]; Petaluma, 3; Point Arena, 1[65]; Smith River, Del Norte County, 2; Point Reyes, 8.[68]

Oregon: Albany, 4[66]; Beaverton, 1; Blaine, 4[69]; Cascade Mountains, 1; Corvallis, 2; Deschutes River (east fork), 2; Deschutes River (Farwell Bend), 1; Drain, 5; Empire, 5; Eugene, 2; Florence, 1; Gardiner, 2[70]; Gold Beach, 4; Hillsboro (5 miles southeast), 1; Lapine, 8; Looking Glass, Douglas County, 1; McKenzie Bridge (10 miles south. O'Leary Mountain, altitude 5,000 feet), 1; McKenzie Bridge (10 miles east, Lost Creek), 2; Mapleton, 1; Marshfield, 10[71]; Mercer, 1[72]; Mount Hood (north slope, altitude 2,800 feet), 2; Mount Hood (west slope, near timberline), 1; Mount Jefferson (west base, Permilia Lake), 2; Oregon City, 3[73]; Parkdale (2 miles west, altitude 1,500 feet), 1; Paulina Lake, 7; Philomath (5 miles southwest), 5; Portland, 22[74]; Portland (Westmoreland addition), 14[76]; Portland (Switzler Lake), 5; Port Orford, 1; Salem, 10[76]; Scottsburg, 3; Seaside, 1; Shelburn,

[59] Acad. Nat. Sci. Philadelphia.
[60] Mus. Comp. Zool.
[61] Provincial Mus. British Columbia.
[62] Mus. Comp. Zool., 4; Provincial Mus. British Columbia, 5.
[63] Mus. Comp. Zool., 20; Acad. Nat. Sci. Philadelphia, 3.
[64] Amer. Mus. Nat. Hist.
[65] Mus. Vert. Zool.
[66] D. R. Dickey coll., Pasadena, Calif.
[67] Mus. Vert. Zool., 2; D. R. Dickey coll., 1.
[68] Mus. Comp. Zool., 1.
[69] Univ. Mich.
[70] Field Mus. Nat. Hist.
[71] Field Mus. Nat. Hist., 8; Mus. Comp. Zool., 2.
[72] S. G. Jewett coll., Portland, Oreg.
[73] D. R. Dickey coll., 1.
[74] Mus. Vert. Zool., 2.
[75] Mus. Vert. Zool., 3; S. G. Jewett coll., Portland, Oreg., 11.
[76] Amer. Mus. Nat. Hist., 2.

1; Sheridan, 2; Silverlake (10 miles southwest, west Silver Creek, altitude 4,650 feet), 3; Three Sisters (north slope, altitude 5,000 to 6,000 feet), 3; Tillamook (Fairview), 2[77]; Upper Klamath Marsh, 2; Vida, 1; Warmsprings (20 miles west, Mill Creek), 2; Yamsay Mountains (West Fork, Silver Creek, altitude 7,000 feet), 4; Yamsay Mountains (Yamsay River, altitude 4,800 feet), 1.

Washington: Aberdeen, 20; Avon, 3; Bear Prairie, Mount Rainier, 1; Beaver Creek (altitude 1,700 feet), Whatcom County, 5[78]; Blaine, 1; Blyn, 1; Carson, 1; Cat Creek (altitude 4,500 feet, Olympic Mountains, 1[79]; Cathlamet, 1; Chehalis, 2; Chehalis (8 miles west), 2; Clinton (3 miles north), 1; Duckabush, 6; Dungeness, 1; East Sound, Orcas Island, 3; Easton, 3; Elwha, 1[79]; Enumclaw, 1; Forks, 1; Fort Steilacoom, 1; Friday Harbor, San Juan Island, 1; Glacier (altitude 900 feet), 1; Goldendale, 1; Goldendale (15 miles north, near Potato Hill, Simcoe Mountains), 1[79]; Greenbank, 2; Greenville (Grays Harbor County), 1; Hamilton, 1; Hoodsport, 1; Ilwaco, 1; Kent, 1; Kirkland, 20; La Conner, 5; Lake Cushman, 17[80]; Lake Quinault, 2; Lake Washington (near Renton), 2; Lake Whatcom, 1; Lapush, 5; Lopez Island, 4[81]; Mount Vernon, 2; Neah Bay, 31[76]; Nisqually, 22[82]; Nisqually Flats, 2; Northbend, 2; Oakville, 1; Olympia (4 miles south), 1; Olympic Mountains (altitude 5,200 feet), Soleduck River, 1; Oso (altitude 550 feet), 2; Port Townsend, 3; Puget Island (1 mile south), 2; Puget Sound, 12; Puyallup, 20[83]; Quinault Lake, 7; Redmont (Sammamish River), 2; Reflection Lake (altitude 4,850 feet), Mount Rainier, 1[79]; Richardson, 6; Roy, 3; San de Fuca, 3; Sauk, 1; Seattle (near), 1[65]; Sequim, 4; Shelton, 3[84]; Shoalwater Bay (type locality), 2; Signal Peak (altitude 4,000 feet), 1; Skokomish River (north fork), Olympic Mountains, 1; Steilacoom (type locality of *suckleyi*), 2; Stevenson, 1; Suez (10 miles south Neah Bay), 2; Tacoma (6 miles south), 2; Tacoma Tide Flats, 2[66]; Tenino, 4; Tokeland (Shoalwater Bay), 4; Toledo, 1; Toledo (45 miles southeast), Cascade Mountains, Skamania County, 2; Trout Lake (15 miles south Mount Adams, altitude 1,940 feet), 5; Vashon Island, 2; Westport, 5; Whidbey Island (north end), 4; White Salmon (15 miles northwest, Berry Creek), 1.

SOREX VAGRANS VANCOUVERENSIS Merriam

Vancouver Shrew

Sorex vancouverensis Merriam, North Amer. Fauna No. 10, p. 70, December 31, 1895.

Type specimen.—No. 71913, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected May 10, 1895, by Clark P. Streator.

Type locality.—Goldstream, Vancouver Island, British Columbia.

Geographic range.—Southern half of Vancouver Island, British Columbia. (Fig. 11.)

Diagnostic characters.—Darker than *S. v. vagrans*, particularly the ventral parts, which are distinctly more brownish; upper parts in winter pelage more reddish-brown (tending less toward grayish) than in *S. v. vagrans*. Tail longer than in *S. v. amoenus* and underparts darker and of different color (brownish). Upper parts in winter pelage more reddish brown and somewhat paler than *S. v. halicoetes* and differing somewhat cranially.

Color.—Winter pelage: Upper parts between chaetura drab and hair brown, tending somewhat toward grayish; sides slightly more brownish than back; underparts between drab and wood brown; tail usually scarcely bicolor, sometimes more distinctly so, near mummy brown above, buffy below at base and sometimes nearly to tip. *Summer pelage:* Upper parts fuscous or slightly

[65] Mus. Vert. Zool.
[66] D. R. Dickey coll., Pasadena, Calif.
[76] Amer. Mus. Nat. Hist., 2.
[77] Alexander Walker coll., Tillamook, Oreg.
[78] State Coll. Wash., 2.
[79] State Coll. Wash.
[80] Amer. Mus. Nat. Hist., 1; Univ. Michigan, 5.
[81] D. E. Brown coll., Seattle, Wash.
[82] Acad. Nat. Sci. Philadelphia, 21.
[83] D. R. Dickey coll., 5; G. G. Cantwell coll., Palms, Calif., 9.
[84] Acad. Nat. Sci. Philadelphia, 1.

darker; sides scarcely paler than back; general tone of underparts drab to hair brown; tail as in winter.

Skull.—Essentially like that of *S. v. vagrans.*

Measurements.—Type specimen (adult male): Total length, 110; tail vertebrae, 43; hind foot, 12. Average of six adult males from Alberni Valley, Vancouver Island, British Columbia: Total length, 106.5 (97–115); tail vertebrae, 41.7 (40–43); hind foot, 12 (11–13). *Skull:* Type specimen (adult male; teeth moderately worn): Condylobasal length, 16.6; palatal length, 6.5; cranial breadth, 8.2; interorbital breadth, 3.2; maxillary breadth, 4.5; maxillary tooth row, 5.7. Average of six skulls of adult males (teeth moderately worn) from Alberni Valley, Vancouver Island, British Columbia: Condylobasal length, 16.4 (16.1–16.8); palatal length, 6.5 (6.4–6.6); cranial breadth, 8.2 (8.1–8.4); interorbital breath, 3.3 (3.2–3.4); maxillary breadth, 4.6 (4.5–4.7); maxillary tooth row, 5.6 (5.5–5.7).

Remarks.—This representative of the species *vagrans* is limited in its distribution to Vancouver Island, British Columbia. It is closely related to *S. v. vagrans*, from which it differs only in its general darker color with its ventral parts more brownish, and in winter pelage with its upper parts more rusty brown.

Specimens examined.—Total number, 97, as follows:

British Columbia: Alberni (18 miles south, Golden Eagle Mine), 4[85]; Alberni Valley, 70[85]; Bear Lake, Vancouver Island, 1[86]; Errington, 2[85]; French Creek, Vancouver Island, 1[85]; Goldstream (type locality), 1; Nanaimo, 1; Parksville, 1[85]; Sahtlam, 1[87]; Shawnigan Lake, 1[88]; Victoria, 14.[89].

SOREX VAGRANS NEVADENSIS Merriam

Nevada Shrew

(Pl. 2, w)

Sorex nevadensis Merriam, North Amer. Fauna No. 10, p. 71, December 31, 1895.

Type specimen.—No. $\frac{24891}{32302}$, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn); collected November 24, 1890, by Vernon Bailey.

Type locality.—Reese River at about 6,000 feet, at line between Lander and Nye Counties, Nev.

Geographic range.—Central Nevada. (Fig. 11.)

Diagnostic characters.—In winter pelage similar to *Sorex v. vagrans* and *S. v. amoenus* in color; skull more flattened, the rostrum weaker and more attenuate. Darker than *S. v. monticola* in winter pelage, smaller, and with more flattened skull having weaker dentition and more attenuate rostrum.

Color.—Winter pelage: Similar to corresponding pelage of *S. v. amoenus*, but slightly paler above, with more distinctly bicolor tail (paler below). Upper parts chaetura drab or between chaetura drab and hair brown; sides paler, drab or between drab and light drab; underparts smoke gray very lightly washed and intermixed with pale pinkish cinnamon; tail bicolor, mummy brown above, drab below nearly to tip. *Summer pelage:* Unknown.

Skull.—Brain case more flattened, and rostrum relatively narrower and more attenuate than in any other subspecies; dentition weak (about as in *S. v. vagrans*).

Measurements.—Type specimen (adult male) and topotype (adult male): Total length, 96, 98; tail vertebrae, 39, 39; hind foot, 12, 13. *Skull:* Type specimen (adult male; teeth slightly worn) and topotype (adult male; teeth slightly worn): Condylobasal length, 16.6, 16.1; palatal length, 6.6, 6.6; cranial breadth,

[85] Mus. Vert. Zool.
[86] Nat. Mus. Canada.
[87] Provincial Mus. British Columbia.
[88] Amer. Mus. Nat. Hist.
[89] Acad. Nat. Sci. Philadelphia, 3; Nat. Mus. Canada, 9; Provincial Mus. British Columbia, 2.

7.9, 8.2; interorbital breadth, 3.2, 3.2; maxillary breadth, 4.6, 4.5; maxillary tooth row, 5.6, 5.7.

Remarks.—On account of insufficient material, the exact status of *S. v. nevadensis* is unsatisfactorily determined. It probably intergrades with both *S. v. amoenus* and *S. v. monticola.* The specimen (an alcoholic) from Cloverdale, Nev., has the weak dentition of typical *nevadensis* and a rather narrow rostrum; the skull is not so much flattened, however, and in this respect the individual tends to approach *amoenus* or *monticola.*

Specimens examined.—Total number, 4, as follows:

Nevada: Cloverdale, 1; Reese River (type locality), 3.

SOREX VAGRANS HALICOETES Grinnell

Salt-marsh Shrew

(Pl. 2, x)

Sorex halicoetes Grinnell, Univ. Calif. Publ. Zool. 10: 183, March 20, 1913.

Type specimen.—No. 3638, Mus. Vert. Zool., Univ. California; ♂ young adult (teeth much worn), skin and skull (skull with left side of brain case broken away); collected May 6, 1908, by Joseph Dixon.

Type locality.—Salt marsh near Palo Alto, Santa Clara County, Calif.

Geographic range.—Coast region of California, south and east of San Francisco Bay; between latitudes 37° and 38° north. (Fig. 11.)

Diagnostic characters.—Color dark (blackish above), the underparts decidedly dark and brownish, the skull with rather broad rostrum and relatively long maxillary tooth row. Upper parts in winter pelage about the color of corresponding pelage of *S. v. vagrans*, but with underparts decidedly darker and more brownish. Underparts about as in *S. v. vancouverensis*, but upper parts less reddish-brown, and somewhat darker. Rostrum heavier and maxillary tooth row longer than in either *S. v. vagrans* or *vancouverensis.* Underparts darker and more brownish than in *S. v. amoenus*, tail rather longer, and rostrum somewhat heavier. Darker both dorsally and ventrally than *S. v. monticola*, with shorter tail, but similar in cranial characteristics.

Color.—Winter pelage: Upper parts chaetura black or between chaetura black and fuscous-black, sometimes almost chaetura drab; ears more reddish than back; sides and flanks scarcely paler than back, a shade more brownish; general tone of underparts a drabish or buffy dark gray, deep mouse gray heavily tinged and intermixed with between drab or hair brown, or buffy brown; tail mummy brown, scarcely bicolor, sometimes paler below particularly basally. *Summer pelage:* Unknown.

Skull.—Rostrum heavier and less attenuate than in *S. v. vagrans* or *S. v. amoenus*, dentition heavier, and length of maxillary tooth row greater. Scarcely distinguishable from the skull of *S. v. monticola.*

Measurements.—Type specimen (adult male): Total length, 108; tail vertebrae, 40; hind foot, 12. Adult male and adult female from type locality: Total length, 106, 105; tail vertebrae, 40, 39; hind foot, 13, 12. *Skull:* Type specimen (adult male; teeth much worn): Condylobasal length, 16.8; palatal length, 6.5; interorbital breadth, 3.6; maxillary breadth, 5.0; maxillary tooth row, 5.9. Skulls of adult male (teeth much worn) and adult female (teeth slightly worn) from type locality; Condylobasal length, 17.0, 16.5;; palatal length, 6.6; 6.4; cranial breadth, 8.5, 8.3; interorbital breadth, 3.5, 3.5; maxillary breadth, 4.8, 4.9; maxillary tooth row, 6.0, 6.0.

Remarks.—This dark form differs from *S. v. vagrans* not alone in color, but also cranially. Intergradation with the subspecies *vagrans* is indicated in specimens from the coast region of California north of San Francisco Bay. Specimens from San Mateo County, Calif., are not in strict conformity with typical *S. v. halicoetes.* In

fact one of the two specimens from San Mateo is almost exactly the color of certain specimens of *S. v. vagrans*. It is in worn and faded pelage, however, and is hardly comparable. The skull of it is indistinguishable from that of *halicoetes*.

Specimens examined.—Total number, 30, as follows:

California: Belmont, 1[90]; Berkeley, 1; Elmhurst, 4[90]; Melrose Marsh, Alameda County, 1[90]; Palo Alto (type locality), 10[91]; Redwood City, 3[90]; San Francisco, 5[92]; San Gregorio, 2[90]; San Mateo, 2; West Berkeley, 1.

SOREX VAGRANS AMOENUS Merriam

Sierra Shrew

Sorex amoenus Merriam, North Amer. Fauna No. 10, p. 69, December 31, 1895.
Sorex shastensis Merriam, North Amer. Fauna No. 16, p. 87, October 28, 1899. Type locality, Wagon Camp, Mount Shasta (altitude 5,700 feet in the lower part of Canadian Zone), Calif.
Sorex vagrans amoenus Merriam, North Amer. Fauna No. 16, p. 87, October 28, 1899.

Type specimen.—$\frac{29784}{41863}$, U. S. Nat. Mus., Biological Survey collection; ♂ old adult (teeth much worn), skin and skull; collected July 22, 1891, by E. W. Nelson.

Type locality.—Near Mammoth, altitude about 8,000 feet[93], head of Owens River, east slope Sierra Nevada, Mono County, Calif.

Geographic range.—South-central Oregon, northwestern California, south in the Sierra Nevada to Mammoth, Calif.; northeastern Nevada. (Fig. 11.)

Diagnostic characters.—Similar to *Sorex v. vagrans* but averaging a trifle darker and less reddish in summer pelage, and with somewhat shorter tail. Paler than *S. v. halicoetes*, particularly the ventral parts, and differing cranially. Skull higher and with less attenuate rostrum than that of *S. v. nevadensis*. Darker, especially in winter, and with shorter tail than *S. v. monticola*, the skull usually with narrower rostrum and weaker dentition.

Color.—Winter pelage: Usually more or less tricolor. Upper parts fuscous-black, sometimes tending toward chaetura drab, certain specimens displaying in some lights greenish reflections; sides and flanks distinctly paler and more drabbish, between drab and hair brown, sometimes inclining toward olive-brown; underparts smoke gray washed with pinkish buff; tail indistinctly bicolor, mummy brown above, paler below, particularly basally. *Summer pelage:* Less tricolor than in winter. Upper parts fuscous or between fuscous and hair brown, scarcely paling on the sides; underparts and tail about as in winter.

Skull.—Essentially like that of *S. v. vagrans*.

Measurements.—Type specimen (old adult male): Total length, 103; tail vertebrae, 38; hind foot, 12. Adult female from Mammoth, Calif.: Total length, 99; tail vertebrae, 38; hind foot, 12.7. *Skull:* Type specimen (old adult male; teeth much worn): Condylobasal length, 16.8; palatal length, 6.6; cranial breadth, 8.5; interorbital breadth, 3.3; maxillary breadth, 4.8; maxillary tooth row, 5.9. Skull of adult female (teeth very slightly worn) from Mammoth, Calif.: Condylobasal length, 16.5; palatal length, 6.4; cranial breadth, 8.2; interorbital breadth, 3.2; maxillary breadth, 4.8; maxillary tooth row, 5.7.

Remarks.—*S. v. amoenus* averages a shade darker than *S. v. vagrans* and has a shorter tail. Intergradation between the two forms is evident in certain specimens from southwestern Oregon and northern California. Thus specimens from Crater and Diamond Lakes, Oreg., can about as well be referred to *S. v. vagrans* as to

[90] Mus. Vert. Zool.
[91] Mus. Vert. Zool., 7.
[92] Amer. Mus. Nat. Hist., 1.
[93] Not Mammoth Pass, 10,000 feet, as stated by Merriam (1895, p. 69). See Howell, A. B., 1923, p. 266.

amoenus, and those from Hornbrook, Calif., although referable to *amoenus*, show a tendency toward the subspecies *vagrans*. The single specimen from Reno, Nev., shows no appreciable approach toward *S. v. nevadensis*.

Merriam's *S. shastensis* is here placed in synonymy under *S. v. amoenus*. The type specimen of *S. shastensis* (No. 95450, United States National Museum, Bureau of Biological Survey collection), upon careful comparison, proves to be only a small representative of *amoenus*. In the series of 23 specimens of *amoenus* from Mount Shasta the type specimen of *S. shastensis* is the minimum in size of skull and dentition, and in some respects is rather aberrant; but it is perfectly connected by gradual intergrades with the rest of the series and can be matched almost perfectly by occasional skulls of *amoenus* throughout the range of the subspecies.

Specimens examined.—Total number, 292, as follows:

California: Alvord (Owen Valley), Inyo County, 1; Bear Creek (head, altitude, 6,400 feet), Trinity County, 1[94]; Beswick, 1; Bieber (altitude, 4,500 feet), 1; Brownell, Klamath Lake (altitude, 4,300 feet), 1; Buck Ranch, Plumas County, 20[95]; Burney (12 miles east, altitude, 4,700 feet, Redding-Bieber Road), 1; Canyon Creek (altitude, 6,000–7,500 feet), Trinity County, 2; Carberrys Ranch, 4; Cassel, 2; Castle Lake (altitude, 5,400 feet), Siskiyou County, 2[94]; Cliff House, 2[96]; Dana, 17; Davis Creek, Goose Lake, 1; Donner (altitude, 7,500–7,900 feet), 3; Dry Creek (altitude, 4,800 feet), Warner Mountains, 1[94]; Fall Lake, Fall River Valley, 3; Fort Crook, 11; Goose Nest Mountain, Siskiyou County, 2; Hornbrook, 3; Independence Lake, Nevada County, 7[94]; Lake Audrain, 1[95]; Lassen Creek, Modoc County, 1[95]; Lassen Peak, 13; Lincoln Creek, Sierra County, 1; Long Valley (Convict Creek, altitude, 6,800 to 6,900 feet), 4[95]; Mammoth, Mono County, 3[95]; Mammoth (head of Owens River, near) (type locality), 2; Mayten, 9[97]; Mono Lake, 5[98]; Mount Conness, 1; Mount Dana, 1; Parker Creek (head north fork, altitude, 7,300 feet), Warner Mountains, 2[94]; Phillips, Eldorado County, 2[95]; Plumas County (altitude, 6000 feet), 1; Prattville (12 miles northeast), 2; Rush Creek (head), Siskiyou County, 3[94]; Salmon River (south fork), Siskiyou County, 3[94]; Shasta region, 1[94]; Sierra Valley, 1; Sisson, 24[99]; Spring Garden Ranch (vicinity), Grizzly Mountains, 3; Squaw Creek (head of), Mount Shasta, 2; Squaw Creek (altitude, 7,800 to 8,100 feet), Mount Shasta, 3; Sugar Hill (Goose Lake Meadows, altitude, 4,800 feet), Modoc County, 1[94]; Tallac, 3; Upper Ash Creek, Mount Shasta, 1; Upper Mud Creek, Mount Shasta, 8; Wagon Camp, Mount Shasta (type locality of *shastensis*), 5; Warmcastle Soda Springs, Squaw Creek Valley, 2; Warner Creek (Drakes Hot Springs), 1; Williams Butte (altitude, 6,900 feet), 2.[94]

Nevada: Mountain City, 1; Reno, 1[94]; Ruby Lake, 3; Ruby Mountains, 9.

Oregon: Anna Creek, Mount Mazama (altitude 6,000 feet), 1; Crater Lake, 24[1]; Diamond Lake, 6; Fort Klamath, 36[2]; Klamath Falls, 8[3]; Old Fort Klamath, 1[95]; Plush, Lake County, 1; Warner Creek, Warner Mountains, 1; Warner Mountains, 3.

SOREX VAGRANS MONTICOLA Merriam

Rocky Mountain Shrew

(Pl. 2, y)

Sorex monticolus Merriam, North Amer. Fauna No. 3, p. 43, September 11, 1890.

Sorex dobsoni Merriam, North Amer. Fauna No. 5, p. 33, July 30, 1891. Type locality, Alturas or Sawtooth Lake, altitude about 7,200 feet, east base of Sawtooth Mountains, Blaine County, Idaho.

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[94] Mus. Vert. Zool.
[95] D. R. Dickey coll., Pasadena, Calif.
[96] Mus. Comp. Zool.
[97] Mus. Vert. Zool., 7.
[98] Mus. Vert. Zool., 4.
[99] Mus. Vert. Zool., 4; D. R. Dickey coll., 13.
[1] D. R. Dickey coll., 6; Mus. Vert. Zool., 1.
[2] Amer. Mus. Nat. Hist., 1.
[3] G. G. Cantwell coll., Palms, Calif., 2.

Sorex vagrans dobsoni Merriam, North Amer. Fauna No. 10, p. 68, December 31, 1895.

Sorex vagrans monticola Merriam, North Amer. Fauna No. 10, p. 69, December 31, 1895.

Type specimen.—No. $\frac{175\,99}{245\,35}$, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected August 28, 1889, by C. Hart Merriam and Vernon Bailey.

Type locality.—San Francisco Mountain, altitude 11,500 feet, Coconino County, Ariz.

Geographic range.—Extreme southern British Columbia, eastern Washington, eastern Oregon, Idaho, western Montana, western Wyoming, south through eastern Utah, western Colorado, eastern Arizona, and western New Mexico to southern Chihuahua, Mexico. (Fig. 11.)

Diagnostic characters.—Differs from *Sorex v. vagrans, S. v. amoenus, S. v. nevadensis,* and *S. v. orizabae* in its slightly larger size and longer tail, distinctly paler and more grayish coloration (particularly in winter); skull with heavier rostrum and larger teeth than in *S. v. vagrans, amoenus,* or *nevadensis.* Skull relatively broader, brain case expanding more abruptly anteriorly, shorter maxillary tooth row, and heavier unicuspids than in *orizabae.* Similar to *S. o. obscurus,* but with average shorter tail and smaller foot, weaker and shorter rostrum, and smaller teeth.

Color.—Winter pelage: Upper parts hair brown or between hair brown and chaetura drab; sides and flanks usually a trifle paler than back, drabbish; underparts pale olive-gray washed with pale pinkish buff; tail bicolor, hair brown or olive-brown above, avellaneous or pinkish buff below. *Summer pelage:* Upper parts usually between olive-brown and fuscous, sometimes almost hair brown, frequently somewhat darker posteriorly than anteriorly; sides usually about same color as upper parts, sometimes slightly paler (drabbish); underparts smoke gray washed with avellaneous, vinaceous-buff, or occasionally tilleul buff; tail about as in winter or less clearly bicolor.

Skull.—Rostrum and teeth relatively heavy for the species *vagrans,* heavier than in any other subspecies of *S. vagrans* except *S. v. halicoetes.* Skull practically indistinguishable from that of *halicoetes.* Similar to that of *S. o. obscurus,* but palate averaging narrower; rostrum smaller, narrower, and more attenuate; dentition weaker, especially unicuspidate teeth.

Measurements.—Type specimen (adult male): Total length, 107; tail vertebrae, 45; hind foot, 12.5. Average of 3 adult males from Mount Thomas, White Mountains, Ariz.: Total length, 107.3 (104–110); tail vertebrae, 41.3 (40–43); hind foot, 12.8 (12.5–13). Adult male from Alturas (Sawtooth) Lake, Blaine County, Idaho (type locality of *S. dobsoni* Merriam): Total length, 106; tail vertebrae, 42; hind foot, 13. *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 16.7; palatal length, 6.7; cranial breadth, 8.2; interorbital breadth, 3.5; maxillary breadth, 4.8; maxillary tooth row, 5.8. Average of 3 skulls of adult males (teeth very slightly worn) from Mount Thomas, White Mountains, Ariz.: Condylobasal length, 16.3 (16.2–16.4); palatal length, 6.6 (6.5–6.7); cranial breadth, 8.2 (8.2–8.2); interorbital breadth, 3.5 (3.5–3.6); maxillary breadth, 4.7 (4.6–4.8); maxillary tooth row, 5.8 (5.7–6.0). Skull of adult male (teeth slightly worn) from Alturas (Sawtooth) Lake, Blaine County, Idaho (type locality of *S. dobsoni*): Condylobasal length, 16.4; palatal length, 6.5; cranial breadth, 8.3; interorbital breadth, 3.3; maxillary breadth, 4.7; maxillary tooth row, 5.7. Skulls of 2 adult females (teeth slightly worn) from Sawtooth City, Idaho (essentially type locality of *S. dobsoni* Merriam): Condylobasal length, 16.2, 16.9; palatal length, 6.6, 6.7; cranial breadth, 8.2, 8.3; interorbital breadth, 3.5, 3.7; maxillary breadth, 4.8, 5.0; maxillary tooth row, 5.9, 5.8.

Remarks.—Merriam's *Sorex dobsoni,* which he later treated as a subspecies of *vagrans,* is here placed in synonymy under *S. v. monticola.* Although there is considerable local variation in the species *vagrans* throughout the Rocky Mountains from Arizona to Idaho, this variation can nowhere be assigned to a definite geographic area, and specimens of *dobsoni* from Idaho can be matched almost per-

fectly with specimens of *monticola* from Arizona, both as to color and cranial characters. In fact, even the topotype series of the two forms when carefully compared are surprisingly similar. The subspecies *monticola* intergrades with *S. v. vagrans* along the eastern slope of the Cascade Mountains, in Washington, winter specimens from Ellensburg and Yakima, in that State, being nearer *monticola* in color, but showing a decided approach toward *S. v. vagrans* cranially, as do also the two specimens from Entiat, Wash. Specimens referred to *monticola* from Sierra Madre near Guadelupe-y-Calvo, Chihuahua, Mexico, indicate a slight approach in cranial characters toward *S. v. orizabae.*

It is sometimes difficult to determine whether certain specimens are *S. o. obscurus* or *S. v. monticola.* Although the two forms are often superficially similar, it seems reasonably certain that they are not specifically related. Much of the geographic range of *monticola* is in common with that of *S. o. obscurus*, yet the two forms are rarely collected at actually the same locality, *S. o. obscurus* apparently having a higher zonal distribution and being largely confined to the Boreal Zone, while *monticola* occurs in the lower parts of the Boreal Zone and in upper Transition Zone. Moreover, it appears that *monticola* more frequently occurs in meadows and marshes, while *S. o. obscurus* inhabits creek banks and moist woods, though too much dependence should not be placed on this habitat preference.

Specimens examined.—Total number, 414, as follows:

Arizona: Burro Creek (near head, altitude 9,000 feet), White Mountains, 1; Fly Park, Chiricahua Mountains, 4; Graham Mountains (altitude, 9,200 feet), 2; Huachuca Mountains, 1; Little Colorado River, White Mountains, 4; Mount Thomas (altitude, 9,500 to 11,000 feet), White Mountains, 12; Prieto Plateau (altitude, 9,000 feet, south end Blue Range), Greenlee County, 1; San Francisco Mountain (altitude, 8,000 to 11,000 feet) (type locality), 3; Springerville, 1; Stone Cabin Canyon (altitude, 8,500 feet), Santa Rita Mountains, 1; Summerhaven (altitude, 7,500 feet), Santa Catalina Mountains, 3; Spruce Creek, Tunitcha Mountains, 7; White River, Horseshoe Cienega (altitude, 8,300 feet), White Mountains, 5.

British Columbia: Cascade (altitude 4,000 feet), 7[4]; Trail, 2.[4]

Chihuahua: Sierra Madre (near (Guadalupe-y-Calvo), 5.

Idaho: Albion, 1; Alturas (Sawtooth) Lake (type locality of *dobsoni*), 2; Bald Mountain Ranger Station (10 miles south Idaho City, altitude, 7,400 feet), Boise National Forest, 1; Cayuse Creek (10 miles north of Featherville), 1; Cedar Mountain (altitude, 4,000 feet), 3[5]; Coeur d'Alene, 2; Irwin (10 miles southeast), 5; McKinnis (7 miles east), Shoshone County, 2[6]; Mullan, 2; Nampa, 6[7]; New Meadows, 1; Nezperce, 2; Osborne, 1; Pocatello, 1; Sawtooth City, 5; Seven Devils Mountains, 1; Swan Lake, 1; Tamarack, 1.

Montana: Bass Creek (altitude 4,600 feet, northwest of Stevensville), 3; Big Snowy Mountains (altitude, 5,500 feet), 1; Big Snowy Mountains, Meagher County, 2; Corvallis, 5; Fish Creek, Glacier Park, 2; Flathead Lake, 6; Florence, 16[8]; Nyack, 1; Prospect Creek (near Thompson), 4; Pryor Mountains, 5; Stevensville, 4; Stevensville (8 miles northeast), 2; Summit, Flathead County, 2; Thompson Pass, 2; Timber Creek (head), Big Snowy Mountains, 1; Tobacco Plains, 1.

New Mexico: Chusca Mountains, 1; Copper Canyon, Magdalena Mountains, 3; Kingston, 1; Willow Creek (altitude, 8,000 feet), Mogollon Mountains, 3.

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[4] Nat. Mus. Canada.
[5] State Coll. Wash.
[6] D. R. Dickey coll., Pasadena, Calif.
[7] Mus. Vert. Zool., 1.
[8] Mont. State Coll., 9.

Oregon: Anthony, 55[9]; Austin, 1; Beech Creek, 6; Bourne, 7; Burns, 4; Cornucopia, 13[10]; Diamond, 2; Elgin, 2; Enterprise (25 miles north at Sled Springs, altitude, 4,600 feet), 4; Homestead (altitude, 1,800 feet), 1; Hot Lake, 2; Huntington (altitude, 2,100 feet), 1; Ironside (altitude, 4,000 feet), 8[11]; Jordan River (8 miles west of Jordan Valley), 1; Kamela, 2; Kieger Gorge, Steen Mountains, 3; Maury Mountains, 3; McEwen, 1; Meacham, 3; Meacham (10 miles west), 2; Pullman, 1; Rock Creek, Baker County, 1; Strawberry Butte, 1; Strawberry Mountains, 12; Wallowa Lake (altitude, 4,000 feet), 23; Wallowa Mountains south of Wallowa Lake (altitude, 8,100 feet), 1.

Utah: Bear River (mouth of), 2; Midvale, 1; Ogden, 4; Provo (near shores of Utah Lake), 1; Salt Lake City, 1.

Washington: Barron (altitude 5,000 feet), 2; Bauerman Ridge (east end, near head Haig Creek, altitude 6,500 feet), Okanogan County, 1; Blewett Pass (2 miles south, altitude 3,000 feet), Kittitas County, 3; Blue Mountains, 7[5]; Bly (altitude 1,000 feet), 1; Cedar Mountains, 4[5]; Conconully, 1; Curlew (5 miles west, altitude 2,800 feet), 2; Dayton (21 miles southeast, Blue Mountains), 1; Ellensburg (altitude 1,500 feet), 2; Entiat, Entiat River (20 miles from mouth), 2; Hidden Lakes (altitude 4,100 feet), Okanogan County, 1; Hompeg Falls, Blue Mountains, 2[12]; Loomis (altitude 1,300 feet), 1; Marcus, 1; Marshall, 7; Metaline (9 miles north, altitude 2,600 feet), 2; Moses Lake (altitude 1,000 feet), 1; Odessa (6 miles east, Sylvan Lake), 4; Oroville (altitude 1,000 feet, Osoyoos Lake), 1; Prescott, 4[12]; Pullman, 1; Rogersburg, 1; Sheep Mountain (Park Mountain, altitude 6,500 feet), 3; Snake River (road to Gap Hill, altitude 2,500 feet), 1[5]; Starbuck (altitude 645 feet), 3; Sullivan Lake (altitude 3,000 feet), 1; Twisp (altitude 1,600 feet), 1; Wallula, 1[12]; Wawawai (altitude 600 feet), 4[6]; Wawawai (5 miles northeast), 1; Yakima (10 miles west at Wiley City, altitude 2,000 feet), 4; Z Canyon, Pend Oreille County, 2.

Wyoming: Apollinaris Spring, Yellowstone National Park, 1[6]; Bighorn Mountains (altitude 8,400–9,000 feet), 3; Cokeville (altitude 6,400 feet), 1; Mammoth Hot Springs, 1; Moran (Lake Emma Matilda), 2; Salt River (10 miles north of Afton, altitude 6,200 feet), 2[5]

SOREX VAGRANS ORIZABAE Merriam

Orizaba Shrew

(Pl. 2, z)

Sorex orizabae Merriam, North Amer. Fauna No. 10, p. 71, December 31, 1895.

Type specimen.—No. 53633, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull (skull broken in two through the orbital region); collected April 24, 1893, by E. W. Nelson.

Type locality.—Mount Orizaba, altitude 9,500 feet on west slope, State of Puebla, Mexico.

Geographic range.—Mountains of west-central Vera Cruz, west to central Michoacan, Mexico. (Fig. 11.)

General characters.—About the size of *Sorex v. vagrans*, but a shade darker in summer pelage, skull relatively longer and narrower, molariform teeth heavier, and maxillary tooth row longer. Apparently smaller and a tone darker than *S. v. monticola*, with shorter tail; skull relatively narrower than in *monticola*, brain case expanding less abruptly anteriorly, maxillary tooth row a trifle longer, and unicuspidate teeth narrower.

Color.—Winter pelage: Upper parts fuscous to nearly fuscous-black, slightly paling on the flanks; underparts smoke gray mixed and washed with light drab or between light drab and avellaneous; tail indistinctly bicolor, between

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[5] State Coll. Wash.
[6] D. R. Dickey coll., Pasadena, Calif.
[9] Amer. Mus. Nat. Hist., 42; Mus. Vert. Zool., 8.
[10] Univ. Mich., 2.
[11] Amer. Mus. Nat. Hist.
[12] Mus. Vert. Zool.

mummy brown and sepia above, buffy brown below, darkening toward tip. *Summer pelage:* Upper parts mummy brown, sometimes tending toward olive-brown paling on the sides and flanks; underparts about as in winter, possibly a little more buffy; tail as in winter.

Skull.—Medium in size; relatively the most elongate and narrowest of the species *vagrans*, maxillary tooth row long, molars relatively large (about as in *S. v. monticola*), posterior emargination of second upper premolar relatively narrow and deep, unicuspidate teeth narrow (narrower than in *monticola*).

Measurements.—Type specimen (adult female): Total length, 103; tail vertebrae, 38; hind foot, 13. Average of 3 adult males from type locality: Total length, 103.7 (98–109); tail vertebrae, 36.3 (31–40); hind foot, 12.8 (12.5–13.0). Adult female from Cofre de Perote, Vera Cruz, Mexico: Total length, 98; tail vertebrae, 33.5; hind foot, 13. Two adult females from north slope of Volcan Toluca, Mexico, Mexico: Total length, 98, 108; tail vertebrae, 35, 40; hind foot, 13, 14. *Skull:* Skulls of 2 adult males (teeth much worn) from type locality: Condylobasal length, 16.9; 16.5; palatal length, 6.6, 6.5; cranial breadth, 8.2, 8.0; interorbital breadth, 3.3, 3.4; maxillary breadth, 4.6, 4.6; maxillary tooth row, 6.0, 6.0. Skull of adult female (teeth moderately worn) from Cofre de Perote, Vera Cruz, Mexico: Condylobasal length, 16.5; palatal length, 6.5; cranial breadth, 7.8; interorbital breadth, 3.5; maxillary breadth, 4.6; maxillary tooth row, 6.0. Skulls of 2 adult females (teeth slightly worn) from north slope of Volcan Toluca, Mexico, Mexico: Condylobasal length, 17.2, 17.0; palatal length, 6.6, 6.5; cranial breadth, 8.0, 7.8; interorbital breadth, 3.5, 3.5; maxillary breadth, 4.8, 4.6; maxillary tooth row, 6.0, 6.1.

Remarks.—The skulls of specimens from the north slope of Volcan Toluca, State of Mexico, Mexico, are a little larger than the typical skulls of *S. v. orizabae* that have been examined. A specimen from Cofre de Perote, State of Vera Cruz, and others from Nahuatzin, Michoacan, although differing for the most part in age from the series from the type locality, agree well in all diagnostic characters. Some of the skulls from Mount Tancitaro, Michoacan, seem to be slightly flatter through the brain case than typical specimens.

Specimens examined.—Total number, 22, as follows:

Mexico: Salazar, 2; Volcano Toluca (north slope), 3.
Michoacan: Mount Tancitaro, 4; Nahuatzin, 3; Patamban, 1.
Puebla: Mount Orizaba (type locality), 6.
Tlaxcala: Mount Malinche, 2.
Vera Cruz: Cofre de Perote, 1.

SOREX DURANGAE Jackson

Durango Shrew

(Pls. 2, A'; 5, E; 6, H; 8, F)

Sorex durangae Jackson, Proc. Biol. Soc. Washington 38: 127, November 13, 1925.

Type specimen.—No. 94540, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth much worn), skin and skull; collected July 19, 1898, by E. W. Nelson and E. A. Goldman. Original number 12774.

Type locality.—El Salto, Durango, Mexico.

Geographic range.—Known only from type locality. (Fig. 11.)

Diagnostic characters.—Larger and darker than *Sorex v. monticola;* skull decidedly broader and heavier than that of *S. v. orizabae* or *monticola*, with more swollen lachrymal region, and heavier rostrum and dentition. Darker and more grayish than *S. o. obscurus*, and differs cranially from any form of *S. obscurus* in its peculiarly high and broad lachrymal region and the relatively narrow (lateral diameter) and deep posterior emargination of the molars.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts fuscous-black scantily flecked and grizzled with whitish hair-tips, scarcely paling on the

sides; general tone of underparts hair brown tending somewhat toward grayish; tail indistinctly bicolor, olive-brown above, buffy brown below darkening a trifle toward tip.

Skull.—Medium in size (about that of *S. o. obscurus*), rather broad interorbitally, moderately flattened through brain case, with relatively high rostrum, broad and high lachrymal region, somewhat heavy dentition with the posterior emargination of molars relatively deep (antero-posteriorly) and narrow (laterally).

Measurements.—Type specimen (adult male): Total length, 112; tail vertebrae, 50; hind foot, 13 (measured from dry skin by the writer). *Skull:* Type specimen (adult male; teeth much worn): Condylobasal length, 17.1; palatal length, 6.7; cranial breadth, 8.4; interorbital breadth, 3.7; maxillary breadth, 5.0; maxillary tooth row, 6.3.

Remarks.—The type specimen and a topotype of *S. durangae*, the only two specimens seen, are both fully adult and have their teeth too worn for satisfactory study. With only this scant material it is impossible to determine the relationship of this form to either *S. vagrans* or *S. obscurus*. Although in many respects similar to *S. obscurus* it seems hardly probable that it is directly connected with that species. Nor is there evidence of connection with *S. vagrans*, although specimens of *S. v. monticola* have been examined from as far south as Sierra Madre near Guadalupe-y-Calvo, Chihuahua. It seems possible, however, that specimens from the region between that locality and the type region of *S. durangae* may show intergradation between *monticola* and *S. durangae*.

Specimens examined.—Two, from the type locality.

SOREX OBSCURUS Merriam

[Synonymy under subspecies]

Geographic range.—Western and north-central Alaska southeasterly through British Columbia and Alberta, Washington, and western Oregon, in the mountains to southern California (latitude 34° north), and through Idaho, western Montana, western Wyoming, and western Colorado, southern Utah, and southern New Mexico. (Fig. 12.)

Diagnostic characters.—Size larger than *Sorex vagrans*, decidedly smaller than *S. yaquinae* or *S. pacificus*. Skull larger, broader, particularly interorbitally and through rostrum, and palate longer than in *S. vagrans;* superior border of foramen magnum tending to be less acute; teeth larger, the protoconid of m_1 higher than in *S. vagrans*, relatively and actually broader unicuspids, and larger *i.*[1] Lachrymal region of skull much more depressed, and relatively and actually narrower than in *S. durangae*, the molars more broadly (lateral diameter) and less deeply emarginate posteriorly.

Subspecies and geographic variation.—The species *obscurus* is divided into 13 subspecies: *obscurus, neomexicanus, parvidens, shumaginensis, alascensis, malitiosus, elassodon, longicauda, prevostensis, isolatus, setosus, permiliensis,* and *bairdi*. Passing directly northward from the type region of *S. obscurus* (Idaho), there is very little variation, even as far north as western Alaska; toward the south from the type region the characters also remain constant except in southern New Mexico, where a noticeable increase in size is recognizable in *neomexicanus*. Southwestward through the Sierra Nevada of California, the representatives of the species are almost identical with those from the type region, but in the San Bernardino Mountains decrease in size associated with a flattened cranium and small teeth is recognized in *parvidens*. Westward from the type region there is a gradual increase in size of the animal and the length of tail through *setosus* into *longicauda* and related Alaska forms *shumaginensis, alascensis, malitiosus, elassodon,* and *prevostensis* on the north, and *permiliensis* and *bairdi* toward the south. On Vancouver Island, British Columbia, the species becomes smaller and a shade darker again in the form *isolatus*.

Time of molting.—The earliest spring molt indicated in material examined is in specimens of *S. o. elassodon* from Admiralty Island, Alaska, where several are in process of molt the last week of April, and 1 has complete summer pelage, May 3. What appears to be a delayed molt occurs in three males from this

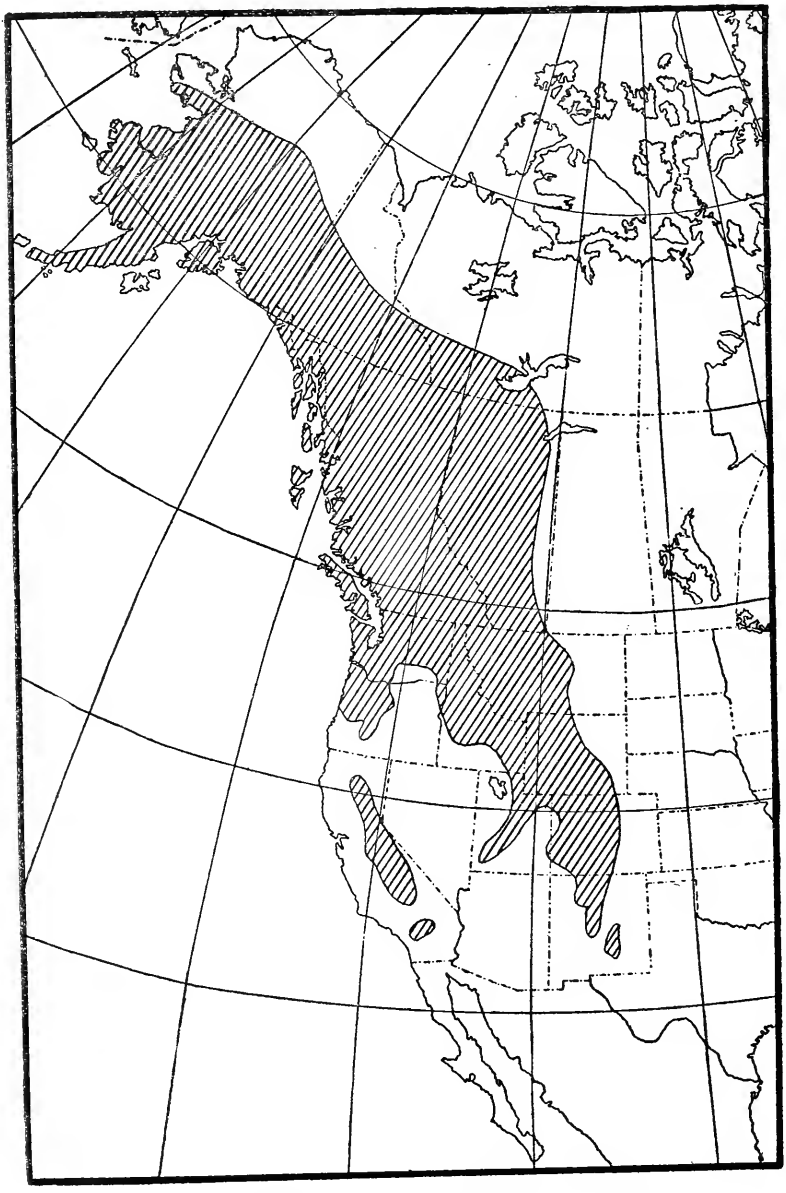

FIG 12.—Geographic range of the species *Sorex obscurus*

same locality, which still show traces of winter fur August 2 and 4. Of 1 specimens collected between May 14 and 26, 1903, on Prince of Wales Islan Alaska, 9 are in complete summer fur, while 6 retain a major portion of th winter fur, 2 of the latter having been collected as late as May 25 and 2

Of 11 specimens of *S. o. obscurus* collected between May 31 and June 17, 1919, at Telegraph Creek, British Columbia, all have acquired complete summer pelage except a male collected June 17, which retains patches of winter fur on the rump, flanks, and shoulders. A female of *S. o. neomexicanus* is in full fresh summer pelage May 31, 1900, at Cloudcroft, N. Mex., while another with same date and locality has fresh summer fur except for a patch of winter pelage on the rump. The majority of specimens of this species have full summer pelage by the first week of June, although molt may sometimes be delayed until late in June or early in July.

The winter fur is usually acquired during September, and by the middle of October the majority of specimens of *S. obscurus*, whether in the northern or southern part of the range of the species, are in winter pelage. All of 7 specimens of *S. o. obscurus* collected September 7 to 9, 1903, at Athabaska River, Alberta, appear on first glance to be in full summer pelage, but examination shows 6 of them to have the winter fur coming in under the summer. Two individuals of *S. o. obscurus* from Glen Aulin, Yosemite National Park, Calif., have the new winter pelage well advanced over the back, October 2 and 3, 1915. Of 41 specimens of *S. o. shumaginensis* collected at Tyonek, Cook Inlet, Alaska, between September 13 and 20, 1900, 20 still retain full summer fur, 13 show early stages of molt, while 8 have the winter fur well advanced or nearly complete. Of these 8 none was taken prior to September 17.

SOREX OBSCURUS OBSCURUS Merriam

Dusky Shrew

(Pls. 2, B'; 5, F; 6, I; 8, G; 11, I; 12, K; 13, G)

Sorex vagrans similis Merriam, North Amer. Fauna No. 5, p. 34, July 31, 1891. (Not *S. similis* Hensel, Zeitschr. der Deutsch. Geolog. Gesellsch. 7: 459, 1855, qui *Neomys similis*.)

Sorex obscurus Merriam, North Amer. Fauna No. 10, p. 72, December 31, 1895. New name for *S. vagrans similis* Merriam.

Sorex obscurus obscurus Miller, U. S. Nat. Mus. Bul. 79, p. 15, December 31, 1912.

Type specimen.—No. $\frac{23525}{30943}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected August 26, 1890, by Vernon Bailey and B. H. Dutcher. Original number 1670 (Bailey catalogue).

Type locality.—Near Timber Creek, altitude 8,200 feet, Salmon River Mountains (now Lemhi Mountains), 10 miles west of Junction, Lemhi County, Idaho.

Geographic range.—Central Alaska, southeasterly through northern and eastern British Columbia, southwestern Northwest Territories, Alberta, extreme southwestern Saskatchewan, eastern Washington, Idaho, western Montana, western Colorado, south to southern Utah and north-central New Mexico. (Fig. 13.)

Diagnostic characters.—Size rather small for the species *obscurus*, with relatively short tail, and medium hind foot. Skull small, with medium-sized rostrum, and moderate dentition. Somewhat similar to *S. o. setosus* but paler, with relatively and actually shorter tail, and average smaller hind foot; skull averaging slightly smaller than that of *setosus*, very slightly less constricted interorbitally, with average smaller molariform teeth. Externally similar to *S. o. parvidens*, the skull broader both mastoidally and interorbitally, molariform teeth usually less deeply emarginate posteriorly, the unicuspids broader, and the first incisors larger. Darker than *S. o. shumaginensis*, tending less toward a tricolor pattern, the skull less depressed orbitally, and on the average with rather longer palate, broader and less attenuate rostrum. Similar in color to *S. o. alascensis*, but slightly smaller, with decidedly smaller hind foot; skull smaller than that of *alascensis* with narrower rostrum and brain case, and weaker dentition. Different in color and much smaller than either *S. o. longicauda* or *S. o. bairdi*, with shorter tail and much smaller hind foot; skull cor-

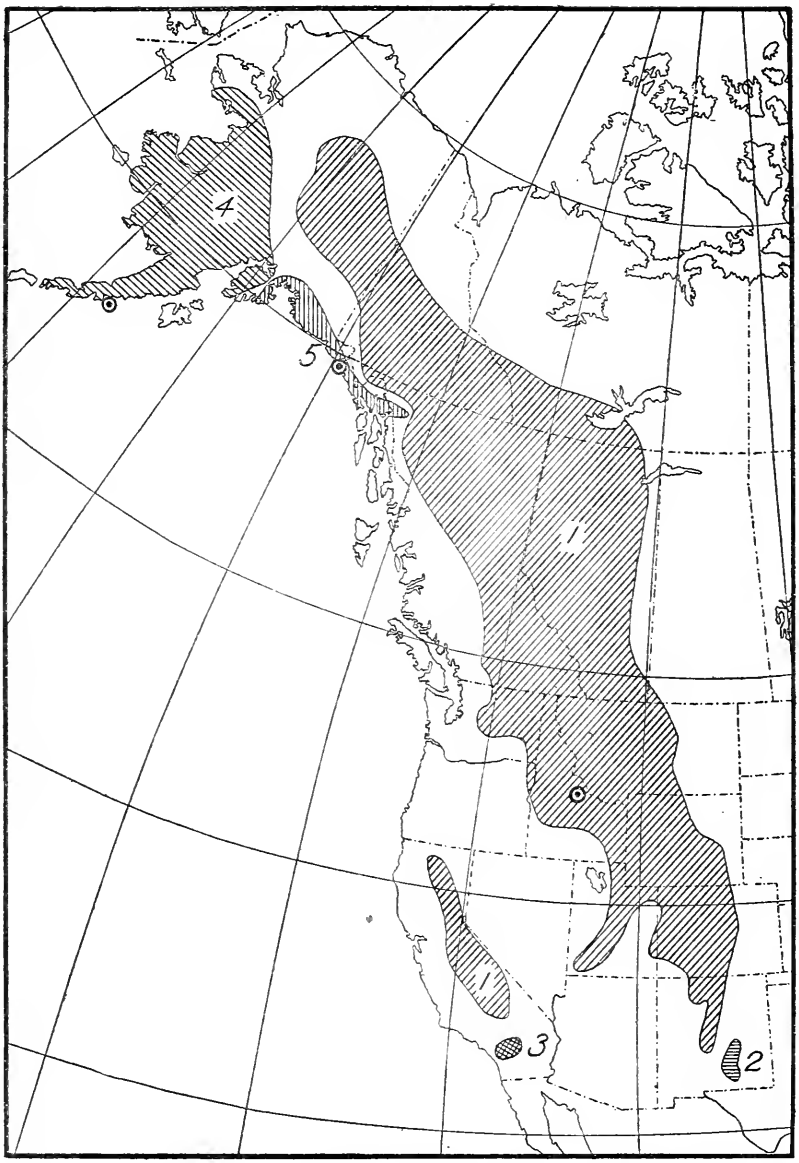

FIG. 13.—Geographic range of *Sorex obscurus obscurus, S. o. neomexicanus, S. o. parvidens, S. o. shumaginensis,* and *S. o. alascensis*

1. *S. o. obscurus.*
2. *S. o. neomexicanus.*
3. *S. o. parvidens.*
4. *S. o. shumaginensis.*
5. *S. o. alascensis.*

respondingly smaller in all proportions. About the size of *S. o. isolatus*, but paler, particularly on ventral parts; skull less constricted interorbitally than that of *isolatus*, with heavier dentition, especially the unicuspidate teeth and incisors. Smaller than *S. o. neomexicanus*, with smaller, narrower skull. Similar to *S. v. monticola*, but with average longer tail and larger foot, longer and heavier rostrum, and larger teeth.

Color.—Winter pelage: Upper parts most nearly hair brown, or between hair brown and chaetura drab, more or less mixed with deep neutral gray of base of hairs, becoming rather paler on the sides and grading into color of underparts; underparts pale smoke gray, sometimes more or less silvery, frequently tinged with pale pinkish buff; tail bicolor, usually olive-brown or between olive-brown and hair brown above, avellaneous to nearly pinkish buff below nearly to tip. *Summer pelage:* Distinctly more brownish (less grayish) than in winter pelage. Upper parts usually between olive-brown and buffy brown, more nearly olive-brown, tending very slightly toward Saccardo's umber, rarely toward hair brown or drab; color of upper parts extending well down on sides and gradually blending with color of the underparts; underparts smoke gray to pale smoke gray, in most cases more or less tinged with avellaneous to pale pinkish buff or pale olive-buff; tail about as in winter.

Skull.—Relatively small for the species *obscurus* (about the size of that of *S. o. parvidens, S. o. shumaginensis,* and *S. o. isolatus*); brain case moderately broad and flattened, rostrum medium, dentition moderate. Less constricted interorbitally than that of either *parvidens* or *isolatus* with heavier dentition, particularly the unicuspids and incisors; cranium broader and less flattened than in *parvidens.* Somewhat smaller than that of *S. o. setosus,* very slightly less constricted interorbitally, with smaller molariform teeth. Distinctly smaller and weaker than that of *S. o. neomexicanus, S. o. alascensis,* or *S. o. longicauda.*

Measurements.—Type specimen (adult female): Total length, 111; tail vertebrae, 46; hind foot, 13. Average of 4 adult males from Mammoth Hot Springs, Yellowstone National Park, Wyo.: Total length, 110.3 (108–113); tail vertebrae, 45.8 (44–47); hind foot, 12.9 (12.7–13). Average of 5 adult males from mountains near Eagle, Alaska: Total length, 115 (109–119); tail vertebrae, 45.6 (40–49); hind foot, 13.3 (13–13.5). Two from Mount Whitney, Calif.: Total length, 103, 119; tail vertebrae, 43, 49; hind foot, 13, 13. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 17.1; palatal length, 7.0; cranial breadth, 8.3; interorbital breadth, 3.7; maxillary breadth, 4.8; maxillary tooth row, 6.2. Skulls of 2 adult females (teeth slightly worn) from type locality: Condylobasal length, 17.3, 16.9; palatal length, 7.0, 6.8; cranial breadth, 8.4, 8.2; interorbital breadth, 3.7, 3.8; maxillary breadth, 4.9, 5.0; maxillary tooth row, 6.4, 6.2. Average of 4 skulls of adult males (teeth slightly worn) from Mammoth Hot Springs, Yellowstone National Park, Wyo.: Condylobasal length, 16.8 (16.4–17.2); palatal length, 6.9 (6.8–7.0); cranial breadth, 8.4 (8.2–8.5); interorbital breadth, 3.7 (3.7–3.7); maxillary breadth, 5.0 (4.9–5.1); maxillary tooth row, 6.2 (6.0–6.3). Average of 5 skulls of adult males (teeth slightly worn) from mountains near Eagle, Alaska: Condylobasal length, 17.2 (16.6–17.6); palatal length, 6.8 (6.7–6.9); cranial breadth, 8.4 (8.4–8.5); interorbital breadth, 3.7 (3.7–3.7); maxillary breadth, 5.0 (4.9–5.2); maxillary tooth row, 6.1 (6.0–6.3). Skulls of 2 adult females (teeth slightly worn) from Mount Whitney, Calif.: Condylobasal length, 16.7, 16.9; palatal length, 6.7, 6.7; cranial breadth 8.4, 8.3; interorbital breadth, 3.8, 3.7; maxillary breadth, 5.0, 4.9; maxillary tooth row, 6.1, 6.0.

Remarks.—The dusky shrew was first recognized by Merriam (1891, p. 34) under the name *Sorex vagrans similis.* The name *Sorex similis,* however, had been previously used by Hensel (1855, p. 459) for a shrew from bone deposits at Cagliari, Sardinia. Later Merriam (1895, p. 72) renamed his Idaho form *Sorex obscurus.*

Like most other shrews, *S. o. obscurus* shows considerable individual variation, but the constancy of its general characters as a whole is truly surprising. It has an extensive latitudinal range throughout the Rocky Mountains from north-central Alaska south to central New Mexico and to the southern end of the Sierra Nevada in California, and specimens from extreme parts of the range match almost perfectly in essential characters. Specimens from many localities in western British Columbia indicate intergradation between *S. o. obscurus* and *S. o. setosus.* Thus specimens from Hope, British Columbia, which the writer has referred to *S. o. obscurus* can, with almost equal propriety, be called *S. o. setosus.* Some of the specimens

from Hazelton and vicinity have larger skulls and longer rostra than in typical *obscurus;* and, in fact, certain specimens from as far inland in British Columbia as Nelson show a tendency toward *setosus* in size of skulls. Skulls from Tanana, Alaska, are essentially like those of typical *obscurus.* The single skin from Tanana, however, shows in its winter pelage a tendency toward the color of *S. o. shumaginensis.* Specimens from Wells, Chilkat Valley, Alaska, although referable to the subspecies *obscurus*, show an approach toward *S. o. alascensis.* Certain specimens from the Cheonee Mountains, British Columbia, however, are noticeably inclined toward *alascensis* in cranial characters. Some of the specimens from southern Colorado and northern New Mexico show a slight approach toward *S. o. neomexicanus*, but it is not pronounced.

Specimens examined.—Total number, 1,082, as follows:

Alaska: Alatna, 1; Bettles, 5; Eagle (mountains near), 18; Richardson (Tanana River), 8; Savage River, 8; Tanana, 1; Toklat River (head of), 11; Wells, Chilkat Valley, 5[13]; Yukon River (20 miles above Circle), 1.

Alberta: Athabaska River (30 miles above Athabaska Landing), 7; Athabaska River (Swift Current), 2; Cavell Creek (mouth, altitude, 4,000 feet, Jasper Park), 1[14]; Crows Nest Pass, 9[15]; Henry House, 2; Henry House (15 miles south of), 5; Moose Mountain, 1[14]; Muskeg Creek (20 miles from mouth), 7; Red Deer River, 1[16]; Rodent Valley (25 miles west of Henry House), 1; Shovel Pass (altitude 7,500 feet), 4[14]; Smoky Valley (50 miles north of Jasper House), 1; Stony River (35 miles north of Jasper House), 1; Sulphur Prairie (Grand Cache River), 3; Waterton Lakes Park, 51.[14]

British Columbia: Babine Mountains (6 miles north of Babine Trail, altitude 5,200 feet), 1; Barkerville, 7; Bear Lake (site of Fort Connolly), 2; Bennett City, 6; Big Salmon River (south branch, near Canyon), 1; Caribou Lake (near Kamloops), 2; Chapa-atan River (mountains near, a head branch of Stikine River), 4; Cheonee Mountains, 3[16]; Cranbrook, 3[17]; Cranbrook (altitude 2,950–3,000 feet), 14[18]; Doch-da-on Creek, Stikine River, 1[19]; Doch Don Creek, Stikine River, 1[19]; Douglas, 3[14]; Fernie, 1[14]; Field, 3[20]; Flood Glacier, Stikine River, 1[19]; Fort Grahame, 3; Glacier, 13[21]; Glenora (above timber line), 1; Glenora, Stikine River, 3[19]; Golden, 1; Hazelton, 24[22]; Hope, 12[23]; Hudsons Hope, 2; Junction (4 miles north of Telegraph Creek), 7; Kispiox Valley (23 miles north Hazelton), 6[19]; Klappan River Valley (20 miles above mouth of Klappan River), 1; Klappan River Valley (Tset-ee-yeh River), 1; Level Mountain, 4[16]; Little Tahltan River, 1[16]; McDame Creek (Dease River, Quartz Creek, altitude 3,500 to 3,600 feet), 3; McDame Post, Dease River, 6; Mica Mountain (altitude 5,000 feet), 1[14]; Midway, 1[14]; Monishee, 1[23]; Moose River (north fork), 1; Moose Lake, 2; Moose Pass, 1; Myers Creek, 1[14]; Nelson, 9[24]; Nelson (6 miles south, Silver King Mine), 6; Nine-mile Mountain (altitude 4,500 feet, northeast of Hazelton), 11[19]; Okanagan, 9[25]; Okanagan Lake (west side, altitude 2,500 to 3,000 feet), 2; Okanagan Lake (9 miles west, altitude 5,000 feet), 1; Raspberry Creek, 10[16]; Salmon River (mouth of), 2[14]; Sawmill Lake (near Telegraph Creek), 5[19]; Second Summit (Skagit River, altitude 5,000 feet), 3[14]; Sicamous, 1; Similkameen River (3 miles east of, 5 miles north of U. S. boundary), 1; Skagit, 1[14]; Telegraph Creek, 3[16]; Telegraph Creek (summit, altitude 3,600 feet), 1; Wall Lake, 1; Wilson Creek (Atlin), 1[17]; Yellowhead Lake, 2[26]

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[13] D. R. Dickey coll., Pasadena, Calif.
[14] Nat. Mus. Canada.
[15] Acad. Nat. Sci. Philadelphia, 2; Nat. Mus. Canada, 7.
[16] Amer. Mus. Nat. Hist.
[17] Provincial Mus. British Columbia.
[18] C. B. Garrett coll., Cranbrook, British Columbia, 4.
[19] Mus. Vert. Zool.
[20] Acad. Nat. Sci. Philadelphia, 1.
[21] Acad. Nat. Sci. Philadelphia, 1; Amer. Mus. Nat. Hist., 7.
[22] Nat. Mus. Canada, 2; Mus. Vert. Zool., 21.
[23] Mus. Comp. Zool.
[24] Acad. Nat. Sci. Philadelphia.
[25] Provincial Mus. British Columbia, 5; Mus. Comp. Zool., 3.
[26] Nat. Mus. Canada, 1.

California: Big Pine Creek (10 miles west Big Pine, Sierra Nevada, altitude 8,000 feet, Inyo County), 1[19]; Bishop Creek (Sierra Nevada, altitude 6,600 to 7,000 feet), 5; Bullfrog Lake (altitude 10,600 feet), Fresno County, 4[19]; Cottonwood Lakes, 1[19]; Donner (altitude 7,900 feet), 1; Echo, Eldorado County (altitude 7,000 feet), 4[23]; Fletcher Creek (near Vogelsang Lake, Yosemite Park), 1[19]; Gem Lake, Mono County, 1[19]; Gilmore Lake, Mount Tallac, 1[19]; Glen Aulin (Tuolumne River, Yosemite Park, altitude 7,700 feet), 4[19]; Greenville (8 miles northwest), 1; Horse Corral Meadows, Fresno County, 3; Horse Corral Meadows (Fresno County, altitude 7,600 feet), 1[19]; Independence Lake, 4[19]; Indian Canyon (east fork, altitude 7,300 feet), Mariposa County, 4[19]; Jordan Hot Springs, Sierra Nevada, Tulare County, 1[19]; Kaweah River (east fork), 7; Kearsarge Pass (Sierra Nevada, altitude 6,000 feet), 1[19]; Kern Lakes, 1; Kern River (north fork, altitude 9,600 feet, Sierra Nevada), 1; Kern River (south fork), 4; Kings River Canyon, Fresno County (altitude 5,000 feet), 4[19]; Lake Tenaya, 5; Little Brush Meadow, Tulare County, 4[19]; Little Cottonwood Creek, Sierra Nevada, Inyo County, 2[19]; Little Onion Valley, Sierra Nevada, 1[19]; Lone Pine Creek (altitude 4,500 feet), Inyo County, 2[19]; Lyell Canyon (head of, altitude 9,800 to 10,800 feet), Yosemite National Park, 5[19]; Mammoth, Mono County, 23[27]; McCloud River, 1; Merced Lake (1 mile east), Yosemite National Park (altitude 7,400 to 7,500 feet), 7[19]; Mineral King, Sierra Nevada, 2; Moltkes Meadows (altitude 9,000 feet), Sierra Nevada, 1; Mono Meadow (near, Yosemite National Park), 7[19]; Mount Dana, 5; Mount Hoffman (near), 1[19]; Mount Lyell, 11; Mount Tallac, 1[28]; Mount Whitney (altitude 10,500 feet), 2[23]; Mount Whitney (head of Big Cottonwood Creek), 5; Mount Whitney (Whitney Creek), 4[28]; Mount Whitney (Whitney Meadows), 1[23]; Mount Whitney (Whitney Meadows, altitude 9,700 feet), 1; Onion Valley (altitude 8,500 feet, Sierra Nevada), 7[19]; Phillips, Eldorado County, 1[27]; Pine City, Mono County, 3[23]; Porcupine Flat (altitude 8,100 feet), Yosemite National Park, 14[19]; Pyramid Peak, Eldorado County, 1[16]; Round Valley, 1; San Joaquin River (altitude 8,000 feet, Sierra Nevada), 4; Sequoia National Park (Halstead Meadows), 4; Silver Lake, 2[16]; Summit, 1; Tuolumne Meadows (Yosemite National Park, altitude 8,600 feet), 15[19]; Tuolumne Meadows (Muir Meadow, altitude 9,300 feet), 1; Tuolumne Meadows (Mount Unicorn), 1; Tuolumne Meadows (north base Mount Lyell), 8; Tuolumne Meadows (Soda Springs), 4; Twin Lakes, Tulare County (head of north fork of Kaweah River), 1[19]; Vogelsang Lake (altitude 10,350 feet), Yosemite National Park, 3[19]; Warren Fork, Mono County (altitude 9,200 feet), 5[19]; Whitney Creek, Tulare County, 1[19]; Williams Butte, Mono County, 2[19].

Colorado: Almont, 2; Baxter Pass (altitude 8,500 feet), 2; Black Hawk, 1; Boulder, 3; Boulder (5 miles west, 5,600 feet), 3; Boulder County, 6; Buchanan Pass, Boulder County, 1; Colorado Springs (Hunters Creek, a tributary of Bear Creek, altitude 7,250 to 7,400 feet), 1[16]; Crested Butte, 1[19]; Eldora, 1; Fort Garland, 2; Gores Range, 1; Hermit, 1; Lake Moraine, El Paso County, 1[23]; Longs Peak (at timberline), 1; Monshower Meadows (27 miles west Saguache, 3 miles east Cochotope Pass), 2; Mount McClellan (altitude, 11,000 feet), 2; Navajo River, 6[30]; Nederland, 8[31]; Poudre (by river), 1[32]; Rabbit Ear Mountains (Arapahoe Pass), 2; St. Elmo (altitude, 10,100 feet), 2; Silver Lake, Boulder County, 5[30]; Silverton, 4; Uncompaghre Plateau (altitude, 8,500 feet), 3; Upper Navajo River, 1[30]; Ward (altitude, 9,500 feet), 1.

Idaho: Bald Mountain Ranger Station (10 miles south Idaho City, altitude, 7,400 feet), 2; Cabinet Mountains (east Priest Lake), 2; Lemhi Mountains (type locality), 7; Pahsimeroi Mountains, 1; Preuss Mountains, 1; Priest Lake, 4; Trude (4 miles south, altitude, 6,500 feet), 1.[27]

Montana: Bass Creek (northwest of Stevensville, altitude 4,000 feet), 1; Bear Paw Mountains (20 miles southeast of Fort Assiniboine), 2; Beartooth Mountains (at timberline), 2; Big Belt Mountains (Camas

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[16] Amer. Mus. Nat. Hist.
[19] Mus. Vert. Zool.
[23] Mus. Comp. Zool.
[27] D. R. Dickey coll.
[28] Field Mus. Nat. Hist.
[29] D. R. Dickey coll., 2.
[30] Colorado Mus. Nat. Hist.
[31] Acad. Nat. Sci. Philadelphia, 2.
[32] Kans. Univ. Mus.

Creek, 4 miles south of Fort Logan), 7; Big Snowy Mountains (15 miles south of Heath, north fork Flat Willow Creek), 1; Buffalo (13 miles west Buffalo Canyon), 2; Corvallis, 2; Emigrant Gulch (3 miles southeast Chico), 2; Fish Creek, Glacier Park, 2; Florence, 1; Gunsight Lake, Glacier Park, 2; Highwood Mountains, 13; Lewistown (7 miles northeast, Judith Mountains), 1; Little Belt Mountains (Dry Wolf Creek, 20 miles southwest of Stanford), 1; Little Belt Mountains (Neihart), 1; Little Belt Mountain (Otter Creek, 10 miles southwest of Geyser), 1; Little Belt Mountain (Sheep Creek, 16 miles north White Sulphur Springs), 1; Moccasin Mountains (5 miles northwest of Hilger), 3; McDermit Lake, 1; Ruby Mountains, 4; St. Mary Lakes, 10 [33]; Stevensville (8 miles northeast), 3; Sula, 1; Upper Stillwater Lake, 1; Ward Peak (Madison National Forest), 1; West Gallatin River (west fork), 4; Yellowstone, 1 [27]; Zortman, 1.

New Mexico: Jemez Mountains (head Santa Clara Creek, altitude 9,000 feet), 2; Jemez Mountains (Valle Sante Rosa, altitude 8,500 feet), 1; Manzano Mountains (east slope, near south end), 2; Pecos Baldy (altitude 11,000 to 11,700 feet), 4; Red River (3 miles north of, altitude 10,700 feet), 2; Taos (altitude 7,400 feet), 1; Twining (5 miles south of, altitude 9,800 to 12,500 feet), 5.

Northwest Territories: Fort Resolution, Mission Island, 1; Fort Simpson, 4 [26]; Nahanni River Mountains, Mackenzie River, 1.

Oregon: Anthony, 2 [34]; Wallowa Lake, 1; Wallowa Mountains (south of Wallowa Lake, altitude 8,500 feet), 1.

Saskatchewan: Cypress Hills (north edge of, 30 miles south of Maple Creek), 13 [14].

Utah: Beaver Mountains (Puffer Lake), 2; Currant Creek, Uinta Forest, 1 Fish Lake Plateau, 2; La Sal Mountains (altitude 11,000 feet), 1 Manti, 3; Parowan Mountains (Brian Head), 2; Pine Valley Mountains (altitude 8,300 feet), 10; Wasatch Mountains (summit, altitude 7,000 feet), 1.

Washington: Bauerman Ridge (west end, at Tungsten Mine, Okanogan County, altitude 6,800 feet), 1; Conconully, 2; Easton, 10; Entiat (20 miles up Entiat River), 1; Lake Chelan (head), 4; Pasayten River (near mouth east fork, altitude 3,900 feet), 1; Round Top Mountain 2 [35]; Stehekin, 4; Wenatchee, 1; Yakima Indian Reservation, Signal Peak (altitude 4,000 feet), 4.

Wyoming: Afton (10 miles north, Salt River), 1; Afton (10 miles south east, Salt River Mountains), 5; Astringent Creek, Yellowstone National Park, 1; Bear Creek (3 miles southwest of Eagle Peak, altitude 7,500 feet), 6; Beartooth Lake, 15; Big Horn Mountains (west slope head of Trappers Creek, altitude 8,500 feet), 6; Black Mountain (northeast base, Pat O'Hara Creek), 12; Black Rock Creek (2 miles west of Pass), 2; Bridgers Pass, 2; Bronx, Fremont County, 2 [23]; Casper Mountains (7 miles south of Casper, altitude 6,000 feet), 6 Evanston, 1; Ferris Mountains (altitude 7,800 to 8,500 feet), 13 Flat Mountain, Yellowstone National Park, 1; Green Mountains (miles east of Rongis, altitude 8,000 feet), 4; Jackeys Creek (3 miles south of Dubois), 1; Laramie Peak (north slope, altitude 8,000 to 8,80 feet), 7; La Barge Creek (altitude 9,000 feet), 1; Mammoth Ho Springs, 11; Moran, 7; Needle Mountain (altitude 10,000 feet), 2 Pacific Creek, 3; Pahaska (mouth of Grinnell Creek), 15; Pahask (Grinnell Creek, altitude 7,000 to 7,500 feet), 18; Pahaska Tepe (north Grinnell Creek, altitude 6,300 feet), 8; Rattlesnake Mountain (altitude 7,000 to 7,500 feet), 18; Shirley Mountains (altitude 7,60 feet), 7; Sierra Madre Mountains (altitude 8,800 feet, south bas Bridger Peak), 3; Springhill (12 miles north of Laramie Peak, altitud 6,300 feet), 10; Stanley (3 miles west, altitude 8,000 to 8,500 feet), 3 Surveyors Park (12 miles northeast of Pinedale, altitude 8,000 feet)

[14] Nat. Mus. Canada.
[23] Mus. Comp. Zool.
[26] Nat. Mus. Canada, 1.
[27] D. R. Dickey coll.
[33] Amer. Mus. Nat. Hist., 1.
[34] Amer. Mus. Nat. Hist., 1; Mus. Vert. Zool., 1.
[35] State Coll. Wash.

2; Teton Mountains (Moose Creek, altitude 6,800 feet), 9; Teton Mountains (south of Moose Creek, altitude 10,000 feet), 3; Teton Pass (above Fish Creek, altitude 7,200 feet), 15; Tower Falls, Yellowstone National Park, 1; Valley (Absaroka Mountains, altitude 7,000 to 7,500 feet), 14; Willow Park, Yellowstone National Park, 2; Woods Post Office, 1.

Yukon: Teslin Lake (near, Teslin Post), 1.[14]

SOREX OBSCURUS NEOMEXICANUS Bailey

New Mexican Dusky Shrew

(Pl. 2, c')

Sorex obscurus neomexicanus Bailey, Proc. Biol. Soc. Washington 26: 133, May 21, 1913.

Type specimen.—No. 100440, U. S. Nat. Mus., Biological Survey collection; ♂ old adult (teeth moderately worn), skin and skull; collected May 29, 1900, by Vernon Bailey.

Type locality.—Cloudcroft, altitude 9,000 feet in the Sacramento Mountains, Otero County, N. Mex.

Geographic range.—Mountains of south-central New Mexico. (Fig. 13.)

Diagnostic characters.—Similar to *Sorex o. obscurus* in size and color, possibly a trifle darker; skull larger and heavier than that of *S. o. obscurus*, much broader interorbitally and through brain case, with decidedly heavier dentition.

Color.—Winter pelage: Unknown. *Summer pelage:* Essentially like corresponding pelage of *S. o. obscurus*, possibly averaging a trifle darker. Upper parts fuscous to olive-brown, the color of the upper parts extending, slightly paler, well down over the sides; underparts smoke gray heavily tinged with avellaneous to light buff; tail indistinctly bicolor, olive-brown above, avellaneous to wood brown or almost buffy brown below, nearly to tip.

Skull.—Moderate in length, relatively rather broad, with heavy dentition. Maxillary tooth row long, about equal in length to that of *S. o. longicauda*. Skull larger and heavier than that of *S. o. obscurus*, much broader, with decidedly heavier dentition.

Measurements.—Type specimen (old adult male): Total length, 118; tail vertebrae, 45; hind foot, 15. Two adult females from type locality: Total length, 106, 103; tail vertebrae, 42, 41; hind foot, 14, 14. *Skull:* Type specimen (old adult male; teeth moderately worn): Condylobasal length,, 18.0; palatal length, 7.2; cranial breadth, 8.9; interorbital breadth, 4.0; maxillary breadth, 5.4; maxillary tooth row, 6.9. Average of three skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 17.6 (17.4–17.7); palatal length, 7.1 (7.0–7.2); cranial breadth, 8.8 (8.6–8.9); interorbital breadth, 3.9 (3.9–3.9); maxillary breadth, 5.3 (5.2–5.4); maxillary tooth row, 6.8 (6.7–6.9).

Remarks.—Specimens of *S. o. neomexicanus* are known only from certain mountain ranges in south-central New Mexico. The subspecies has a larger skull than that of *S. o. obscurus* with broader rostrum and heavier dentition. The size of the molariform teeth approaches that of *S. o. longicauda*, but the general shape of the skull is different and the New Mexican animal has a decidedly shorter tail. Intergradation with *S. o. obscurus* is indicated in certain specimens of the subspecies *obscurus* from northern New Mexico.

Specimens examined.—Total number, 10, as follows:

New Mexico: Capitan Mountains (southwest slope), 2; Cloudcroft (type locality), 7; Cloudcroft (10 miles northeast of), 1.

[14] Nat. Mus. Canada.

SOREX OBSCURUS PARVIDENS Jackson

San Bernardino Dusky Shrew

(Pls. 2, d'; 5, g)

Sorex obscurus parvidens Jackson, Journ. Mamm. 2: 161, August 19, 1921.

Type specimen.—No. 56561, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected October 3, 1893, by J. E. McLellan. Original number 242.

Type locality.—Spring known as Thurmans Camp, Bluff Lake, altitude about 7,500 feet, San Bernardino Mountains, Calif.[36]

Geographic range.—Known only from the San Bernardino and San Gabriel Mountains, San Bernardino County, Calif. (Fig. 13.)

Diagnostic characters.—Similar in size and color to *Sorex o. obscurus;* skull about the size of that of *S. o. obscurus*, narrower interorbitally, with distinctly flatter cranium, which is less expanded mastoidally (consequently the skull averages narrower in greatest lateral diameter); molariform teeth more deeply emarginate posteriorly than in *S. o. obscurus*, the unicuspids narrower, and the first incisors smaller. Paler than *S. o. isolatus* and less brownish ventrally; skull with flatter and narrower brain case than in that of *isolatus*.

Color.—*Winter pelage* unknown. Probably not essentially different from winter pelage of *S. o. obscurus*. *Summer pelage:* Similar to that of *S. o. obscurus;* upper parts between olive-brown and buffy brown, tending slightly toward Saccardo's umber, and gradually blending with color of underparts; underparts smoke gray more or less tinged with avellaneous or light ochraceous-buff; tail indistinctly bicolor, olive-brown above, buffy brown below darkening toward tip.

Skull.—Narrower interorbitally than that of *S. o. obscurus*, with narrower and distinctly flatter brain case, and on the average weaker dentition, particularly the unicuspidate teeth, the molariform teeth usually with more deeply emarginate posterior borders. Skull similar to that of *S. o. isolatus* but with narrower and decidedly flatter brain case.

Measurements.—Type specimen (adult male): Total length, 105; tail vertebrae, 45; hind foot, 12 (12.8 measured from dry skin by writer). Adult female from type locality: Total length, 106; tail vertebrae, 41; hind foot, 12 (12.6 measured from dry skin by writer). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.1; palatal length, 6.7; cranial breadth, 8.1; interorbital breadth, 3.5; maxillary breadth, 5.0; maxillary tooth row, 6.2. Skull of adult female (teeth slightly worn) from type locality: Condylobasal length, 16.4; palatal length, 6.4; cranial breadth, 8.0; interorbital breadth, 3.5; maxillary breadth, 4.9; maxillary tooth row, 5.8.

Remarks.—The rather flat and narrow skull of *S. o. parvidens*, combined with its weak dentition, distinguishes it from other forms of *S. obscurus*. The subspecies is probably confined to the San Bernardino and San Gabriel Mountains, Calif.

Specimens examined.—Total number, 7, as follows:

California: Bluff Lake, San Bernardino Mountains (altitude 7,500 feet) (type locality), 6[37]; Camp Baldy (San Antonio Canyon, altitude 4,200 feet), San Bernardino County, 1.[38]

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[36] In the original description of this form the writer designated Thurmans Camp, Bluff Lake, as on the "western side of San Bernardino Peak," obtaining these data from the catalogue and a letter of the collector of the type specimen, J. E. McLellan. (Jackson, 1921b, p. 161.) The writer is indebted to several of his California friends, namely, Joseph Grinnell, Laurence M. Huey, Donald R. Dickey, and Edmund C. Jaeger, for calling attention to the fact that Bluff Lake is not on the western side of San Bernardino Peak, but is separated from the peak by Santa Ana Canyon. McLellan's original notes give the locality as "a spring (called Thurmans Camp) on the west side of San Bernardino Peak at an altitude of about 9,000 feet." The only camp in the San Bernardino Mountains known as Thurmans Camp has long been abandoned and was located on what is now known as Bluff Lake, at an altitude of about 7,500 feet.

[37] D. R. Dickey coll., Pasadena, Calif., 2.

[38] D. R. Dickey coll.

SOREX OBSCURUS SHUMAGINENSIS Merriam

SHUMAGIN DUSKY SHREW

(Pls. 3, A; 6, J)

Sorex alascensis shumaginensis Merriam, Proc. Washington Acad. Sci. 2: 18, March 14, 1900.

S[orex] shumaginensis Osgood, North Amer. Fauna No. 21, p. 71, September 26, 1901.

[*Sorex*] [*glacialis*] *shumaginensis* Elliot, Field Columb. Mus. Publ. 45 (zoöl. series 2): 373, 1901.

Sorex obscurus shumaginensis Allen, Bul. Amer. Mus. Nat. Hist. 16: 228, 1902.

Type specimen.—No. 97993, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected July 17, 1899, by DeA. Saunders (measured by C. Hart Merriam and numbered 2210 in A. K. Fisher's catalogue).

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

Geographic range.—Western Alaska, from Seward Peninsula southeast to the northern part of Kenai Peninsula. (Fig. 13.)

Diagnostic characters.—About the size of *Sorex o. obscurus*, but paler and tending more toward a tricolor pattern, the sides buffy and paler than the upper parts, but darker and more buffy than the underparts; skull about the size of that of *S. o. obscurus*, with on the average somewhat shorter palate, rather narrower and more attenuate rostrum; more depressed orbitally, the brain case usually higher and rising more abruptly in the frontal region, dentition weaker. Smaller and paler than *S. o. alascensis;* skull smaller than that of *alascensis*, with shorter palate, narrower rostrum, and weaker dentition.

Color.—Winter pelage: Essentially like the winter pelage of *S. o. obscurus*. *Summer pelage:* Paler than corresponding pelage of *S. o. obscurus*, and tending toward a tricolor pattern, the sides buffy, paler than the upper parts, darker and more buffy than the underparts. Upper parts between olive-brown and buffy brown, slightly tending toward Saccardo's umber; sides, from the cheeks to the thighs, between wood brown and avellaneous, more nearly avellaneous; underparts pale smoke gray, sometimes tinged with pale olive-buff; tail as in *S. o. obscurus*.

Skull.—About the size of that of *S. o. obscurus*, with shorter palate, somewhat narrower and more attenuate rostrum; more depressed and constricted interorbitally, the brain case usually higher and rising more abruptly in the frontal region; dental pigmentation dark and intense; molariform teeth averaging smaller than in *S. o. obscurus*. Skull smaller than that of *S. o. alascensis*, with shorter and narrower palate, narrower and more attenuate rostrum; relatively narrower interorbitally, with weaker dentition.

Measurements.—Type specimen (adult male): Total length, 112; tail vertebrae, 42; hind foot, 14. Average of 6 adult males from King Cove, Alaska: Total length, 112.7 (107–118); tail vertebrae, 48.3 (45–52); hind foot, 13.8 (13–14). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.3; palatal length, 6.5; cranial breadth, 8.7; interorbital breadth, 3.6; maxillary breadth, 4.9; maxillary tooth row, 6.0. Average of 5 skulls of adult males (teeth very slightly worn) from type locality: Condylobasal length, 17.4 (17.1–17.8); palatal length, 6.6 (6.4–6.8); cranial breadth, 8.4 (8.3–8.5); interorbital breadth, 3.6 (3.5–3.7); maxillary breadth, 4.9 (4.8–5.0); maxillary tooth row, 6.1 (6.0–6.2). Average of 6 skulls of adult males (teeth slightly worn) from King Cove, Alaska: Condylobasal length, 16.8 (16.7–17.0); palatal length, 6.5 (6.4–6.6); cranial breadth, 8.6 (8.5–8.7); interorbital breadth, 3.5 (3.4–3.7); maxillary breadth, 4.8 (4.6–4.9); maxillary tooth row, 5.9 (5.8–6.0).

Remarks.—In summer pelage, *S. o. shumaginensis* in its typical form is readily separable from *S. o. obscurus* by its color; there are also good cranial differences. Specimens from Tyonek and Hope on Cook Inlet, Alaska, show an approach toward *S. o. obscurus* or *S. o.*

alascensis in that some of them have skulls that have rather longer rostra than in typical *shumaginensis*, and are less depressed orbitally and have their brain cases more flattened. They approach the subspecies *obscurus* more nearly than they do *alascensis*, and probably represent intergrades between *S. o. obscurus* and *shumaginensis*.

Five alcoholic specimens with imperfect skulls from Nulato, Alaska, and a similar specimen from St. Michael are provisionally referred to *S. o. shumaginensis*.

Specimens examined.—Total number, 381, as follows:

Alaska: Alaska Peninsula, 6[39]; Aniak, 1; Barabori, Kenai Peninsula, 1[39]; Becharof Lake, 8; Bethel, 7; Caribou Camp, Kenai Peninsula, 7[39]; Chignik, 6; Cold Bay, 14; Dillingham, 1; Ekwok, 1; Frosty Peak (east base), Alaska Peninsula, 15; Good News Bay, 1; Homer, 1[39]; Hope, 15; Hope (mountains near), 13; Kakhtul River, 5; Kakwok, 3; Kakwok River (80 miles up), 1; Kanatak, Portage Bay, 4; Katmai, 1[40]; Kenai Mountains, 37[39]; Kenai Peninsula, 24[39]; King Cove, 22; Kuskokwim River (200 miles above Bethel, Crooked Creek), 1[41]; Lake Aleknagik, 6; Moose Camp, Kenai Peninsula, 3[39]; Morzhovoi Bay, 7; Moller Bay, 1; Nome River, 2[39]; Nulato, 5; Nushagak, 15; Nushagak (25 miles above, Nushagak River), 1; Nushagak River, 1; Popof Island (type locality), 3; Russian Mission, 1[42]; Sand Point, Popof Island, 45[39]; St. Michaels, 1; Sawtooth Mountains, 2; Seldovia, 24[39]; Sheep Creek, 14[39]; Skwentna River (Mountain Climber Road House), 1; Tyonek, 48; Ugagik River, Alaska Peninsula, 3; Unga, 2; Unga Island, 1.

SOREX OBSCURUS ALASCENSIS Merriam

Alaskan Dusky Shrew

(Pl. 3, b)

Sorex obscurus alascensis Merriam, North Amer. Fauna No. 10, p. 76, December 31, 1895.

Sorex glacialis Merriam, Proc. Washington Acad. Sci. 2: 16, March 14, 1900. Type locality: Point Gustavus, east side of entrance to Glacier Bay, Alaska.

S[orex] alascensis Merriam, Proc. Washington Acad. Sci. 2: 18, March 14, 1900.

[*Sorex*] [*glacialis*] *alascensis* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 372. 1901.

Sorex alascensis alascensis Miller, U. S. Nat. Mus. Bul. 79, p. 16, December 31, 1912.

Type specimen.—No. 73539, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected July 10, 1895, by C. P. Streator.

Type locality.—Yakutat, Alaska.

Geographic range.—Coast region of Alaska from southern part of Kenai Peninsula south to Juneau; also Sheslay River, British Columbia. (Fig. 13.)

Diagnostic characters.—Similar in color to *Sorex o. obscurus* or very slightly darker, a trifle larger, with distinctly larger hind foot; skull larger than that of *S. o. obscurus*, with broader rostrum and brain case, and heavier dentition. Smaller, with shorter tail, and averaging paler than *S. o. longicauda;* skull smaller than that of *longicauda*, with noticeably shorter palate and rostrum, shorter maxillary tooth row, and weaker dentition. Larger and darker than *S. o. shumaginensis;* skull larger than that of *shumaginensis*, with longer palate, broader rostrum, and heavier dentition. Similar to *S. o. elassodon*, but

[39] Amer. Mus. Nat. Hist.
[40] Nat. Geog. Soc., Washington, D. C.
[41] D. R. Dickey coll., Pasadena, Calif.
[42] Mus. Vert. Zool.

hind foot larger; skull similar to that of *elassodon*, with broader rostrum and heavier unicuspidate teeth.

Color.—Winter pelage: Not appreciably different from that of *S. o. obscurus* or *S. o. shumaginensis*. *Summer pelage:* Similar to that of *S. o. obscurus*, averaging a trifle darker. Upper parts usually between olive-brown and sepia, frequently almost mummy brown, or mummy brown tending toward Dresden brown; color of upper parts extending well down on the sides and gradually mixing with color of ventral parts; underparts smoke gray more or less tinged with light buff or pinkish buff; tail bicolor, near olive-brown above, usually avellaneous to cinnamon-buff, sometimes buffy brown, below nearly to tip.

Skull.—Larger than that of *S. o. obscurus*, with relatively shorter palate (actually about the same), broader brain case and rostrum, longer tooth row, and heavier dentition. Larger than that of *S. o. shumaginensis*, with longer and broader palate, broader and less attenuate rostrum; relatively broader interorbitally, with distinctly heavier dentition. Compared with that of *S. o. longicauda*, smaller, with distinctly shorter palate and rostrum, shorter tooth row, and weaker dentition. Somewhat similar to that of *S. o. elassodon*, with broader brain case and rostrum, heavier dentition (particularly unicuspidate teeth), the dental pigmentation more extensive and intensive. Brain case higher, and dentition heavier with more extensive and intensive pigmentation than in *S. o. malitiosus*.

Measurements.—Type specimen (adult female): Total length, 115; tail vertebrae, 45; hind foot, 14.5. Average of three adult females from type locality: Total length, 118.3 (114–121); tail vertebrae, 50 (50–50); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 17.6; palatal length, 6.8; cranial breadth, 8.6; interorbital breadth, 3.7; maxillary breadth, 5.1; maxillary tooth row, 6.2. Average of three skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 17.7 (17.7–17.8); palatal length, 6.8 (6.7–6.9); cranial breadth, 8.7 (8.7–8.8); interorbital breadth, 3.7 (3.6–3.8); maxillary breadth, 5.2 (5.0–5.3); maxillary tooth row, 6.3 (6.2–6.4). Skull of type specimen of *S. glacialis* (adult male; teeth moderately worn) from Point Gustavus, Glacier Bay, Alaska: Condylobasal length, 17.6; palatal length, 6.8; cranial breadth, 8.6; interorbital breadth, 3.8; maxillary breadth, 5.0; maxillary tooth row, 6.4.

Remarks.—The comparatively large series of shrews now available from the coast region of Alaska shows that *Sorex glacialis* Merriam is identical with *S. o. alascensis* Merriam. The type specimen of *S. glacialis* is in very fresh summer pelage (June 12), and consequently the color of the upper parts is darker and more grayish than it would have been later in the season. A topotype taken a day earlier than the type specimen is darker above than typical *alascensis*, but matches specimens of *S. o. longicauda* from Wrangell, Alaska; the underparts of it are identical in color with specimens of *alascensis* in similar pelage. The skulls of both of the Point Gustavus specimens are indistinguishable from those of *alascensis*. Both specimens are easily referable to *alascensis*, at best showing only a slight tendency toward *longicauda* in the color of the underparts. Specimens from Juneau, Alaska, are intermediate between *alascensis* and *longicauda* in both external and cranial character. They are nearer to *alascensis*, however, to which they are here referred. A single specimen of a young animal from Taku River, Alaska, is likewise referable to *alascensis*, though showing a slight inclination toward *longicauda*.

Some of the specimens from islands in Prince William Sound have weaker dentition than typical *S. o. alascensis*, indicative of an approach toward *S. o. shumaginensis*.

Specimens examined.—Total number, 201, as follows:

Alaska: Bartlett Bay (in Glacier Bay), 26[43]; Cordova Bay (head of Prince William Sound), 1[44], Cordova Bay (head of, head of Cordova Inlet, Prince William Sound), 1[44]; Disc Island (Prince William Sound), 10[44]; Drier Bay (Knight Island, Prince William Sound), 20[44]; Eleanor Island (Prince William Sound), 6[44]; Elrington Island (north end, Prince William Sound), 3[44]; Glacier Bay (type locality of *glacialis*), 5[45]; Green Island (Prince William Sound), 3[44]; Hanning Bay (Montague Island, Prince William Sound), 5[44]; Hawkins Island (Prince William Sound), 5[44]; Herring Bay (Knight Island, Prince William Sound), 3[44]; Hinchinbrook Island (Prince William Sound), 6[44]; Hoodoo Island (Prince William Sound), 5[44]; Juneau, 36; La Touche (La Touche Island, Prince William Sound), 5[44]; Mendenhall River, 1; Montague Island (Prince William Sound), 16[44]; Montague Island (Zaikof Bay, Prince William Sound), 6[46]; Orca, 1; Portage, 2[44]; Port Nell Juan (mouth, Prince William Sound), 2[44]; Taku River, 2[44]; Valdez Narrows (Prince William Sound), 12[44]; Wortmans (Prince William Sound), 1[44]; Yakutat (type locality), 9[47]; Yakutat Bay, 1; Yakutat Bay (north shore), 2.

British Columbia: Sheslay River, 5[48]; Sheslay River (headwaters), 1.[48]

SOREX OBSCURUS MALITIOSUS Jackson

Warren Island Dusky Shrew

Sorex obscurus malitiosus Jackson, Proc. Biol. Soc. Washington 32: 23, April 11, 1919.

Type specimen.—No. 8401, Mus. Vert. Zool., Univ. California; ♀ adult (teeth slightly worn), skin and skull; collected May 21, 1909, by H. S. Swarth.

Type locality.—East side of Warren Island, Alaska.

Geographic range.—Known only from Warren and Coronation Islands, Alaska. (Fig. 14.)

Diagnostic characters.—Similar in size and superficial appearance to *Sorex o. longicauda*. Skull slightly more flattened than that of *longicauda* of corresponding age, the lachrymal foramen smaller and superior portion of rostrum broader. Larger than *S. o. classodon* with relatively larger feet; skull broader than that of *classodon* with longer rostrum. Larger than *S. o. alascensis* with longer tail; skull larger than that of *alascensis*, more flattened and averaging broader interorbitally.

Color.—Winter pelage: Tending to be more brownish than corresponding pelage of *S. o. longicauda*. Upper parts between chaetura drab and fuscous-black; underparts smoke gray heavily washed and intermixed with drab to wood brown; tail bicolor, between olive brown and sepia above, between buffy brown and tawny olive below nearly to tip. *Summer pelage:* Essentially like *longicauda* in similar pelage. Upper parts near mummy brown, becoming a very trifle darker on posterior parts (rump) and paling gradually into drabbish on the flanks; underparts and tail essentially as in winter.

Skull.—Broad, flat, and rather massive for the species *obscurus*. Slightly more flattened than that of *S. o. longicauda*, less depressed interorbitally, the brain case flatter and rising somewhat less abruptly in the frontal region, superior portion of rostrum broader and more flattened, lachrymal foramen smaller, unicuspidate teeth narrower, dental pigmentation less extensive. Larger, broader interorbitally, with broader, longer rostrum, and more deeply pigmented and heavier dentition than in *S. o. classodon*. Larger than that of *S. o. alascensis*, more flattened, averaging broader interorbitally, with relatively longer palate and heavier dentition.

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[43] D. R. Dickey coll., Pasadena, Calif., 4; Mus. Vert. Zool., 22.
[44] Mus. Vert. Zool.
[45] Mus. Vert. Zool., 3.
[46] Mus. Vert. Zool., 4.
[47] D. R. Dickey coll., 1.
[48] Amer. Mus. Nat. Hist.

Measurements.—Type specimen (adult female): Total length, 120; tail vertebrae, 56; hind foot, 15. Average of five adult males from type locality: Total length, 129.8 (126–135); tail vertebrae, 56.4 (53–61); hind foot, 15.4 (15–16). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.4; palatal length, 7.3; cranial breadth, 8.8; interorbital breadth, 3.8; maxillary breadth, 5.3; maxillary tooth row, 6.6. Average of five skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 18.4 (17.8–18.8); palatal length, 7.3 (7.2–7.4); cranial breadth, 8.9 (8.7–9.1); interorbital breadth, 4.0 (3.9–4.0); maxillary breadth, 5.2 (5.1–5.4); maxillary tooth row, 6.6 (6.4–6.7).

Remarks.—As far as known *S. o. malitiosus* is confined to Warren and Coronation Islands, Alaska. The specimens from Coronation Island are not strictly typical of *malitiosus*, being somewhat smaller, and the skulls have rather narrower brain cases. In fact, they could with almost equal propriety be called *S. o. elassodon*. In appearance and general characters *malitiosus* is more like *S. o. longicauda* than *elassodon*, although its geographic range is completely separated from that of *longicauda* by that of *elassodon*. Its skull is flattened, as in *elassodon*, but is much larger, heavier, and more massive.

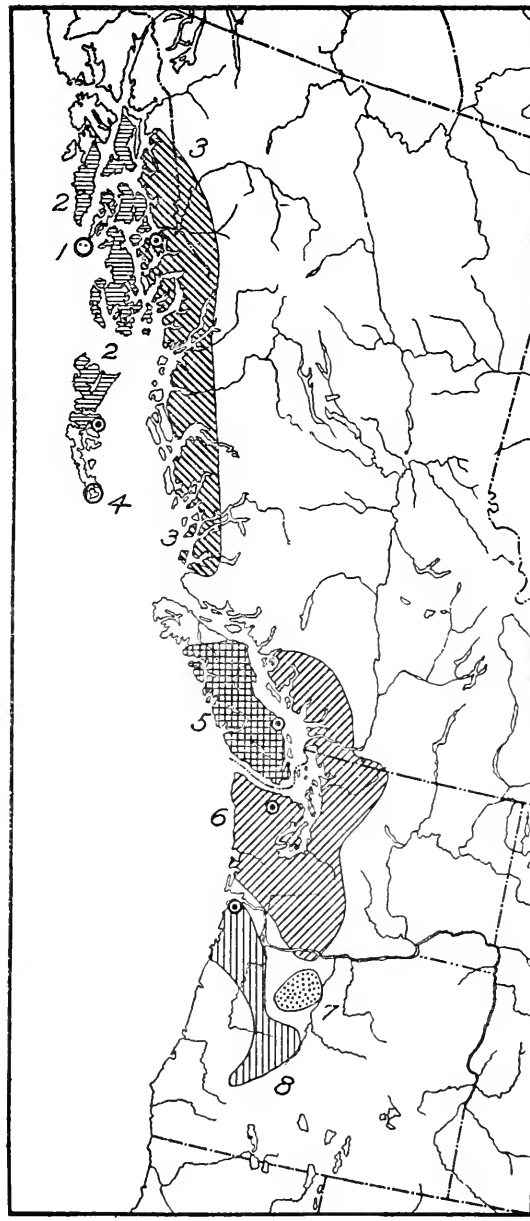

FIG. 14.—Geographic range of *Sorex obscurus malitiosus*, *S. o. elassodon*, *S. o. longicauda*, *S. o. prevostensis*, *S. o. isolatus*, *S. o. setosus*, *S. o. permiliensis*, and *S. o. bairdi*

1. *S. o. malitiosus.*
2. *S. o. elassodon.*
3. *S. o. longicauda.*
4. *S. o. prevostensis.*
5. *S. o isolatus.*
6. *S. o. setosus.*
7. *S. o. permiliensis.*
8. *S. o. bairdi.*

Specimens examined.—Total number, 21, as follows:

Alaska: Egg Harbor, Coronation Island, 11;[49] Warren Island (east side type locality), 10.[49]

SOREX OBSCURUS ELASSODON Osgood

Queen Charlotte Dusky Shrew

(Pl. 3, c)

Sorex longicauda elassodon Osgood, North Amer. Fauna No. 21, p. 35, September 26, 1901.

Sorex obscurus elassodon Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 450, 1905.

Type specimen.—No. 100597, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected June 13, 1900, by W. H. Osgood.

Type locality.—Cumshewa Inlet near old Indian village of Clew, Moresby Island, Queen Charlotte Islands, British Columbia.

Geographic range.—Certain islands of southeastern Alaska and British Columbia from Admiralty Island, Alaska, south to Moresby Island, Queen Charlotte Group, British Columbia (except Coronation and Warren Islands, Alaska, inhabited by *Sorex o. malitiosus*), including Admiralty, Baranof, Prince of Wales, Duke, Mitkof, and Forrester Islands, Alaska, and Graham, Langara, and Moresby Islands, British Columbia. (Fig. 14.)

General characters.—About the color of *S. o. longicauda*, but smaller, with relatively and actually shorter tail and smaller feet; skull smaller than that of *longicauda*, with shorter palate and narrower rostrum. Smaller and paler than *S. o. prevostensis*, with shorter palate and narrower rostrum. Much larger with distinctly longer tail and somewhat larger hind foot than *S. o. obscurus;* slightly darker; skull longer than that of *S. o. obscurus*, with rostrum actually about same dimensions, relatively smaller. Externally similar to *S. o. alascensis*, but hind foot shorter; skull about same size as that of *alascensis*, narrower through brain case and rostrum. Smaller than *S. o. malitiosus*, with smaller feet; skull narrower than that of *malitiosus* with shorter rostrum. Tail averaging shorter than in *S. o. setosus* and skull different.

Color.—Winter pelage: Unknown. *Summer pelage:* Similar to corresponding pelage of *S. o. longicauda*. Upper parts mummy brown to fuscous, the color of the back extending well down over the sides, changing gradually to color of underparts: underparts usually drab, or between wood brown and avellaneous, sometimes almost buffy brown, usually showing more or less of deep neutral gray of underparts; tail indistinctly bicolor, near fuscous above, drab or buffy brown below.

Skull.—Smaller than that of *S. o. longicauda* or *S. o. prevostensis*, with shorter palate and narrower rostrum. Skull longer than that of *S. o. obscurus*, with rostrum relatively smaller (actually about same dimensions). Similar to that of *S. o. alascensis*, with narrower brain case and rostrum, weaker dentition (particularly unicuspidate teeth), and less extensive and intensive dental pigmentation. Smaller, narrower interorbitally, with shorter, narrower rostrum and less intensely pigmented and weaker dentition than in *S. o. malitiosus*. Compared with that of *S. o. setosus*, the brain case is flatter, rostrum lower, and dentition less intensely and extensively pigmented.

Measurements.—Type specimen (adult male): Total length, 123; tail vertebrae, 52; hind foot, 14. Average of four adult males from type locality: Total length, 126 (119–131); tail vertebrae, 53.5 (52–55); hind foot, 13.8 (13–14). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.9; palatal length, 6.9; cranial breadth, 8.6; interorbital breadth, 3.5; maxillary breadth, 4.7; maxillary tooth row, 6.1. Average of four skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 17.9 (17.6–18.1); palatal length, 6.8 (6.7–6.9); cranial breadth, 8.6 (8.4–8.7); interorbital

[49] Mus. Vert. Zool.

breadth, 3.7 (3.5–3.9); maxillary breadth, 4.9 (4.7–5.0); maxillary tooth row, 6.3 (6.1–6.4).

Remarks.—Although confined to certain islands off the coast of British Columbia and Alaska, intergradation of characters between *S. o. elassodon*, *S. o. longicauda*, and *S. o. alascensis* seems clearly established. Specimens from the extreme northern end (Hawk Inlet) of Admiralty Island, Alaska, show a decided approach toward *alascensis*, several of the skulls being almost indistinguishable from typical skulls of *alascensis*. Certain skulls from Mitkof Island, Alaska, show, in their dentition, a slight approach toward *longicauda*, but on the whole they are easily referable to *elassodon*. A skin without skull (No. 238296, U. S. Nat. Mus.) from Port Conclusion, Baranof Island, Alaska, is provisionally referred to *elassodon*.

Specimens from Forrester Island, Alaska, are not strictly like typical *S. o. elassodon*, but the differences are too slight and inconstant for diagnosis as a different form. Externally these specimens are like *elassodon*, but some of their skulls seem a trifle larger than those of *elassodon* and have higher brain cases. There is indeed considerable variation, both geographic and individual, among the individuals of this species from nearly all the different islands. To recognize each of these slight geographic variations by name would cause only incomprehensible confusion.

Specimens examined.—Total number, 191, as follows:

Alaska: Admiralty Island (near Killisnoo), 2; Calder Bay, Prince of Wales Island, 2[50]; Coffman Cove, Prince of Wales Island, 1[51]; Duke Island, 2[50]; Forrester Island, 13[52]; Hawk Inlet, 13[50]; Heceta Island, 1[50]; Klawak Lake, Prince of Wales Island, 4[53]; Kuiu Island (Three-mile Arm), 1[50]; Kupreanof Island, 30[54]; Mitkof Island, 5[55]; Mitkof Island (Petersburg), 10; Mole Harbor, Admiralty Island, 7[50]; Point Baker, 1[51]; Port Conclusion, Baranof Island, 1[56]; Port Protection, Prince of Wales Island, 3[50]; Prince of Wales Island (Kasaan Bay), 18; Rocky Bay (northwest coast of Dall Island), 1[50]; St. John Harbor (Zarembo Island), 1[50]; San Alberta Bay (Prince of Wales Island, north shore), 2[50]; Scow Bay, Kupreanof Island, 1; Scow Bay, Mitkof Island, 2[51]; Shakan, Prince of Wales Island, 1[50]; Windfall Harbor, Admiralty Island, 10[50]; Woewodski Island, 4[57].

British Columbia: Graham Island, Queen Charlotte Islands, 2[58]; Langara Island, Queen Charlotte Islands, 2[51]; Massett (Graham Island, Queen Charlotte Islands), 10[59]; Moresby Island (Cumshewa Inlet, Queen Charlotte Islands) (type locality), 25; Skidegate (Graham Islands, Queen Charlotte Islands), 3[60]; Queen Charlotte Islands, 13.[57]

SOREX OBSCURUS LONGICAUDA Merriam

Long-tailed Dusky Shrew

(Pl. 3, d)

Sorex obscurus longicauda Merriam, North Amer. Fauna No. 10, p. 74, December 31, 1895.

S[orex] longicauda Merriam, Proc. Washington Acad. Sci. 2:16, March 14, 1900.

[*Sorex*] [*obscurus*] *longicaudus* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 372, 1901.

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[50] Mus. Vert. Zool.
[51] D. R. Dickey coll., Pasadena, Calif.
[52] D. R. Dickey Coll., 1; Mus. Vert. Zool., 10.
[53] Mus. Vert. Zool., 3.
[54] Mus. Vert. Zool., 14.
[55] Mus. Vert. Zool., 4.
[56] No skull, provisionally referred to *S. o. elassodon*.
[57] Amer. Mus. Nat. Hist.
[58] Nat. Mus. Canada.
[59] D. R. Dickey coll., 1; Nat. Mus. Canada, 3.
[60] Nat. Mus. Canada, 2.

Type specimen.—No. 74711, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected September 9, 1895, by C. P. Streator.

Type locality.—Wrangell, Alaska.

Geographic range.—Coastal region of southeastern Alaska and British Columbia from Port Snettisham, Alaska, south to River Inlet, British Columbia, including certain adjacent islands in Alaska, as Etolin, Gravina, Revillagigedo, Sergief, and Wrangell. (Fig. 14.)

Diagnostic characters.—Size large for the species *obscurus* (total length about 125); about the size of *Sorex o. bairdi* but with tail averaging longer, and color decidedly less reddish; skull somewhat similar in size and proportions to that of *bairdi*, with average shorter palate, narrower rostrum, higher and narrower brain case, and smaller and narrower unicuspids. Much larger, darker, with decidedly longer tail and hind foot than *S. o. obscurus;* skull decidedly larger in all dimensions than that of *S. o. obscurus*, with relatively longer rostrum, higher brain case, and heavier dentition. Averaging somewhat darker than *S. o. alascensis*, larger, with longer tail and hind foot; skull larger than that of *alascensis* with relatively longer and narrower rostrum, and longer maxillary teeth row, and heavier dentition. Larger than *S. o. elassodon*, with relatively and actually longer tail and larger feet; skull larger than that of *elassodon*, with longer, broader rostrum. Differs cranially from *S. o. malitiosus*, which it resembles externally. Averaging paler than *S. o. prevostensis* with relatively longer tail and larger hind foot; skull similar to that of *prevostensis*, the rostrum averaging slightly narrower. In color about like *S. o. setosus*, but larger, with larger hind foot; skull larger than that of *setosus*, with longer, heavier rostrum, longer tooth row, and heavier dentition.

Color.—Winter pelage: Usually a trifle darker than corresponding pelage of *S. o. obscurus* or *S. o. alascensis*. General effect of upper parts chaetura drab to fuscous, showing more or less dark neutral gray of base of hairs; color of upper parts extending, scarcely paling, well down on the sides, gradually changing into color of underparts; underparts usually pale olive-gray, or smoke gray to pale smoke gray, sometimes very faintly tinged with avellaneous; tail bicolor or indistinctly bicolor, near olive-brown, or tending toward sepia, above usually avellaneous, sometimes buffy brown below nearly to tip. *Summer pelage:* Upper parts fuscous to mummy brown, becoming scarcely, if any, paler on the sides; underparts relatively dark (but distinctly paler than upper parts), usually avellaneous to drab, more or less mixed with deep neutral gray of base of hairs, sometimes almost buffy brown; tail essentially as in winter.

Skull.—About the size and proportions of that of *S. o. bairdi*, with average shorter palate, narrower rostrum, higher and narrower brain case, smaller molariform teeth, which are generally more deeply emarginate posteriorly, and smaller and distinctly narrower unicuspids. Decidedly larger in all dimensions than that of *S. o. obscurus*, with relatively and actually longer rostrum, higher brain case, and much heavier dentition. Larger than the skull of *S. o. alascensis*, with relatively longer and narrower rostrum, longer maxillary tooth row, and heavier dentition. Larger than that of *S. o. elassodon*, with longer, broader rostrum and heavier and more deeply pigmented dentition. Slightly less flattened than that of *S. o. malitiosus*, a trifle more depressed interorbitally, the brain case higher and arising somewhat less abruptly in the frontal region, superior portion of rostrum narrower, lachrymal foramen larger, unicuspidate teeth broader, and dental pigmentation more extensive. Similar to that of *S. o. prevostensis*, the rostrum averaging somewhat narrower. Larger than that of *S. o. setosus*, with longer, heavier rostrum, longer tooth row, and heavier dentition, and tending to have the anterior end of first upper molariform tooth (second premolar) less truncate anteriorly (the tooth appearing more triangular in outline) than in *setosus*.

Measurements.—Type specimen (adult male): Total length, 128; tail vertebrae, 59; hind foot, 15.5. Average of eight adult females from type locality: Total length, 128 (122–133); tail vertebrae, 58.8 (56–62); hind foot, 15.3 (14.5–16). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 18.7; palatal length, 7.5; cranial breadth, 8.8; interorbital breadth, 3.8; maxillary breadth, 5.1; maxillary tooth row, 6.8. Average of eight skulls of adult females (teeth very slightly worn) from type locality: Condylobasal length, 18.6 (17.7–19.1); palatal length, 7.3 (7.1–7.5); cranial breadth,

8.8 (8.4–9.0); interorbital breadth, 3.9 (3.7–4.0); maxillary breadth, 5.2 (5.1–5.3); maxillary tooth row, 6.7 (6.5–6.9).

Remarks.—The large series of specimens of *S. o. longicauda* from the type locality displays a surprising degree of individual variation, especially in cranial characters. The subspecies as a whole, however, is well defined. Intergradation with the subspecies *elassodon*, *alascensis*, and *setosus* is clearly established. In fact, specimens from the entire coast region of British Columbia as far south as River Inlet are intermediate between *longicauda* and *setosus*, but in the aggregate are referable to *longicauda*.

Specimens examined.—Total number, 281, as follows:

Alaska: Anan Creek (mainland), 3[61]; Boca de Quadra, 4[62]; Bradfield Canal, 2[63]; Burroughs Bay (mainland), 1[64]; Chickamin River (Behm Canal), 5[63]; Crittenden Creek (mainland near Wrangell), 1; Etolin Island, 3[65]; Fort Wrangell, 14[66]; Gravina Island (opposite Ketchikan), 1[63]; Helm Bay, 9[63]; Ketchikan (mouth of Fish Creek), 2; Loring, 11; Portage Cove, Revillagigedo Island, 5[63]; Port Snettisham, 1[63]; Quadra Cannery, 7[67]; Quadra Lake, 3[64]; Sergief Island (mouth of Stikine River), 2[63]; Sumdum Village (mainland), 1[64]; Thomas Bay, 16[65]; Wrangell (type locality), 88[66]; Wrangell Island, 10.[63]

British Columbia: Great Glacier, Stikine River, 9[63]; Inverness (mouth Skeena River), 15; Khutze Inlet, 2[69]; Metlakatla, 6[70]; Port Simpson, 25; River Inlet (head), 35.

SOREX OBSCURUS PREVOSTENSIS Osgood

Prevost Island Dusky Shrew

Sorex longicauda prevostensis Osgood, North Amer. Fauna No. 21, p. 35, September 26, 1901.

Sorex obscurus prevostensis Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 450, 1905.

Type specimen.—No. 100618, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected July 3, 1900, by W. H. Osgood.

Type locality.—North end of Prevost Island (Kunghit Island on some maps), on coast of Houston Stewart Channel, Queen Charlotte Islands, British Columbia.

Geographic range.—Known only from type locality. (Fig. 14.)

Diagnostic characters.—Similar to *Sorex o. longicauda* but averaging darker, with relatively slightly shorter tail; skull similar to that of *longicauda*, the rostrum averaging slightly broader. Larger and darker than *S. o. classodon*, with larger hind foot; skull with longer palate and broader rostrum than in that of *elassodon*.

Color.—*Winter pelage:* Color of full winter fur unknown. Worn winter pelage of upper parts apparently darker and slightly more brownish than in *S. o. longicauda*, about fuscous-black; worn winter fur of underparts apparently about same color as in summer pelage. *Summer pelage:* Slightly darker than that of *longicauda* or *S. o. classodon*. Upper parts fuscous to fuscous-black, or mummy brown, the color of back encroaching well down over sides and changing gradually to color of underparts; underparts usually near drab, or between wood brown and buffy brown; tail rather indistinctly bicolor, fuscous or between clove brown and olive-brown above, usually near buffy brown or wood brown below.

Skull.—Similar to that of *S. o. longicauda*, the rostrum averaging slightly broader. Compared with that of *S. o. classodon*, palate longer, rostrum broader, dentition heavier.

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[61] D. R. Dickey coll., Pasadena, Calif., 2.
[62] D. R. Dickey coll., 2; Mus. Vert. Zool., 2.
[63] Mus. Vert. Zool.
[64] D. R. Dickey coll.
[65] Mus. Vert. Zool., 2.
[66] Amer. Mus. Nat. Hist.
[67] G. G. Cantwell coll., Palms, Calif., 1; D. R. Dickey coll., 5.
[68] D. R. Dickey coll., 24; G. G. Cantwell coll., 2; Mus. Vert. Zool., 8.
[69] Provincial Mus., British Columbia.
[70] Nat. Mus., Canada.

Measurements.—Type specimen (adult male): Total length, 133; tail vertebrae, 58; hind foot, 15. Average of three adult females from type locality: Total length, 136.3 (132–142); tail vertebrate, 56 (53–59); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 18.8; palatal length, 7.2; cranial breadth, 9.1; interorbital breadth, 4.0; maxillary breadth, 5.5; maxillary tooth row, 6.5. Average of four skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 18.5 (18.3–18.7); palatal length, 7.2 (7.1–7.3); cranial breadth, 8.9 (8.7–9.0); interorbital breadth, 3.9 (3.7–4.1); maxillary breadth, 5.4 (5.2–5.7); maxillary tooth row, 6.7 (6.5–6.8).

Remarks.—The Prevost Island shrew is not a widely differentiated subspecies and is more nearly like *S. o. longicauda* than *S. o. elassodon*, the nearest subspecies geographically. It is rather darker colored than *longicauda* and tends to be more brownish.

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

SOREX OBSCURUS ISOLATUS Jackson

VANCOUVER DUSKY SHREW

(PL. 3, E)

Sorex obscurus isolatus Jackson. Journ. Washington Acad. Sci. 12: 263, June 14, 1922.

Type specimen.—No. 177719, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected May 21, 1911, by Alexander Wetmore. Original number 517.

Type locality.—Mouth of Millstone Creek, Nanaimo, Vancouver Island, British Columbia.

Geographic range.—Vancouver Island, British Columbia. (Fig. 14.)

Diagnostic characters.—About the size of *S. o. obscurus* or *S. o. parvidens*, but darker than either, particularly the ventral parts, which are also decidedly more brownish. Unicuspidate teeth smaller than in *S. o. obscurus*, and the posterior borders of molariform teeth tending to be more deeply emarginate. Somewhat similar in color to *S. o. setosus*, but averaging smaller in all proportions, with relatively shorter tail; skull smaller than that of *setosus*, with relatively weaker dentition.

Color.—Winter pelage: Upper parts most nearly chaetura drab mixed with grayish, gradually blending with color of underparts; underparts smoke gray tinged with drab or between drab and avellaneous; tail somewhat bicolor, olive-brown above, buffy brown to almost tawny olive or clay color below. *Summer pelage:* Upper parts fuscous to olive-brown, paling slightly on the sides, and gradually encroaching on color of underparts; underparts smoke gray, heavily tinged with buffy brown or even darker; tail as in winter.

Skull.—Similar to that of *S. o. obscurus*, narrower interorbitally, with on the average rather weaker dentition, particularly the unicuspidate teeth, the molariform teeth being usually a trifle more emarginate posteriorly. Skull similar to that of *S. o. parvidens*, but broader and higher through the brain case.

Measurements.—Type specimen (adult male): Total length, 113; tail vertebrae, 49; hind foot, 14. Adult female from type locality: Total length, 118; tail vertebrae, 48; hind foot, 14. *Skull:* Type specimen (adult male; teeth moderately worn): Condylobasal length, 17.4; palatal length, 6.6; cranial breadth, 8.5; interorbital breadth, 3.5; maxillary breadth, 4.9; maxillary tooth row, 6.3. Skull of adult female (teeth moderately worn) from type locality: Condylobasal length, 17.3; palatal length, 6.7; cranial breadth, 8.6; interorbital breadth, 3.5; maxillary breadth, 4.9; maxillary tooth row, 6.1.

Remarks.—In some respects *S. o. isolatus* is more nearly like *S. o. obscurus* than *S. o. setosus*, though geographically its range is adjacent to *setosus*. In color it is more nearly like *setosus*, and also in the general aspect of its skull; in size and body proportions, however,

and in dental characters it is more nearly like *S. o. obscurus*. In color it is not at all dissimilar to *S. v. vancouverensis*, but it has on the average a longer tail, larger hind feet, and the skull is broader rostrally and has heavier dentition.

Specimens examined.—Total number, 48, as follows:

British Columbia: Alberni Valley, Vancouver Island, 7[71]; Barclay Sound, 1[72]; Comox, 2[73]; Cowichan Lake, 1[74]; Departure Bay, 1[74]; Errington, Vancouver Island, 4[71]; French Creek, Vancouver Island, 2[71]; Golden Eagle Mine (18 miles south of Alberni, Vancouver Island), 5[71]; Goldstream, 5; Little Qualican River (Vancouver Island), 7[71]; Nanaimo (type locality), 3; Newcastle Island, 1[74]; Nootka, 3[74]; Parkville, Vancouver Island, 6[71].

SOREX OBSCURUS SETOSUS Elliot

Olympic Dusky Shrew

(Pl. 3, f)

Sorex setosus Elliot, Field Columb. Mus. Publ. 32 (zool. series 1): 274, March, 1899.

Sorex obscurus setosus Jackson, Proc. Biol. Soc. Washington 31: 127, November 29, 1918.

Type specimen.—No. $\frac{6213}{2358}$, Field Mus. Nat. Hist.; ♂ adult (teeth slightly worn), skin and skull; collected August 18, 1898, by D. G. Elliot.

Type locality.—Happy Lake, Olympic Mountains, Clallum County, Wash.

Geographic range.—Extreme southwestern British Columbia, western Washington, and extreme northwest-central Oregon (Parkdale), chiefly west of the Cascade Mountains. (Fig. 14.)

Diagnostic characters.—Color dark; tail relatively long. Similar in color to *S. o. longicauda*, smaller, with smaller feet; skull smaller than that of *longicauda*, with shorter, weaker rostrum, shorter maxillary tooth row and weaker dentition. Similar to *S. o. classodon* with average slightly longer tail and cranial differences. Darker than *S. o. obscurus*, with relatively and actually longer tail, and average larger hind foot; skull averaging slightly larger than that of *S. o. obscurus*, very slightly more constricted interorbitally, with, on the average, rather larger molariform teeth. About the size of *S. o. permiliensis*, with tail averaging a trifle longer, and color darker and decidedly more grayish (less reddish); skull essentially the size of that of *permiliensis*, possibly averaging slightly shorter, with narrower brain case, the unicuspidate teeth (particularly anterior two) somewhat weaker, and the posterior margins of molariform teeth usually less deeply emarginate. Larger than *S. o. isolatus* with longer tail; dentition, especially unicuspids and first incisors, heavier than in *isolatus*.

Color.—Winter pelage: Somewhat darker than corresponding pelage of *S. o. obscurus*, about as in *S. o. longicauda*. General effect of upper parts fuscous to fuscous-black, sometimes almost mummy brown, showing more or less dark neutral gray of base of hairs; color of upper parts extending well down on the sides, becoming scarcely paler, and gradually mixing with color of underparts, which are decidedly paler; underparts usually pale olive-gray, or smoke gray to pale smoke gray, sometimes faintly tinged with light buff or avellaneous; tail indistinctly bicolor, near olive-brown or tending toward sepia above, buffy brown or avellaneous, sometimes drabbish, below nearly to tip. *Summer pelage:* Darker than that of *S. o. obscurus;* essentially like that of *longicauda*. Upper parts mummy brown to fuscous, becoming scarcely paler on the sides; underparts usually relatively dark (decidedly paler than upper parts), about drab to

[71] Mus. Vert. Zool.
[72] Amer. Mus. Nat. Hist.
[73] Nat. Mus. Canada, 1.
[74] Nat. Mus. Canada.

avellaneous; more or less mixed with deep neutral gray of base of hairs, sometimes almost buffy brown; tail essentially as in winter.

Skull.—Intermediate in many respects between that of *S. o. obscurus* and *S. o. longicauda*. Averaging slightly larger than that of *S. o. obscurus* with higher brain case, somewhat more constricted interorbitally, with average larger molariform teeth. Smaller than the skull of *longicauda*, with shorter, weaker rostrum, shorter maxillary tooth row, weaker dentition, and tending to have anterior end of first upper molariform tooth (second premolar) more truncate anteriorly (appearing less triangular in outline of superior surface) than in *longicauda*. Apparently averaging shorter than the skull of *S. o. permiliensis*, with narrower cranium, the unicuspids (particularly anterior two) somewhat weaker, and the posterior borders of molariform teeth tending to be less deeply emarginate. Compared with that of *S. o. classodon* the skull of *setosus* is higher and more arched, particularly through brain case and rostrum, and the dental pigmentation is heavier and more extensive.

Measurements.—Type specimen (adult male): Total length, 120; tail vertebrae, 54; hind foot, 13. Average of 3 adult males from Quinault Lake, Wash.: Total length, 125.3 (124–126); tail vertebrae, 59.7 (59–60); hind foot, 13.7 (13–14). Average of 4 adult females from Mount Vernon, Wash.: Total length, 123.3 (118–128); tail vertebrae, 56.8 (55–59); hind foot, 14 (14–14). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.3; palatal length, 6.7; cranial breadth, 8.3; interorbital breadth, 3.6; maxillary breadth, 4.9; maxillary tooth row, 6.0. Average of 3 skulls of adult males (teeth slightly worn) from Quinault Lake, Wash.: Condylobasal length, 17.6 (17.3–17.8); palatal length, 7.1 (7.0–7.2); cranial breadth, 8.6 (8.5–8.7); interorbital breadth, 3.6 (3.5–3.6); maxillary breadth, 5.0 (4.9–5.0); maxillary tooth row, 6.3 (6.2–6.4). Average of 4 skulls of adult females (teeth slightly worn) from Mount Vernon, Wash.: Condylobasal length, 17.6 (17.4–17.8); palatal length, 7.0 (6.9–7.1); cranial breadth, 8.6 (8.5–8.7); interorbital breadth, 3.6 (3.5–3.7); maxillary breadth, 5.1 (4.9–5.3); maxillary tooth row, 6.3 (6.2–6.4).

Remarks.—Persons who are familiar with Soricidae, as understood to-day, know that the presence or absence of a flank gland is of no specific or subspecific diagnostic value, although its size, shape, and other characteristics may be. Nevertheless Elliot's description of this form and his specific name, *setosus*, were based primarily upon the presence of flank glands in two specimens that he himself collected in the Olympic Mountains, Wash. The name becomes tenable for the subspecies of *obscurus* found in the coastal region of southwestern British Columbia and in Washington west of the Cascade Mountains. A number of the specimens from British Columbia have smaller skulls and weaker dentition than typical *setosus*, indicating an approach toward *S. o. obscurus*. Indeed, in several of these the teeth are as small as in the smaller toothed representatives of the subspecies *obscurus*, but in other essential characters they are nearer *setosus*. Specimens from Carson and Mount Rainier, Wash., though referable to *setosus*, are intermediate between it and *S. o. obscurus*.

Specimens examined.—Total number, 475, as follows:

British Columbia: Agassiz, 10[75]; Brackendale, Howe Sound, 4[75]; Burrard Inlet, 7[75]; Chilliwack, 1; Chilliwack Lake, 3[75]; Chilliwack Valley, 47[75]; Gibsons Landing, Howe Sound, 16; Huntingdon, 2[75]; Langley, 2; Lund, Malaspina Inlet, 17; Mount Baker Range, 2[76]; Mount Baker Range (altitude 6,000 feet), 1[77]; Mount Lehman, 1[78]; Port Moody, 19; Rossland, 2[75]; Sumas, 21[79]; Tami Hy Creek, 1[75]; Thurston, 13[75]; Vancouver District (altitude 7,300 feet), 1.[75]

Oregon: Parkdale (2 miles west, altitude 1,500 feet), 2.

[75] Nat. Mus. Canada.
[76] Mus. Comp. Zool.
[77] Acad. Nat. Sci. Philadelphia.
[78] Amer. Mus. Nat. Hist.
[79] Acad. Nat. Sci. Philadelphia, 3; Mus. Comp. Zool., 1; Nat. Mus. Canada, 2.

Washington: Aberdeen, 5; Avon, 1; Barron (Bonite Mine, altitude 5,000 feet, Whatcom County), 1; Bear Prairie, Mount Rainier, 3; Buck Creek Pass (7 miles east Glacier Peak, altitude 5,500 feet), 1; Canyon Creek (3 miles south Soleduck River, altitude 3,550 to 4,550 feet), Clallam County, 10[80]; Carson (15 miles north at Government Springs, altitude 1,300 feet), 5; Cascade River (head of), 2; Cascade Tunnel, Chelan County (altitude 3,373 feet), 3[80]; Cat Creek (headwaters, altitude 4,500 feet), Clallam County, 9[81]; Cathlamet, 5; Cedarville, 3; Chehalis (8 miles west), 1; Chilliwack River (altitude 2,600 feet), Whatcom County, 2; Cloudy Pass (headwaters Agnes Creek), 1[82]; Conrad Meadows, 1; Crescent Lake (5 miles west), Olympic Mountains, 1; Dosewallips River (headwaters, Olympic Mountains, altitude, 4,500 feet), 3; Duckabush, 1; Elwha Basin (altitude 2,750 feet), Jefferson County, 5; Elwha River (Boulder Creek, altitude 560 feet), Clallam County, 4; Enumclaw, 1; Everett, 2; Glacier, 3; Glacier Basin (altitude 5,900 feet), Mount Rainier, 4; Grenville, Grays Harbor County, 2; Hamilton, 1; Happy Lake (type locality), 2[83]; Happy Lake (altitude 4,900 feet), Clallam County, 2; Hoh River (Glacier Creek, 8 miles southeast Olympic Ranger Station), Jefferson County, 1; Ilwaco, 3; James Lake (altitude 4,370 feet), Mount Rainier, 2[80]; Kapowsin, 1; Keechelus Lake, 9[84]; Kirkland, 1; Lake Cushman, 9[85]; Lake Quinault (altitude 180 feet), 3; Lapush, 8[86]; Longmire, Mount Rainier, 8[80]; Lyman Lake (altitude 5,500 feet), Chelan County, 1; McCain (Scenic, Tye River, altitude 2,100 feet), King County, 1; Messlers Ranch (1 mile west Rainier Park, altitude 2,000 feet), Mount Rainier, 5; Mora, 1; Mount Adams (Gotchen Creek, altitude 5,500 feet), 4[87]; Mount Angeles (altitude 5,000 to 6,000 feet), 4; Mount Baker, 6[82]; Mountain Meadows (altitude 4,900 feet), Mount Rainier, 1; Mount Rainier (west slope 5,400 feet), 1; Mount Rainier (west slope 6,800 feet), 1; Mount St. Helens (altitude 5,500 to 6,000 feet), 2; Mount St. Helens (8 miles south, altitude 600 feet), 2; Mount Vernon, 28; Neah Bay, 17; Oakville, 3; Ohanapecosh Lake (altitude 2,000 feet), Mount Rainier, 5; Olympia (4 miles south), 1; Owyhigh Lakes (altitude 5,100 feet), Mount Rainier, 2; Paradise Park (altitude 5,400 to 6,300 feet), Mount Rainier, 8[88]; Paradise Creek (altitude 5,200 feet), Mount Rainier, 4; Pasayten River (west fork, altitude 4,700 feet), Okanogan County, 2; Potlatch, 6[89]; Puget Island (1 mile south Cathlamet), 1; Puget Sound, 2; Quinault Lake, 18; Quinault River (headwaters, north fork, altitude 4,000 feet), Jefferson County, 1; Reflection Lake (altitude 4,900 feet), Mount Rainier, 3; Rockport (altitude 300 feet), 2; Roy, 1; St. Andrews Park (altitude 5,500 feet), Mount Rainier, 2; Seattle, 1; Scenic, 1[82]; Shelton, 2; Soleduck Divide (altitude 5,000 feet), 2[82]; Soleduck River (near head, altitude 4,500 feet), Olympic Mountains, 2; Spirit Lake (altitude 5,000 feet), Mount St. Helens, 2; Spray Park (altitude 5,500 feet), Mount Rainier, 4[80]; Stehekin (altitude 1,079 feet), 4[82]; Steilacoom, 2; Suez (10 miles south Neah Bay), 2; Suiattle River (Chiwawa Mountain fork, altitude 4,500 feet), Snohomish County, 4; Sunset Park (altitude 5,000 feet), 2[80]; Tacoma, 1; Tacoma (5 miles east), 1[89]; Tahoma Creek (altitude 2,500 to 2,900 feet), Mount Rainier, 3; Tenino, 2; Tokeland, Shoalwated Bay 2; Whatcom Pass (altitude 5,200 feet), Whatcom County, 2.

SOREX OBSCURUS PERMILIENSIS Jackson

Cascade Dusky Shrew

Sorex obscurus permiliensis Jackson, Proc. Biol. Soc. Washington 31: 128, November 29, 1918.

Type specimen.—No. 91048, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected October 2, 1897, by J. A. Loring.

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[80] State Coll. Wash., 1.
[81] State Coll. Wash., 2.
[82] State Coll. Wash.
[83] Field Mus. Nat. Hist.
[84] D. R. Dickey coll., Pasadena, Calif., 1; Acad. Nat. Sci. Philadelphia, 7; Univ. Mich., 1.
[85] Univ. Mich., 5.
[86] G. G. Cantwell coll., Palms, Calif., 1.
[87] State Coll. Wash., 3.
[88] D. R. Dickey coll., 2.
[89] D. R. Dickey coll.

Type locality.—Permilia Lake, west base of Mount Jefferson, Cascade Range, Marion County, Oreg.

Geographic range.—Known only from the Cascade Mountains (and foothills) of northern Oregon (Mount Hood south to Mount Jefferson). (Fig. 14.)

Diagnostic characters.—About the size of *Sorex o. setosus* with, on the average, slightly shorter tail; decidedly more reddish and paler in summer pelage than *setosus;* skull essentially the size of that of *setosus* (possibly averaging slightly longer), with broader brain case, the unicuspidate teeth (particularly anterior two) somewhat heavier, and the posterior margins of molariform teeth usually more emarginate. Slightly smaller and paler than *S. o. bairdi,* with actually and relatively smaller feet; skull smaller than that of *bairdi* with shorter palate, and decidedly weaker dentition.

Color.—*Winter pelage:* Upper parts slightly darker than hair brown, occasionally approaching chaetura drab, extending, very slightly paler, well down on sides; color of underparts in winter pelage unknown. *Summer pelage:* Decidedly more reddish than winter pelage. Upper parts between snuff brown and sepia, or slightly more yellowish than olive-brown, between Saccardo's umber and olive-brown, paling very slightly on the sides and grading into color of the underparts; underparts slightly paler than back, usually between buffy brown and tawny-olive, sometimes tending toward avellaneous; tail scarcely bicolor, above about same color as upper parts of body, becoming very slightly paler below.

Skull.—Large for the species *obscurus;* somewhat smaller than that of *S. o. bairdi,* averaging very slightly larger than that of *S. o. setosus,* and much larger and heavier than that of *S. o. obscurus.* Brain case broad, slightly flattened; rostrum relatively rather long and wide; interorbital region somewhat elongate, not much depressed; dentition moderately heavy, with intense and moderately extensive pigmentation. Skull most nearly like that of *setosus,* but averaging slightly longer, with broader brain case, the unicuspidate teeth (especially anterior two) somewhat heavier, and the posterior margins of the molariform teeth usually more emarginate. Rostrum and palate shorter than in that of *bairdi,* with decidedly weaker dentition. The zygomatic ridge of squamosal shows slight tendency to develop into shelf-like extension, but less so than in the skull *bairdi.*

Measurements.—Type specimen (adult male): Total length, 117; tail vertebrae, 51; hind foot, 14. Average of five adult females from type locality: Total length, 116.8 (112–120); tail vertebrae, 53.4 (50–58); hind foot, 14 (14–14). *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 17.9; palatal length, 7.2; cranial breadth, 8.8; interorbital breadth, 3.7; maxillary breadth, 5.2; maxillary tooth row, 6.4. Average of five skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 17.9 (17.6–18.4); palatal length, 7.2 (7.0–7.5); cranial breadth, 9.0 (8.8–9.3); interorbital breadth, 3.8 (3.6–4.0); maxillary breadth, 5.2 (5.1–5.3); maxillary tooth row, 6.4 (6.2–6.6).

Remarks.—The series of 17 specimens of *S. o. permiliensis* from the type locality was collected October 1 to 4, 1897. Three of these are in worn summer pelage; the others, including the type, are in various stages of molting from summer to winter pelage; none is in full winter fur, the underparts of all still retaining the summer coat. September specimens in summer pelage from Mount Hood, Oreg., appear a trifle darker than those from the type locality; this is partly due to the less expanded condition of the skins and partly to less worn pelage, but it may also indicate an approach toward *S. o. setosus.* A specimen of *setosus* from Conrad Meadows, Yakima County, Wash., also indicates in color and cranial characters intergradation between *setosus and permiliensis.* A single specimen from Detroit, Oreg., shows cranially an approach toward *S. o. bairdi.*

Specimens examined.—Total number, 21, as follows:

Oregon: Cascade Mountains (east base, Camas Prairie, southeast Mount Hood), 1: Detroit, 1: Mount Hood (near timberline), 2; Mount Jefferson (west base, Permilia Lake) (type locality), 17.

SOREX OBSCURUS BAIRDI Merriam

Baird Dusky Shrew

(Pl. 3, g)

Sorex bairdi Merriam, North Amer. Fauna No. 10, p. 77, December 31, 1895.
Sorex obscurus bairdi Jackson, Proc. Biol. Soc. Washington 31: 127, November 29, 1918.

Type specimen.—No. $\frac{17414}{24318}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected August 2, 1889, by T. S. Palmer.

Type locality.—Astoria, Oreg.

Geographic range.—Extreme northwestern Oregon (Astoria, Netarts, Portland) southeasterly and southeast of the Willamette River and west of the Cascade Mountains to Prospect, Jackson County. (Fig. 14.)

Diagnostic characters.—Size large for the species *obscurus;* about the size of *Sorex o. longicauda,* but with shorter tail and more reddish color; skull somewhat similar in size and proportions to that of *longicauda,* with average longer palate, broader rostrum, flatter and broader brain case, and larger and broader unicuspids. Slightly larger and darker than *S. o. permiliensis,* with actually and relatively larger feet; skull larger than that of *permiliensis,* with longer palate and decidedly heavier dentition. Somewhat similar in color to *Sorex yaquinae* (not so reddish), but decidedly smaller; skull smaller and higher than that of *S. yaquinae,* with weaker dentition, particularly noticeable in the unicuspids and first upper incisors.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Darker than corresponding pelage of *S. o. permiliensis;* somewhat like that of *S. o. longicauda,* but a trifle paler and more reddish. Upper parts usually most nearly between olive-brown and sepia, rarely almost fuscous, the color of upper parts extending well down over the sides, mixing gradually with color of the underparts; underparts drab tending strongly toward wood brown or buffy brown; tail scarcely bicolor, olive-brown above, buffy brown (darkening toward tip) below.

Skull.—Large and broad for the species *obscurus,* with large rostrum, and heavy dentition. About the size and general proportions of that of *S. o. longicauda* but with average longer palate, broader rostrum, broader and lower brain case, larger molariform teeth, which are usually less deeply emarginate posteriorly, and larger and distinctly broader unicuspids. Larger than that of *S. o. permiliensis,* with longer palate and rostrum, and decidedly heavier dentition, and with the zygomatic ridge of squamosal tending more to develop into a shelflike extension.

Measurements.—Type specimen (adult female): Total length, 130; tail vertebrae, 57; hind foot, 15. Average of three adult females from type locality: Total length, 125.7 (124–127); tail vertebrae, 53.7 (52–55); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 19.1; palatal length, 7.8; cranial breadth, 9.3; interorbital breadth, 4.1; maxillary breadth, 5.5; maxillary tooth row, 6.9. Average of three skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 18.5 (18.2–18.6); palatal length, 7.5 (7.4–7.6); cranial breadth, 9.0 (8.9–9.0); interorbital breadth, 3.8 (3.7–3.9); maxillary breadth, 5.3 (5.2–5.4); maxillary tooth row, 6.7 (6.6–6.7).

Remarks.—The Baird shrew is confined to lower elevations in Oregon west of the Cascade Mountains where it occurs at least as far south as Prospect, in Jackson County. The exact limits of its range and its relation to *Sorex yaquinae* are not satisfactorily determined. Specimens from Portland show an approach toward *S. o. permiliensis.* In color they are like *S. o. bairdi,* but in size of hind foot they are about as near *permiliensis.* The skulls also show the influence of *permiliensis,* one being practically identical with those of *bairdi* from

the type locality, others showing a tendency toward those of *permiliensis*.

Specimens examined.—Total number, 71, as follows:

Washington: Alpha, 1.[90]

Oregon: Astoria (type locality), 12; Blaine, 8[91]; Blue River, 1; McKenzie Bridge, 1; Netarts, 10[92]; Netarts Bay, 2[93]; Portland, 6; Prospect, 8[92]; Seaside, 3; Three Sisters (north slope, altitude 6,000 feet), 4; Tillamook, 6[94]; Tillamook (8 miles south, Pleasant Valley), 2[92]; Vida, 7.

SOREX YAQUINAE JACKSON

YAQUINA SHREW

(PLS. 3, H; 5, H; 6, K; 8, H; 12, L)

Sorex yaquinae Jackson, Proc. Biol. Soc. Washington 31: 127, November 29, 1918.

Type specimen.—No. 73051, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected July 18, 1895, by B. J. Bretherton.

Type locality.—Yaquina Bay, Lincoln County, Oreg.

Geographic range.—West-central Oregon north of the Umpqua River, from the coast east to Willamette Valley. (Fig. 15.)

Diagnostic characters.—In color and superficial appearance similar to *Sorex pacificus*, but smaller and with shorter tail and feet. Skull decidedly smaller in all dimensions than that of *S. pacificus*, with weaker rostrum, noticeably shorter tooth row and smaller teeth, particularly the second maxillary premolar; dental pigmentation darker than in *S. pacificus*. Somewhat more reddish in color than *S. o. bairdi*, and decidedly larger; skull larger and somewhat flatter than that of *bairdi*, with heavier dentition, particularly prominent in the unicuspids and first upper incisors.

Color.—Winter pelage: General tone of upper parts mummy brown or fuscous, tending slightly toward fuscous-black, paling almost imperceptibly on the head and face; color of back continuing well down on the sides and gradually changing into color of underparts. Underparts slightly paler than upper parts, near olive-brown or slightly darker; tail indistinctly bicolor, hair brown or drab above, light drab or avellaneous below; feet and tarsi avellaneous. *Summer pelage:* Distinctly more reddish than in winter. Upper parts between Prout's brown and cinnamon-brown, sometimes inclining toward sepia. Underparts slightly paler; near snuff brown, usually between snuff brown and Saccardo's umber; tail and feet about as in winter.

Skull.—Similar in general outline to that of *S. pacificus* but much smaller in all dimensions. Compared with that of other American members of the subgenus Sorex large, with broad and moderately flattened brain case; zygomatic ridge of squamosal developed, forming a trace of a shelf (more than in *S. o. bairdi* and decidedly less than in *S. pacificus*); interorbital region elongate, depressed; dentition heavy, heavier than that of *bairdi*, much weaker than that of *S. pacificus;* teeth rather intensively but not extensively pigmented; first and second unicuspids relatively broad, appearing more or less swollen (less so than in *S. pacificus*).

Measurements.—Type specimen (adult female): Total length, 137; tail vertebrae, 59; hind foot, 16. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 20.7; palatal length, 8.3; cranial breadth, 9.7; interorbital breadth, 4.3; maxillary breadth, 5.9; maxillary tooth row, 7.6. Skull of adult male (teeth slightly worn) from Gardiner, Oreg.: Condylobasal length, 20.0; palatal length, 8.0; cranial breadth, 9.9; interorbital breadth, 4.2; maxillary breadth, 6.1; maxillary tooth row, 7.4.

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[90] Univ. Mich.

[91] Univ. Mich., 6; D. R. Dickey coll., Pasadena, Calif., 2.

[92] D. R. Dickey coll.

[93] S. G. Jewett coll., Portland, Oreg.

[94] S. G. Jewett coll., 3; Alex. Walker coll., Tillamook, Oreg., 3.

Remarks.—The specimens of this shrew available are entirely inadequate for a satisfactory determination of its relationships with *S. o. bairdi* and *S. pacificus*. The species occupies a limited geographic range in western Oregon, and at Gardiner apparently occurs with *S. p. pacificus*, but in spite of general similarities these two shrews seem to be entirely distinct. It may be possible that the Umpqua River separates the two forms at Gardiner and that additional specimens may show intergradation between them nearer the headwaters of that stream. In a series of eight shrews from Vida, Oreg., there is a single specimen of *S. yaquinae* that is distinctly separable from the other seven, which are referable to *S. o. bairdi*. The differences, however, between certain specimens of *S. yaquinae* and *bairdi* are not great, and it is possible that additional specimens may show specific affinity between these two forms.

Specimens examined.—Total number, 12, as follows:

Oregon: Elkhead, 1; Eugene (3 miles west, Spencer Butte), 2[95]; Gardiner, 2; Mapleton, 3; Philomath (5 miles southwest), 2; Vida, 1; Yaquina Bay (type locality), 1.

SOREX PACIFICUS COUES

[Synonymy under subspecies]

Geographic range.—Pacific coast region from Umpqua River, Oreg., south to Point Reyes, Marin County, Calif. (Fig. 15.)

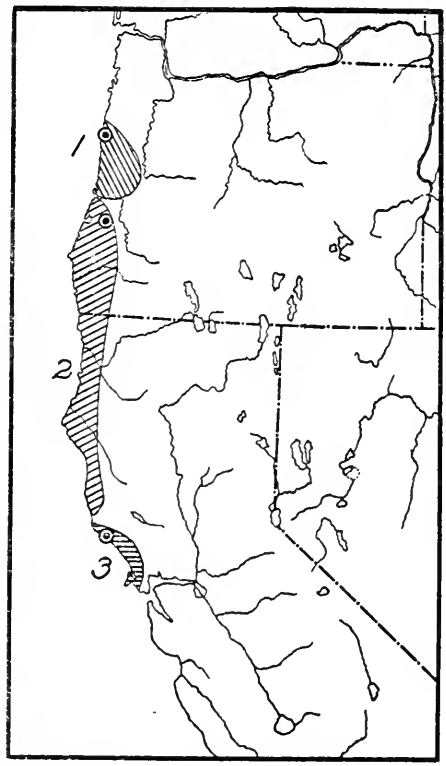

FIG. 15.—Geographic range of *Sorex yaquinae* and of subspecies of *S. pacificus*

1. *S. yaquinae.*
2. *S. p. pacificus.*
3. *S. p. sonomae.*

Diagnostic characters.—Size large (largest of the subgenus Sorex); cinnamon-like both above and below, the underparts scarcely differentiated from the back, the tail essentially unicolor; skull large and broad, with heavy rostrum; zygomatic ridge of squamosal well developed, forming a distinct shelf-like process extending posteriorly nearly to mastoidal region; dentition heavy, the unicuspids broad and swollen. Needs critical comparison only with *Sorex yaquinae*, which it resembles in color; larger than *S. yaquinae*, with larger feet; skull decidedly larger in all dimensions than that of *S. yaquinae*, with heavier rostrum, zygomatic ridge of squamosal more developed, noticeably longer tooth row and larger teeth, particularly the second upper premolar; dental pigmentation less intense.

Subspecies and geographic variation.—The species *pacificus* includes two subspecies—the typical form, *pacificus*, in the northern part of its range, and

[95] S. G. Jewett coll., Portland, Oreg.

sonomae in the southern part. The only noticeable geographic variation is a slight decrease in size and reduction of the reddish cinnamon color, in summer, toward the south, which culminates in the subspecies *sonomae*.

Time of molting.—Only a few specimens of *S. pacificus* in transition from winter to summer pelage are available, but it would appear that the spring molting usually occurs during May. Most of the June specimens are in complete summer pelage. Three males, however, from Crescent City, Calif., are in process of molt, though nearly completed, July 1, 3, and 5, 1899, and a female from the same locality still retains a trace of the winter pelage on the rump as late as July 30, 1894. A male from near Hardy, Calif., has a remnant of the winter fur June 22, 1919.

Winter pelage is usually acquired during October, and by the first to the middle of November the majority of specimens are in full winter coat. Seven males collected at Fair Oaks, Humboldt County, Calif., show indications of the beginning of the autumnal molt August 25 to 29, 1910, and three other males collected at Requa, Calif., show first traces of the molt on August 27, 28, and 31, 1901. A male from Gardiner, Oreg., has retained the summer pelage and is in early process of molt as late as November 26, 1901, and a female collected at the same place is in similar condition of pelage November 28, 1901.

SOREX PACIFICUS PACIFICUS Coues

Pacific Shrew

(Pls. 3, 1; 5, 1; 6, L; 8, 1)

Sorex pacificus Coues, Bul. U. S. Geol. and Geog. Surv. Terr. 3: no. 3, p. 650, May 15, 1877.

Sorex pacificus pacificus Jackson, Journ. Mamm. 2: 162, August 19, 1921.

Type specimen.—No. 3266, U. S. Nat. Mus., adult (teeth slightly worn), sex unknown, poorly made skin, with fragmentary skull inside; skin torn about the mouth so as to expose what teeth are present, which consist of the upper incisors and unicuspids of both sides, the first upper molariform tooth (upper second premolar) of right side, the first four mandibular teeth of right side and first three of left; catalogued March 8, 1858, in U. S. National Museum; received from E. P. Vollum.

Type locality.—Fort Umpqua, mouth of Umpqua River, Douglas County, Oreg.

Geographic range.—Pacific coast region from the mouth of the Umpqua River, Oreg., south to Mendocino, Calif. (Fig. 15.)

Diagnostic characters.—Characters given under the species *pacificus* will separate the subspecies *pacificus* from all shrews except *S. p. sonomae.* Summer pelage usually slightly paler than in *sonomae;* size averaging larger, particularly noticeable cranially.

Color.—Winter pelage: Upper parts mummy brown or fuscous, tending toward fuscous-black; color of back extending well down over sides; underparts slightly paler than upper parts, nearly between olive-brown and buffy brown, sometimes tending toward Saccardo's umber; tail essentially unicolor, usually olive-brown, sometimes buffy brown, or even Saccardo's umber or tawny-olive. *Summer pelage:* Distinctly more reddish or cinnamon than in winter. Upper parts between Prout's brown and cinnamon-brown, sometimes between snuff brown and Saccardo's umber; underparts scarcely paler than back, usually between snuff brown and Saccardo's umber, sometimes inclining toward sepia; tail essentially as in winter.

Skull.—Large, broad, and massive (largest of the subgenus Sorex), with heavy rostrum and large teeth. Similar to that of *S. p. sonomae*, but averaging larger in all dimensions.

Measurements.—Adult female from Gardiner, Oreg. (essentially type locality): Total length, 150; tail vertebrae, 64; hind foot, 17.5. Average of five adult males from Eureka, Calif.: Total length, 144.8 (137–153); tall vertebrae,

64.2 (62–67); hind foot, 17.2 (17–17.5). *Skull:* Adult female (teeth very slightly worn) from Gardiner, Oreg. (essentially type locality): Condylobasal length, 21.6; palatal length, 9.0; cranial breadth, 10.4; interorbital breadth, 4.7; maxillary breadth, 6.4; maxillary tooth row, 8.1. Average of five skulls of adult males (teeth slightly to moderately worn) from Eureka, Calif.: Condylobasal length, 22.1 (21.4–23.0); palatal length, 9.3 (9.0–9.5); cranial breadth, 10.6 (10.4–11.2); interorbital breadth, 4.5 (4.4–4.7); maxillary breadth, 6.6 (6.5–6.9); maxillary tooth row, 8.5 (8.3–8.8).

Remarks.—There is some variation in size among the skulls of *S. p. pacificus* and in any large series of Californian specimens individuals can occasionally be found that are scarcely larger than certain skulls of *S. p. sonomae.* Specimens from the vicinity of Mendocino City, Calif., are intermediate in characters between *S. p. pacificus* and *sonomae*, but in the aggregate they are nearer *S. p. pacificus.*

Specimens examined.—Total number, 186, as follows:

California: Arcata, 9[96]; Carlotta, 3[97]; Carsons Camp, Mad River, Humboldt Bay, 5; Cape Mendocino, 2; Crescent City, 18[98]; Cuddleback, 4[99]; Dyerville (5 miles south of), 1; Elk River, 1[1]; Eureka, 33[2]; Fair Oaks, 19[3]; Ferndale, 1[99]; Gasquet, 4; Hardy, 3[97]; Hardy (7 miles north), 1[97]; Loleta, 7[97]; Mendocino, 19[4]; Orick, 15[5]; Requa, 16[6]; Smith River, 2; Trinidad, 9[99]; Trinidad Head, 1.

Oregon: Fort Umpqua, Douglas County (type locality), 1; Gardiner, 2[7]; Goldbeach, 6[7]; Marshfield, 3[8]; Myrtle Point, 1.

SOREX PACIFICUS SONOMAE Jackson

Sonoma Shrew

Sorex pacificus sonomae Jackson, Journ. Mamm. 2: 162, August 19, 1921.

Type specimen.—No. 19658, Mus. Vert. Zool., University of California; ♀ adult (teeth moderately worn), skin and skeleton; collected July 2, 1913, by Alfred C. Shelton.

Type locality.—Sonoma County side of Gualala River, Gualala, Calif.

Geographic range.—Coast region of California from Point Arena south to Point Reyes. (Fig. 15.)

Diagnostic characters.—Similar to *Sorex p. pacificus* but averaging smaller, and a trifle darker and less reddish in summer pelage.

Color.—*Winter pelage:* Essentially like that of *S. p. pacificus. Summer pelage:* Averaging somewhat darker and less reddish than that of *S. p. pacificus;* scarcely more reddish or cinnamon than winter pelage. Upper parts mummy brown or fuscous, the color of the upper parts extending well down over the sides; underparts between olive-brown and buffy brown, tending toward sepia; tail essentially unicolor, about same color as underparts.

Skull.—Similar to that of *S. p. pacificus* but averaging smaller. Separable from that of *S. yaquinae* by specific characters.

Measurements.—Type specimen (adult female): Total length, 133; tail vertebrae, 59; hind foot, 16. Average of three adult males from type locality: Total length, 141.7 (141–143); tail vertebrae, 59 (54–63); hind foot, 17 (17–17). *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 21.1; palatal length, 8.9; cranial breadth, 10.3; interorbital breadth, 4.5; maxillary breadth, 6.3; maxillary tooth row, 8.1. Average of three skulls of adult males (teeth moderately worn) from type locality: Condylobasal

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[96] Mus. Vert. Zool., 6.
[97] D. R. Dickey coll., Pasadena, Calif.
[98] Field Mus. Nat. Hist., 1.
[99] Mus. Vert. Zool.
[1] Mus. Comp. Zool.
[2] D. R. Dickey coll., 2; Mus. Comp. Zool., 1; Field Mus. Nat. Hist., 11; Mus. Vert. Zool., 17.
[3] Mus. Comp. Zool., 3; Mus. Vert. Zool., 16.
[4] Field Mus. Nat. Hist., 3; Mus. Vert. Zool., 10.
[5] D. R. Dickey coll., 2.
[6] Field Mus. Nat. Hist., 15; Mus. Comp. Zool., 1.
[7] Field Mus. Nat. Hist.
[8] Field Mus. Nat. Hist., 2.

length, 21.4 (21.0–21.7); palatal length, 9.1 (8.9–9.2); cranial breadth, 10.5 (10.3–10.8); interorbital breadth, 4.5 (4.4–4.6); maxillary breadth, 6.4 (6.3–6.5); maxillary tooth row, 8.2 (8.0–8.4).

Remarks.—The southern form of *S. pacificus* is separable from true *pacificus* only in average differences of size and color. The larger skulls of *S. p. sonomae* can be fairly well matched by a very few small skulls of the subspecies *pacificus* from Eureka and other points in northern California. The differences on the whole, however, are well marked.

Specimens examined.—Total number, 35, as follows:

California: Bohemian Grove, Monte Rio, Sonoma County, 1[8]; Cazadero (7 miles west), Sonoma County, 2[8]; Gualala, 14[8]; Gualala, Gualala River (Sonoma County side) (type locality), 11[9]; Inverness, 5[10]; Point Arena, 2.[9]

TABLE 9.—*Cranial measurements of adult specimens of* Sorex vagrans-obscurus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. v. vagrans:										
Washington—Aberdeen.	24321	♂	16.4	6.5	7.9	3.2	4.6	5.5	Slight	
Do	24331	♂	16.6	6.6	8.3	3.4	4.8	5.7	do	
Do	24336	♂	16.8	6.4	8.2	3.3	4.6	5.6	do	
Do	24339	♂	16.5	6.4	8.2	3.3	4.5	5.6	do	
S. v. vancouverensis:										
British Columbia—Goldstream	71913	♂	16.6	6.5	8.2	3.2	4.5	5.7	Moderate	Type specimen.
Alberni Valley	[1] 12508	♂	16.1	6.4	8.1	3.2	4.6	5.6	do	
Do	[1] 12514	♂	16.6	6.6	8.2	3.3	4.6	5.7	do	
Do	[1] 12516	♂	16.5	6.5	8.4	3.2	4.5	5.6	do	
Do	[1] 12525	♂	16.1	6.5	8.2	3.4	4.5	5.5	do	
Do	[1] 12526	♂	16.5	6.5	8.2	3.2	4.7	5.6	do	
Do	[1] 12541	♂	16.8	6.5	8.2	3.3	4.5	5.7	do	
S. v. halicoetes:										
California—Palo Alto	[1] 3638	♂	16.8	6.5	----	3.6	5.0	5.9	Much	Type specimen.
Do	[1] 3635	♀	16.5	6.4	8.3	3.5	4.9	6.0	Slight	Type locality.
Do	[1] 3639	♂	17.0	6.6	8.5	3.5	4.8	6.0	Much	Do.
S. v. amoenus:										
California—Mammoth (near).	41863	♂	16.8	6.6	8.5	3.3	4.8	5.9	do	Type specimen.
Do	[2] D97	♀	16.5	6.4	8.2	3.2	4.8	5.7	Very slight	Type locality.
S. v. nevadensis:										
Nevada—Reese River	32302	♂	16.6	6.6	7.9	3.2	4.6	5.6	Slight	Type specimen.
Do	32303	♂	16.1	6.6	8.2	3.2	4.5	5.7	do	Type locality.
S. v. monticola:										
Arizona—San Francisco Mountain.	24535	♂	16.7	6.7	8.2	3.5	4.8	5.8	do	Type specimen.
White Mountains	208664	♂	16.3	6.7	8.2	3.6	4.8	5.8	Very slight	
Do	208665	♂	16.4	6.6	8.2	3.5	4.7	6.0	do	
Do	208335	♂	16.2	6.5	8.2	3.5	4.6	5.7	do	
Idaho—Alturas Lake	75000	♂	16.4	6.5	8.3	3.3	4.7	5.7	Slight	Type locality of *S. dobsoni.*
Sawtooth City	74999	♀	16.2	6.6	8.2	3.5	4.8	5.9	do	Do.
Do	75005	♀	16.9	6.7	8.3	3.7	5.0	5.8	do	Do.
S. v. orizabae:										
Puebla—Mount Orizaba.	53631	♂	16.9	6.6	8.2	3.3	4.6	6.0	Much	Type locality.
Do	53634	♂	16.5	6.5	8.0	3.4	4.6	6.0	do	Do.
Vera Cruz—Cofre de Perote.	54440	♀	16.5	6.5	7.8	3.5	4.6	6.0	Moderate	
Mexico—North slope of Volcan Toluca.	55898	♀	17.2	6.6	8.0	3.5	4.8	6.0	Slight	
Do	55900	♀	17.0	6.5	7.8	3.5	4.6	6.1	do	
S. durangae:										
Durango—El Salto	94540	♂	17.1	6.7	8.4	3.7	5.0	6.3	Much	Type specimen.

[1] Mus. Vert. Zool.
[2] D. R. Dickey coll., Pasadena, Calif.
[8] Mus. Vert. Zool.
[10] D. R. Dickey coll., 4; Mus. Vert. Zool., 1.

TABLE 9.—*Cranial measurements of adult specimens of* Sorex vagrans-obscurus *group*—Continued

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. o. obscurus:										
Idaho—Salmon River Mountains.	30943	♀	17.1	7.0	8.3	3.7	4.8	6.2	Slight	Type specimen.
Do	30940	♀	17.3	7.0	8.4	3.7	4.9	6.4	do	Type locality.
Do	30942	♀	16.9	6.8	8.2	3.8	5.0	6.2	do	Do.
Alaska—Mountains near Eagle.	131014	♂	16.6	6.7	8.4	3.7	4.9	6.0	do	
Do	131065	♂	17.4	6.9	8.5	3.7	5.2	6.0	do	
Do	131068	♂	17.1	6.8	8.5	3.7	5.0	6.1	do	
Do	131079	♂	17.6	6.8	8.4	3.7	5.1	6.3	do	
Do	131082	♂	17.3	6.9	8.4	3.7	4.9	6.2	do	
California—Mount Whitney.	41224	♀	16.7	6.7	8.4	3.8	5.0	6.1	do	
Do	42550	♀	16.9	6.7	8.3	3.7	4.9	6.0	do	
Wyoming—Mammoth Hot Springs, Yellowstone National Park.	120590	♂	16.8	6.8	8.5	3.7	5.0	6.3	do	
Do	120591	♂	16.8	6.8	8.2	3.7	4.9	6.1	do	
Do	120594	♂	16.4	6.8	8.5	3.7	4.9	6.0	do	
Do	120597	♂	17.2	7.0	8.4	3.7	5.1	6.2	do	
S. o. neomexicanus:										
New Mexico—Cloudcroft.	100440	♂	18.0	7.2	8.9	4.0	5.4	6.9	Moderate	Type specimen.
Do	100442	♀	17.4	7.2	8.6	3.9	5.4	6.9	Slight	Type locality.
Do	118789	♀	17.7	7.1	8.8	3.9	5.3	6.7	do	Do.
Do	118791	♀	17.6	7.0	8.9	3.9	5.2	6.7	do	Do.
S. o. parvidens:										
California—Bluff Lake, San Bernardino Mountains.	56561	♂	17.1	6.7	8.1	3.5	5.0	6.2	do	Type specimen.
Do	56558	♀	16.4	6.4	8.0	3.5	4.9	5.8	do	Type locality.
Do	56559	♂	17.2	6.5	8.0	3.3	4.9		do	Do.
S. o. shumaginensis:										
Alaska—										
Pop of Island, Shumagin Islands.	97993	♂	17.3	6.5	8.7	3.6	4.9	6.0	do	Type specimen.
Do	[3] 17648	♂	17.8	6.8	8.3	3.6	4.9	6.2	Very slight	Type locality.
Do	[3] 17655	♂	17.8	6.6	8.4	3.7	5.0	6.0	do	Do.
Do	[3] 17670	♂	17.1	6.4	8.3	3.6	4.8	6.0	do	Do.
Do	[3] 17681	♂	17.2	6.5	8.4	3.5	5.0	6.1	do	Do.
Do	[3] 17682	♂	17.3	6.8	8.5	3.6	5.0	6.1	do	Do.
Kings Cove, Alaska Peninsula.	177020	♂	16.8	6.5	8.6	3.4	4.6	5.9	Slight	
Do	177021	♂	16.8	6.5	8.5	3.7	4.9	6.0	do	
Do	177025	♂	16.7	6.5	8.7	3.4	4.8	5.9	do	
Do	177041	♂	17.0	6.4	8.6	3.6	4.8	6.0	do	
Do	177395	♂	16.8	6.4	8.6	3.5	4.9	5.8	do	
Do	177397	♂	16.9	6.6	8.5	3.4	4.6	5.8	do	
S. o. alascensis:										
Alaska—										
Yakutat Bay	73539	♀	17.6	6.8	8.6	3.7	5.1	6.2	do	Type specimen.
Do	73536	♀	17.7	6.9	8.8	3.8	5.3	6.4	do	Type locality.
Do	73538	♀	17.7	6.7	8.7	3.7	5.3	6.4	do	Do.
Do	73541	♀	17.8	6.8	8.7	3.6	5.0	6.2	do	Do.
Point Gustavus, Glacier Bay.	97769	♂	17.6	6.8	8.6	3.8	5.0	6.4	Moderate	Type specimen of *S. glacialis*.
S. o. malitiosus:										
Alaska—East side of Warren Island.	[1] 8401	♀	18.4	7.3	8.8	3.8	5.3	6.6	Slight	Type specimen.
Do	[1] 8398	♂	18.3	7.4	8.7	4.0	5.3	6.7	do	Type locality.
Do	[1] 8399	♂	18.6	7.3	9.1	3.9	5.4	6.7	do	Do.
Do	[1] 8402	♂	18.4	7.3	8.9	4.0	5.2	6.7	do	Do.
Do	[1] 8405	♂	17.8	7.2	8.8	4.0	5.2	6.4	do	Do.
Do	[1] 8406	♂	18.3	7.3	8.8	4.0	5.1	6.6	do	Do.
S. o. elassodon:										
British Columbia—Cumshewa Inlet, Moresby Island, Queen Charlotte Islands.	100597	♂	17.9	6.9	8.6	3.5	4.7	6.1	do	Type specimen.
Do	100593	♂	17.6	6.7	8.4	3.5	4.7	6.1	do	Type locality.
Do	100595	♂	17.9	6.9	8.6	3.7	4.9	6.3	do	Do
Do	109598	♂	18.0	6.8	8.7	3.9	5.0	6.4	do	Do.
Do	100601	♂	18.1	6.8	8.7	3.7	4.8	6.3	do	Do.

[1] Mus. Vert. Zool.

[3] Amer. Mus. Nat. Hist.

TABLE 9.—*Cranial measurements of adult specimens of* Sorex vagrans-obscurus *group*—Continued

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. o. longicauda:										
Alaska—Wrangell	74711	♂	18.7	7.5	8.8	3.8	5.1	6.8	Slight	Type specimen.
Do	74694	♀	18.5	7.3	9.0	3.8	5.3	6.6	Very slight	Type locality.
Do	74697	♀	18.3	7.2	8.7	3.9	5.2	6.5	do	Do.
Do	74708	♀	18.5	7.4	9.0	4.0	5.3	6.8	do	Do.
Do	74709	♀	18.8	7.4	9.0	3.9	5.2	6.8	do	Do.
Do	74713	♀	19.1	7.5	9.0	4.0	5.2	6.9	do	Do.
Do	74718	♀	17.7	7.1	8.6	3.8	5.1	6.5	do	Do.
Do	100566	♀	19.0	7.5	9.0	3.8	5.2	6.8	do	Do.
Do	100568	♀	18.8	7.3	8.4	3.7	5.3	6.7	do	Do.
S. o. prevostensis:										
British Columbia—Houston Stewart Channel, Prevost Island, Queen Charlotte Islands	100618	♂	18.8	7.2	9.1	4.0	5.5	6.5	Slight	Type specimen.
Do	100612	♀	18.4	7.2	8.7	4.0	5.4	6.6	do	Type locality.
Do	100616	♀	18.6	7.2	9.0	4.1	5.7	6.8	do	Do.
Do	100619	♀	18.7	7.3	8.9	3.7	5.2	6.7	do	Do.
Do	107254	♀	18.3	7.1	8.9	3.8	5.4	6.5	do	Do.
S. o. isolatus:										
British Columbia—Nanaimo	177719	♂	17.4	6.6	8.5	3.5	4.9	6.3	Moderate	Type specimen.
Do	177721	♀	17.3	6.7	8.6	3.5	4.9	6.1	do	Type locality.
S. o. setosus:										
Washington—Happy Lake, Olympic Mountains	[4] 238	♂	17.3	6.7	8.3	3.6	4.9	6.0	Slight	Type specimen.
Quinault Lake	89647	♂	17.7	7.1	8.7	3.6	4.9	6.4	do	
Do	89655	♂	17.8	7.2	8.6	3.5	5.0	6.3	do	
Do	89660	♂	17.3	7.0	8.5	3.6	5.0	6.2	do	
Mount Vernon	88817	♀	17.8	7.1	8.6	3.7	5.3	6.4	do	
Do	88824	♀	17.8	7.1	8.7	3.5	4.9	6.3	do	
Do	88832	♀	17.5	6.9	8.5	3.6	5.0	6.3	do	
Do	88833	♀	17.4	6.9	8.6	3.6	5.2	6.2	do	
S. o. permiliensis:										
Oregon—Permilia Lake, west base Mount Jefferson	91048	♂	17.9	7.2	8.8	3.7	5.2	6.4	do	Do.
Do	91047	♀	17.6	7.1	8.9	3.8	5.2	6.4	do	Type locality.
Do	91053	♀	17.8	7.2	8.8	3.7	5.1	6.4	do	Do.
Do	91055	♀	17.6	7.0	9.3	4.0	5.3	6.2	do	Do.
Do	91059	♀	18.4	7.5	9.0	3.8	5.2	6.6	do	Do.
Do	91061	♀	18.3	7.4	8.8	3.6	5.3	6.4	do	Do.
S. o. bairdi:										
Oregon—Astoria	24318	♀	19.1	7.8	9.3	4.1	5.5	6.9	do	Type specimen.
Do	24317	♀	18.6	7.4	9.0	3.7	5.2	6.6	do	Type locality.
Do	89022	♀	18.4	7.6	8.9	3.8	5.4	6.7	do	Do.
Do	89129	♀	18.2	7.5	9.0	3.9	5.3	6.7	do	Do.
S. yaquinae:										
Oregon—Yaquina Bay	73051	♀	20.7	8.3	9.7	4.3	5.9	7.6	do	Type specimen.
Gardiner	69445	♂	20.0	8.0	9.9	4.2	6.1	7.4	do	
S. p. pacificus:										
Oregon—Gardiner	[4] 9633	♀	21.6	9.0	10.4	4.7	6.4	8.1	Very slight	Essentially type locality.
California—Eureka	63521	♂	22.5	9.5	10.6	4.4	6.5	8.5	Moderate	
Do	[4] 9647	♂	21.6	9.3	10.4	4.4	6.5	8.3	Slight	
Do	[4] 9648	♂	23.0	9.5	11.2	4.7	6.9	8.8	do	
Do	[1] 11748	♂	21.4	9.0	10.4	4.5	6.5	8.3	do	
Do	[1] 11758	♂	22.2	9.4	10.5	4.6	6.8	8.5	do	
S. p. sonomae:										
California—Gualala	[1] 19658	♀	21.1	8.9	10.3	4.5	6.3	8.1	Moderate	Type specimen.
Do	[1] 19651	♂	21.4	9.2	10.8	4.5	6.4	8.4	do	Type locality.
Do	[1] 19652	♂	21.0	8.9	10.3	4.4	6.3	8.0	do	Do.
Do	[1] 19668	♂	21.7	9.2	10.4	4.6	6.5	8.2	do	Do.

[1] Mus. Vert. Zool.

[4] Field Mus. Nat. Hist.

SOREX STIZODON GROUP

The *stizodon* group includes a single species: *Sorex stizodon*. All the necessary group comparisons are made under the species.

SOREX STIZODON MERRIAM

PALE-TOOTHED SHREW

(PLS. 3, J; 5, J; 6, M; 8, J; 12, M)

Sorex stizodon Merriam, North Amer. Fauna No. 10, p. 98, December 31, 1895.

Type specimen.—No. 75885, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn); skin and skull; collected September 25, 1895, by E. W. Nelson and E. A. Goldman.

Type locality.—San Cristobal, altitude 9,000 feet, Chiapas, Mexico.

Geographic range.—Known only from the type locality.

Diagnostic characters.—Size rather small, color of ventral parts scarcely paler than back, tail relatively short. Skull broad and flattened, with noticeably short and wide rostrum; dentition moderately heavy, weakly pigmented, the third unicuspid about equal the fourth in size. Most nearly like *S. s. saussurei*, somewhat smaller, and darker ventrally; skull relatively shorter and broader than that of the species *saussurei*, particularly the rostral region; dentition weaker.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Upper parts bister, or a shade darker; underparts a trifle paler than upper parts, bister tending toward snuff brown; tail dark mummy brown above, slightly paler beneath.

Skull.—Distinctly flat and broad in superior aspect, the rostrum relatively short and wide, and brain case broad and flat; mesopterygoid space short and broad; occipital foramen small, narrow in intero-exterior diameter; dentition moderately heavy, very weakly pigmented; third unicuspid about equal in size to fourth. Differs from other Mexican Sorex in the scanty pigmentation of the teeth; and in having the intero-exterior diameter of first upper molariform tooth distinctly greater than the antero-posterior diameter.

Measurements.—Type specimen (adult female): Total length, 107; tail vertebrae, 41; hind foot, 13.5. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 17.5; palatal length, 7.0; cranial breadth, 8.9; interorbital breadth, 4.2; maxillary breadth, 5.6; maxillary tooth row, 6.4.

Remarks.—Only the type specimen of *S. stizodon* is available for study. This shows so many distinctive characters and differs so widely from other shrews in two or three of these characters that it seems well to place the species in a group by itself. Its nearest affinity is probably *S. saussurei*, from which, however, it is distinctive in cranial characters.

Specimen examined.—One, the type specimen.

SOREX VERAEPACIS GROUP

The *veraepacis* group includes two species—*Sorex veraepacis* and *S. macrodon*.

Geographic range.—Central Vera Cruz and central Guerrero south and east to southern Oaxaca, Mexico; central and southern Chiapas, Mexico, and western Guatemala. (Fig. 16.)

Diagnostic characters.—Size large; tail long, dark both superiorly and inferiorly; color of body parts dark both dorsally and ventrally, the underparts scarcely, if any, paler than upper parts. Skull rather massive with relatively broad, high, and laterally angular cranium; broad interorbitally; wide mesopterygoid space; dentition rather heavy, the third unicuspidate tooth

smaller than the fourth; unicuspids with well-defined internal ridge (usually more or less pigmented in unworn teeth) extending from apex to cingulum, the cingulum relatively broad and distinct. Skull relatively higher, broader, and more angular than in any of the *saussurei* group, and the unicuspidate teeth different.

Remarks.—Shrews of the *veraepacis* group hardly need critical comparison with those of any other except the *saussurei* group. The large size, long tail, and dark colors of the members of this group together with the large skull with high and broad cranium are distinctive among other Mexican and Central American Sorex. Certain individual specimens of *S. v. mutabilis* may be superficially similar to some specimens of *S. saussurei*, particularly of the subspecies *veraecrucis*, but the combined external and cranial characters readily separate the two forms.

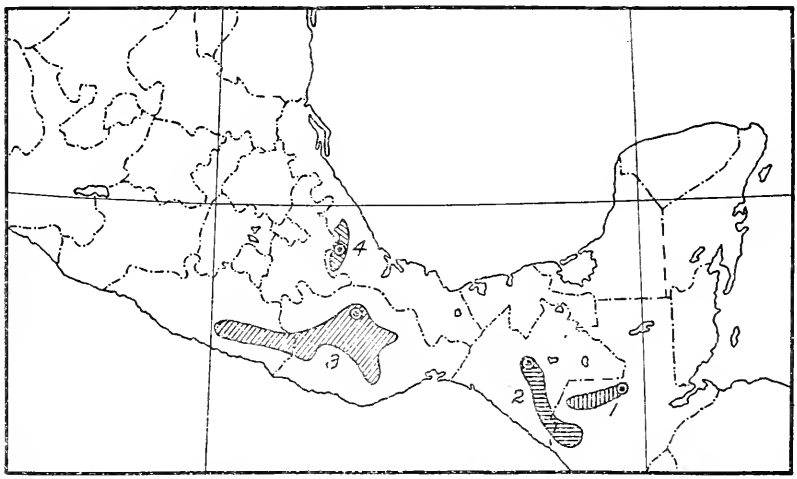

FIG. 16.—Geographic range of subspecies of *Sorex veraepacis* and of the species *S. macrodon*

1. *S. v. veraepacis.* 2. *S. v. mutabilis.* 3. *S. v. chiapensis.* 4. *S. macrodon.*

SOREX VERAEPACIS ALSTON

[Synonymy under subspecies]

Geographic range.—Central Guerrero east through central Oaxaca; central and southern Chiapas, and western Guatemala. (Fig. 16.)

Diagnostic characters.—Similar to *Sorex macrodon;* rostrum narrower; anterior nares smaller with noticeably thinner and weaker premaxillary borders, and molariform dentition weaker.

Subspecies and geographic variation.—The species *veraepacis* is composed of three subspecies, namely, *veraepacis, mutabilis,* and *chiapensis.* In the more westerly and northwesterly part of its range (subspecies *mutabilis*) the species is smaller and more brownish and a shade paler in color, with skull that is comparatively narrow in all dimensions and has smaller teeth. There is a gradual accentuation in size, in broadness of the skull, and size of teeth toward the east and south, which reaches a maximum in the subspecies *veraepacis* in Guatemala. There is also a tendency for the species to become progressively less brownish from the northwest toward the southeast.

Time of molting.—A male collected near Ozolotepec, Oaxaca, Mexico, March 26, 1895, has the spring molt well started; a male and a female, collected respectively March 26 and 27, from the same locality are still in winter pelage. Beginning of molt is shown in a male from Omilteme, Guerrero, May 18, 1903.

Just the bare beginning of the autumnal molt is indicated in three specimens collected October 20 to 22, 1894, at Reyes, Oaxaca; the other specimens from that locality collected at the same time still retain their summer fur without signs of molting. Specimens from San Cristobal, Chiapas, Mexico, collected between September 29 and October 6, all show that the autumnal molt has begun, although but slightly advanced in any of them.

SOREX VERAEPACIS VERAEPACIS Alston

Verapaz Shrew

(Pls. 3, K; 5, K; 6, N; 9, A; 11, J; 12, N)

Corsira temlyas Gray, Proc. Zool. Soc. London, part 11, 1845, p. 79, 1843. (Nomen nudum.)

Sorex verae-pacis Alston, Proc. Zool. Soc. London, 1877, p. 445, October, 1877.

C[orsira] teculyas (sic) Alston, Proc. Zool. Soc. London, 1877, p. 445, October, 1877. (In synonymy.)

Sorex veraepacis veraepacis Jackson, Proc. Biol. Soc. Washington 38: 130, November 13, 1925.

Type specimen.—Two cotypes: No. 43.6.13.8, British Museum (Natural History), skin and skull; No. 43.9.15.2, British Museum (Natural History), skin without skull. Upon the suggestion of Oldfield Thomas, No. 43.6.13.8, British Museum (Natural History), is hereby designated a lectotype, and No. 43.9.15.2, British Museum (Natural History), a lectoparatype.

Type locality.—Coban, Guatemala.

Geographic range.—Central and western Guatemala at about latitude 16° north. (Fig. 16.)

Diagnostic characters.—Size largest of the species *veraepacis;* skull relatively and actually broader than that of *Sorex v. mutabilis* or *chiapensis*, particularly interorbitally and through the brain case.

Color.—*Winter pelage:* Upper parts clove brown or darker, between clove brown and chaetura black; underparts between chaetura drab and hair brown, tending toward fuscous; tail above essentially same color as back, scarcely, if any, paler below. *Summer pelage:* Unknown.

Skull.—Largest of the species (condylobasal length over 19); noticeably broad interorbitally and through brain case (cranial breadth 10 or more); mesopterygoid space wide; dentition rather heavy. In size about equal that of *S. macrodon*, but anterior nares smaller with distinctly thinner and weaker premaxillary borders.

Measurements.—Average of four adult females from Todos Santos, Guatemala: Total length, 124.3 (119–128); tail vertebrae, 51 (48–57); hind foot, 15.5 (15–16). *Skull:* Average of four skulls of adult females (teeth slightly worn) from Todos Santos, Guatemala: Condylobasal length, 19.7 (19.4–19.9); palatal length, 8.0 (7.9–8.1); cranial breadth, 10.2 (10.1–10.3); interorbital breadth, 4.6 (4.4–4.8); maxillary breadth, 5.9 (5.7–6.1); maxillary tooth row, 7.5 (7.3–7.6).

Remarks.—The writer has seen no specimens of *S. v. veraepacis* from the type locality. Alston, who based his description on two specimens, says, "second to fourth [incisors] simple, gradually diminishing in size, canine [fourth unicuspid] slightly smaller than fourth incisor [third unicuspid]" (Alston, 1877, p. 455). This is also shown in his figure (op. cit., p. 446). Merriam, however, states on authority of Oldfield Thomas, who examined the type specimen, that the fourth unicuspid is distinctly higher than the third, and that

Alston's description is wrong (Merriam, 1895, p. 83). As already pointed out by Merriam (op. cit., p. 83), the relations of these teeth are correctly shown by Dobson (1890, pl. 23, fig. 8). The species, however, was misidentified by Dobson with *Sorex pacificus*.

Specimen examined.—Total number, 12, as follows:

Guatemala: Todos Santos, 12.

SOREX VERAEPACIS CHIAPENSIS Jackson

Chiapas Shrew

Sorex veraepacis chiapensis Jackson, Proc. Biol. Soc. Washington 38: 129, November 13, 1925.

Type specimen.—No. 75877, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected October 1, 1895, by E. W. Nelson and E. A. Goldman. Original number 8528.

Type locality.—San Cristobal, altitude 9,500 feet, Chiapas, Mexico.

Geographic range.—Central Chiapas, Mexico, to west-southwestern Guatemala. (Fig. 16.)

Diagnostic characters.—Intermediate in many respects between *Sorex v. veraepacis* and *S. v. mutabilis;* color in winter pelage, essentially like *S. v. veraepacis*, more grayish (less brownish) than *mutabilis;* smaller than *S. v. veraepacis*, about the size of *mutabilis* or a trifle larger, with shorter tail. Skull somewhat similar to that of *mutabilis*, broader through cranium and interorbitally, with wider mesopterygoid space.

Color.—Winter pelage: Upper parts clove brown or between clove brown and chaetura black; underparts slightly paler than clove brown or between chaetura drab and hair brown tending toward fuscous; tail near clove brown above, scarcely paler below. *Summer pelage:* Fuscous above, sometimes tending toward clove brown; underparts hair brown or between hair brown and fuscous; tail fuscous to clove brown above, scarcely paler below.

Skull.—Decidedly smaller than that of *S. v. veraepacis*, with noticeably narrower cranium. About the size of that of *S. v. mutabilis*, broader through cranium and interorbitally, *mesopterygoid space wider*, dentition usually somewhat heavier.

Measurements.—Type specimen (adult female): Total length, 120; tail vertebrae, 48; hind foot, 14.5. Average of three adult males from type locality: Total length, 119.3 (117–123); tail vertebrae, 48.3 (45–51); hind foot, 14.7 (14–15). *Skull:* Type specimen (adult female; teeth slightly worn); Condylobasal length, 18.3; palatal length, 7.3; cranial breadth, 9.5; interorbital breadth, 4.2; maxillary breadth, 5.3; maxillary tooth row, 7.0. Average of three skulls of adult males (teeth slightly worn) from type locality: Condylobasal length, 18.4 (18.3–18.6); palatal length, 7.3 (7.2–7.4); cranial breadth, 9.4 (9.3–9.5); interorbital breadth, 4.3 (4.2–4.4); maxillary breadth, 5.4 (5.3–5.5); maxillary tooth row, 7.1 (6.9–7.2).

Remarks.—Although in reality an intermediate between *S. v. veraepacis* and *S. v. mutabilis*, *S. v. chiapensis* is more like the former in external appearance but nearer the latter cranially. Skulls of *chiapensis* can be separated from those of true *veraepacis* by their smaller size, and from those of *mutabilis* by their wide mesopterygoid space. The geographic range of this form, when considered in relation to the range of the subspecies *veraepacis*, is rather aberrant and does not conform strictly with what one might expect from the topography of the region. The affinities of the few specimens available, however, seem very clear.

Specimens examined.—Total number, 19, as follows:

Chiapas: Piuabete, 1; San Cristobal (type locality), 8.
Guatemala: Calel, 4; Volcano Santa Maria, Quezaltenango, 6.

SOREX VERAEPACIS MUTABILIS Merriam

Dark-bellied Shrew

(Pl. 3, l)

Sorex saussurei caudatus Merriam, North Amer. Fauna No. 10, p. 84, December 31, 1895. Not *S. caudatus* Hodgson (nomen nudum, qui *S. caudatus* Horsfield), Annals and Mag. Nat. Hist. (series 2) 3: 203, 1849. Not *S. caudatus* Horsfield, Catal. Mamm. Mus. East Indian Co., p. 135, 1851, from Sikim and Darjeling, India.

Sorex saussurei mutabilis Merriam, Science (n. s.) 8: 782, December 2, 1898. New name for *S. saussurei caudatus* Merriam.

Sorex saussurii mutabilis Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 456, 1905.

Sorex veraepacis mutabilis Jackson, Proc. Biol. Soc. Washington 38: 130, November 13, 1925.

Type specimen.—No. 69600, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected October 21, 1894, by E. W. Nelson and E. A. Goldman.

Type locality.—Reyes (near Cuicatlan), altitude 10,200 feet, Oaxaca, Mexico.

Geographic range.—Central Guerrero east to north-central and east-central, and south to south-central Oaxaca. (Fig. 16.)

Diagnostic characters.—About the size of *S. v. chiapensis* or a trifle smaller, with relatively longer tail; color more brownish than in either *S. v. veracpacis* or *chiapensis;* skull averaging smaller and relatively narrower than that of *chiapensis*, decidedly smaller and narrower than that of *s. v. veracpacis*, with weaker dentition.

Color.—Winter pelage: Upper parts clove brown or a shade paler; underparts slightly darker than between wood brown and drab; tail clove brown above, very slightly, if any, paler beneath. *Summer pelage:* Upper parts between clove brown and sepia, sometimes almost bister or mummy brown; underparts usually darker than wood brown, almost between Saccardo's umber and bister, frequently scarcely paler than upper parts; tail as in winter.

Skull.—About the size of that of *S. v. chiapensis*, averaging a trifle smaller and relatively narrower; *mesopterygoid space narrower* than in *chiapensis;* and dentition averaging weaker.

Measurements.—Type specimen (adult female): Total length, 126; tail vertebrae, 57; hind foot, 14.5. Average of three adult females from type locality: Total length, 123.7 (121–128); tail vertebrae, 57 (56–58); hind foot, 14.8 (14.5–15). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.7; palatal length, 7.3; cranial breadth, 9.4; interorbital breadth, 4.3; maxillary breadth, 5.3; maxillary tooth row, 6.9. Average of three skulls of adult females (teeth slightly to moderately worn) from type locality: Condylobasal length, 18.3 (18.0–18.5); palatal length, 7.3 (7.2–7.4); cranial breadth, 9.1 (9.0–9.1); interorbital breadth, 4.1 (4.0–4.2); maxillary breadth, 5.3 (5.1–5.5); maxillary tooth row, 6.8 (6.6–6.9).

Remarks.—In his original description of this shrew, Merriam remarked upon the variability of skulls from single localities, more particularly from Reyes and Mount Zempoaltepec, stating that two types exist: "(1) A large skull with high brain case, large m^3 (with squarish body), long unicuspidate row, the anterior teeth of which are not markedly swollen; and (2) a slightly smaller skull with flatter brain case, smaller m^3 (with narrower body and rounded angles), shorter unicuspidate row, the first and second teeth of which are conspicuously swollen (broadened)" (Merriam, 1895, p. 84). Merriam was inclined to look upon these differences as sexual. The critical studies of the present investigator indicate clearly to him that these two so-called types represent two distinct species; the one with

the small flat skull, *saussurei;* the one with the large skull and high brain case, *veraepacis.* Moreover, in each of the series, the two forms can be separated by color differences, *S. s. saussurei* having distinctly paler ventral parts than *S. v. mutabilis.*

Specimens examined.—Total number 35, as follows:

Guerrero: Omilteme, 1.
Oaxaca: Cerro San Felipe, 4; Mount Zempoaltepec, 13; Ozolotepec, 3; Reyes (near Cuicatlan) (type locality), 7; Tontontepec, 7.

SOREX MACRODON Merriam

Large-toothed Shrew

(Pls. 3, m; 5, l; 9, b)

Sorex macrodon Merriam, North Amer. Fauna No. 10, p. 82, December 31, 1895.

Type specimen.—No. 58272, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected January 26, 1894, by E. W. Nelson and E. A. Goldman.

Type locality.—Orizaba, altitude 4,200 feet, Vera Cruz, Mexico.

Geographic range.—West-central Vera Cruz. (Fig. 16.)

Diagnostic characters.—Similar to *Sorex v. mutabilis* in color, possibly darker; size large, about as *S. v. veraepacis.* Differs cranially from any forms of the species *veraepacis* in the broad anterior nares with thick and heavy premaxillary borders.

Time of molting.—Only two specimens showing the molt are available. One of these, a male, was collected at Xico, Vera Cruz, July 6, 1893, and is apparently in complete summer pelage except for the retention of a very small patch of winter fur on the rump. The other, also a male, collected January 26, 1894, at Orizaba, Vera Cruz, is in complete winter pelage except on the cheeks, face, and occiput, which are in process of molt.

Color.—Winter pelage: Upper parts clove brown or a shade darker, or tending toward sepia, but darker; underparts scarcely paler than upper parts, between clove brown and sepia or a shade paler; tail dark clove brown above, clove brown or between clove brown and olive-brown below. *Summer pelage:* Barely different from winter pelage, possibly a shade paler. Upper parts clove brown tending toward bister; underparts most nearly between clove brown and sepia; tail as in winter.

Skull.—Large and massive; about the size of that of *S. v. veraepacis;* rostrum broader anteriorly; anterior nares broad, the premaxillary borders thick and heavy; dentition heavy; third unicuspid distinctly smaller than the fourth.

Measurements.—Type specimen (adult male): Total length, 128; tail vertebrae, 52; hind foot, 15.5. Adult male from Xico, Vera Cruz, Mexico: Total length, 130; tail vertebrae, 50; hind foot, 15. *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 19.6; palatal length, 8.0; cranial breadth, 9.7; interorbital breadth, 4.6; maxillary breadth, 6.0; maxillary tooth row, 7.4. Skull of adult male (teeth moderately worn) from Xico, Vera Cruz, Mexico: Condylobasal length, 19.2; palatal length, 8.0; cranial breadth, 9.9; interorbital breadth, 4.7; maxillary breadth, 6.1; maxillary tooth row, 7.3.

Remarks.—The geographic range of *S. macrodon,* as far as is known, occupies a small area in central Vera Cruz. The species shows close affinities with *S. veraepacis* and it would seem not at all improbable that when specimens are available from other localities the two forms may prove to be conspecific.

E. W. Nelson, in his manuscript report, states that his first specimen of this species was taken in the fir belt at 9,500 feet on the west slope of Mount Orizaba. Soon after he began his work at Xico, a specimen was taken under a rock in a damp place in a dense patch of low woods on the side of a canyon near town. Afterwards, in work-

ing higher up the slope, he found them to be rather common in the dense oak forest from 5,500 to 6,500 feet, which he considered to be their proper home. According to Nelson (manuscript), they are never found among grass and weeds, but seek the bare situations under logs and large stones in the damp forest, where their presence is indicated by curious broad runways made in the soft, loose earth. These runways were often from 3 to 4 inches broad and extended the entire length of the log or other shelter, and usually began at the entrance of the animal's burrow, which led into the ground under the base of the shelter.

Specimens examined.—Total number, 7, as follows:

Vera Cruz: Orizaba (type locality), 4; Xico, 3.

TABLE 10.—*Cranial measurements of adult specimens of* Sorex veraepacis *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. v. veraepacis:										
Guatemala—Todos Santos.	77029	♀	19.4	8.0	10.1	4.4	5.7	7.3	Slight	
Do	77030	♀	19.8	8.1	10.3	4.5	5.8	7.5	do	
Do	77032	♀	19.9	8.1	10.2	4.7	6.1	7.6	do	
Do	77033	♀	19.7	7.9	10.3	4.8	6.0	7.4	do	
Do	77034	♀	19.5	7.9	10.2	4.6	5.9	7.5	do	
S. v. mutabilis:										
Oaxaca—Reyes	69600	♀	18.7	7.3	9.4	4.3	5.3	6.9	do	Type specimen.
Do	69598	♀	18.0	7.2	9.1	4.2	5.2	6.9	do	Type locality.
Do	69601	♀	18.5	7.3	9.0	4.1	5.5	6.6	Moderate	Do.
Do	69602	♀	18.5	7.4	9.1	4.0	5.1	6.9	do	Do.
S. v. chiapensis:										
Chiapas—San Cristobal.	75877	♀	18.3	7.3	9.5	4.2	5.3	7.0	Slight	Type specimen.
Do	75878	♂	18.3	7.2	9.5	4.2	5.5	6.9	do	Type locality.
Do	75882	♂	18.6	7.4	9.3	4.3	5.3	7.1	do	Do.
Do	75884	♂	18.4	7.3	9.4	4.4	5.5	7.2	do	Do.
S. macrodon:										
Vera Cruz—										
Orizaba	58272	♂	19.6	8.0	9.7	4.6	6.0	7.4	do	Type specimen.
Xico	55101	♂	19.2	8.0	9.9	4.7	6.1	7.3	Moderate	

SOREX SAUSSUREI GROUP

The *saussurei* group includes four species: *Sorex saussurei*, *S. emarginatus*, *S. ventralis*, and *S. oreopolus*.

Geographic range.—Mexico, from southern Coahuila and southern Zacatecas south through Chiapas; extreme western Guatemala. (Fig. 17.)

Diagnostic characters.—Size medium to small; skull relatively flat, brain case rounded laterally (not angular); mesopterygoid space relatively narrow (except in *S. emarginatus*); teeth medium to small, the third unicuspid about equal the fourth in size, sometimes slightly smaller, sometimes slightly larger (distinctly larger in the three available specimens of *S. emarginatus*); unicuspids with poorly defined internal ridge (not pigmented) extending from near apex to cingulum, the cingulum relatively narrow, sloping, and indistinct. Compared with any of the *veraepacis* group the skull of any of the *saussurei* group is flatter, has a brain case more rounded (less angular) laterally, shorter unicuspidate tooth row, with different internal ridge and cingulum on unicuspids. Except in *S. emarginatus*, the mesopterygoid space in any of the *saussurei* group is relatively longer and narrower than in the *veraepacis* group

Remarks.—The members of the *saussurei* group, particularly the species *saussurei*, show many similarities to members of the *trowbridgii* group, especially in the general shape of skull and in the dentition. Geographically the two groups are now widely separated, but it seems not improbable either that one is the direct offshoot of the other, or that both are derived from a common ancestral form.

SOREX SAUSSUREI Merriam

[Synonymy under subspecies]

Geographic range.—Mexico, from southern Coahuila and southern Zacatecas south through Chiapas; extreme western Guatemala. (Fig. 17.)

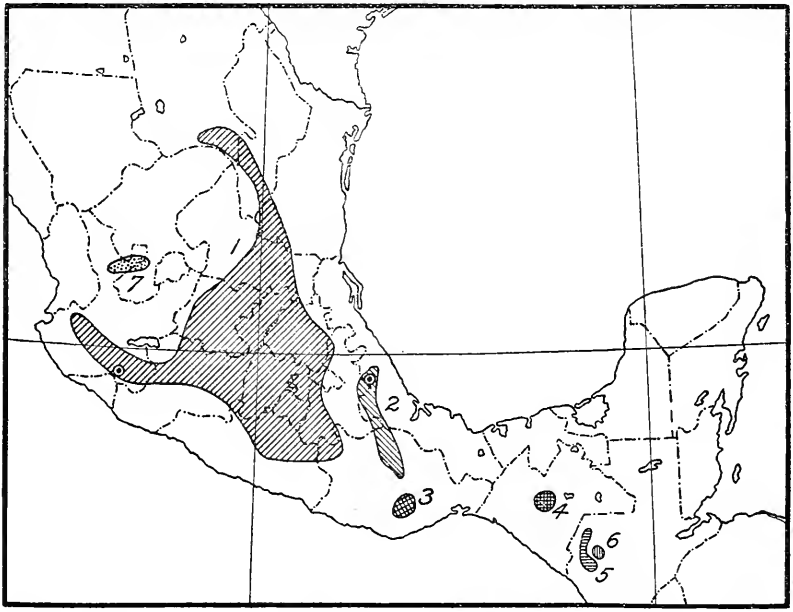

Fig. 17.—Geographic range of subspecies of *Sorex saussurei* and the species *S. emarginatus*

1. *S. s. saussurei.* 3. *S. s. oaxacae.* 5. *S. s. godmani.* 7. *S. emarginatus.*
2. *S. s. veraecrucis.* 4. *S. s. cristobalensis.* 6. *S. s. salvini.*

Diagnostic characters.—Except its subspecies *salvini*, the species *saussurei* is larger than *S. emarginatus*, *S. ventralis*, or *S. oreopolus*. The skull of *S. saussurei* is more depressed rostrally, the brain case more flattened, palate longer, and dentition heavier than in either *S. ventralis* or *S. oreopolus*. Compared with the skull of *S. emarginatus* that of the species *saussurei* differs in its larger size, relatively narrower and longer mesopterygoid space, broader and less emarginate first upper molariform tooth, and relatively larger fourth upper unicuspid.

Subspecies and geographic variation.—The species *saussurei* includes six subspecies: *saussurei*, *veraecrucis*, *oaxacae*, *cristobalensis*, *godmani*, and *salvini*. The subspecies *saussurei*, which occupies the most northwesterly part of the range of the species, is the palest in color and has a comparatively short tail. Passing easterly there is a slight tendency toward darkening in the color, and a noticeable increase in tail length, which culminates in the subspecies *veraecrucis*. The tendency toward darkening reaches extreme in the forms *oaxacae* and *cristobalensis*. The subspecies *godmani* is also dark colored and

with long tail, but quite in contrast the form *salvini*, although dark, has a short tail.

Time of molting.—Very few of the specimens at hand show indications of molting. A female from Omilteme, Guerrero, has fresh pelage May 17, 1903.

A female collected at Encarnacion, Hidalgo, Mexico, on October 4, 1896, has a trace of the winter pelage under the old fur over the posterior half of the back. Two females collected at Nahuatzin, Michoacan, have the molt well begun October 9 and 10, 1892, while a third appears to be in worn summer pelage October 12, and two others have the fresh pelage October 9 and 10.

SOREX SAUSSUREI SAUSSUREI MERRIAM

SAUSSURE SHREW

(PLS. 3, N, O; 5, M; 6, O; 9, C; 11, K; 13, A)

Sorex saussurei Merriam, Proc. Biol. Soc. Washington 7: 173, September 29, 1892.
Sorex saussurii Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 456, 1905.
Sorex saussurei saussurei Miller, U. S. Nat. Mus. Bul. 79, p. 19, December 31, 1912.

Type specimen.—Number $\frac{33667}{45702}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull; collected April 23, 1892, by E. W. Nelson.

Type locality.—North slope of Sierra Nevada de Colima, altitude about 8,000 feet, Jalisco, Mexico.

Geographic range.—Extreme southern Coahuila south through western Tamaulipas, Guanajuato, Hidalgo, and western Puebla to northwestern Oaxaca and central Guerrero, west through northern Michoacan to west-central Jalisco. (Fig. 17.)

Diagnostic characters.—Similar in color to *Sorex s. veraecrucis* and *S. emarginatus*, tail shorter than in *veraecrucis;* paler, particularly ventrally, than *S. s. oaxacae*. Skull averaging relatively broader and shorter in interorbital region than in that of *veraecrucis*, but relatively and actually narrower in all proportions than in *oaxacae*. Differs cranially and dentally from *S. emarginatus*.

Color.—Winter pelage: Upper parts fuscous to clove brown; underparts smoke gray to nearly pale smoke gray, more or less tinged with drabbish, rarely tinged with almost wood brown; tail sepia to mummy brown or sometimes near clove brown above, paler beneath, usually near wood brown. *Summer pelage:* Somewhat paler and more brownish than winter pelage. Upper parts fuscous or slightly paler, more frequently near bister or between sepia and bister; underparts about as in winter, possibly in certain specimens more stained with brownish; tail as in winter.

Skull.—Medium in size, moderately flattened, rather heavy rostrum. Relatively broader and shorter in interorbital region than that of *S. s. veraecrucis;* relatively and actually narrower in all proportions than that of *S. s. oaxacae*. Essentially like that of *S. s. salvini*, on the average a trifle larger.

Measurements.—Type specimen (adult female): Total length, 115; tail vertebrae, 48; hind foot, 14. Adult female from type locality: Total length, 122; tail vertebrae, 46; hind foot, 15. Two adult females from Nahuatzin, Michoacan, Mexico: Total length, 109, 115; tail vertebrae, 48, 47; hind foot, 14, 14. *Skull:* Type specimen (adult female, teeth moderately worn): Condylobasal length, 18.4; palatal length, 7.6; cranial breadth, 8.9; interorbital breadth, 4.3; maxillary breadth, 5.6; maxillary tooth row, 6.8. Skull of adult female (teeth moderately worn) from type locality: Condylobasal length, 18.0; palatal length, 7.5±; cranial breadth, 8.8; interorbital breadth, 4.2; maxillary breadth, 5.6; maxillary tooth row, 6.8. Skulls of two adult females (teeth slightly worn) from Nahuatzin, Michoacan, Mexico; Condylobasal length, 18.1, 18.2; palatal length, 7.3, 7.4; cranial breadth, 8.6, 8.7; interorbital breadth, 4.1, 4.2; maxillary breadth, 5.4, 5.3; maxillary tooth row, 6.5, 6.6.

Remarks.—The subspecies *saussurei* has one of the most extensive geographic ranges in Mexico of any form of Sorex. There is some local cranial variation in the available specimens, and to a less degree

occasionally an apparent slight color variation. On the whole, however, the subspecies is fairly constant in characters, and to recognize these slight local variations by name would only cause hopeless confusion.

Specimens examined.—Total number, 46, as follows:

Coahuila: Sierra Guadelupe, 2.
Guanajuato: Santa Rosa, 1.
Guerrero: Chilpancingo (mountains near), 2; Omilteme, 1.
Hidalgo: Encarnacion, 2.
Jalisco: San Sebastian, 2; Sierra Nevada de Colima (type locality), 2.
Mexico: Mount Popocatepetl, 2; Salazar, 2; Volcano Toluca (north slope), 1.
Michoacan: Mount Patamban (altitude 10,000 feet), 2; Mount Tancitaro, 6; Nahuatzin, 5; Patzcuaro, 1.[11]
Morelos: Tetela del Volcan, 1.
Nuevo Leon: Miquihuana, 4.
Oaxaca: Tamazulapan, 3; Tlapancingo, 2.
Puebla: Huachinango, 1.
Queretaro: Pinal de Amoles, 4.

SOREX SAUSSUREI VERAECRUCIS Jackson

Vera Cruz Shrew

(Pl. 3, p)

Sorex saussurei veraecrucis Jackson, Proc. Biol. Soc. Washington 38: 128, November 13, 1925.

Type specimen.—Number 55106, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected July 14, 1893, by E. W. Nelson. Original number 5235.

Type locality.—Xico, altitude 6,000 feet, State of Vera Cruz, Mexico.

Geographic range.—North-central part of the State of Vera Cruz south to Mount Zempoaltepec, eastern Oaxaca, Mexico. (Fig. 17.)

Diagnostic characters.—In color essentially like *Sorex s. saussurei*, tail averaging longer, and skull relatively more elongate and narrower in interorbital region. Paler, particularly ventrally, than *S. s. oaxacae*, or any subspecies of *S. saussurei* ranging to the south or east of it.

Color.—*Winter pelage:* Essentially like winter pelage of *S. s. saussurei*. *Summer pelage:* Averaging a shade darker than summer pelage of *S. s. saussurei*. Upper parts fuscous or slightly darker to clove brown; underparts mouse gray heavily tinged with drab or sometimes darker; clove brown to mummy brown above, slightly paler beneath.

Skull.—Relatively more elongate and narrow in interorbital region than that of *S. s. saussurei* or *S. s. oaxacae*. Dentition on the average somewhat heavier than in *S. s. saussurei*.

Measurements.—Type specimen (adult female): Total length, 118; tail vertebrae, 52; hind foot, 15. Adult female from type locality: Total length, 128; tail vertebrae, 60; hind foot, 15. Adult female from Mount Zempoaltepec, Oaxaca, Mexico: Total length, 126; tail vertebrae, 57; hind foot, 15. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.3; palatal length, 7.4; cranial breadth, 8.7; interorbital breadth, 4.1; maxillary breadth, 5.3; maxillary tooth row, 6.6. Skull of adult female (teeth unworn) from type locality: Condylobasal length, 18.1; palatal length, 7.4; cranial breadth, 8.7; interorbital breadth, 4.0; maxillary breadth, 5.4; maxillary tooth row, 6.7. Skull of adult female (teeth slightly worn) from Mount Zempoaltepec, Oaxaca, Mexico: Condylobasal length, 18.2; palatal length, 7.5; cranial breadth, 8.7; interorbital breadth, 4.0; maxillary breadth, 5.3; maxillary tooth row, 6.9.

Remarks.—The Vera Cruz shrew is a long-tailed form of *S. saussurei* the geographic range of which is confined principally to the

[11] Field Mus. Nat. Hist.

higher parts of the Atlantic drainage from central Vera Cruz and Puebla south to northeastern Oaxaca, Mexico. This form occurs with *S. v. mutabilis* at Reyes and Mount Zempoaltepec in the State of Oaxaca, and possibly at other localities. It may be separated from *mutabilis* by its narrower and more depressed skull with less laterally angular brain case. Intergradation with *S. s. saussurei* is indicated in specimens from the western part of the range of *S. s. veraecrucis*.

Specimens examined.—Total number, 12, as follows:

Oaxaca: Mount Zempoaltepec, 2; Reyes (near Cuicatlan), 3.
Puebla: Mount Orizaba, 1.
Vera Cruz: Las Vegas, 1; Xico (altitude 6,000 to 6,500 feet) (type locality), 5.

SOREX SAUSSUREI OAXACAE Jackson

Oaxaca Shrew

(Pl. 3, q)

Sorex saussurei oaxacae Jackson, Proc. Biol. Soc. Washington 38: 128, November 13, 1925.

Type specimen.—Number 71467, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull (first left upper incisor missing); collected March 27, 1895, by E. W. Nelson and E. A. Goldman. Original number 7748.

Type locality.—Mountains near Ozolotepec, altitude 10,000 feet, Oaxaca, Mexico.

Geographic range.—Known only from type locality. (Fig. 17.)

Diagnostic characters.—Size and color essentially as in *Sorex s. cristobalensis*, but with skull distinctly shorter, broader, and more depressed. Color decidedly darker than in *S. s. saussurei* or *S. s. veraecrucis*, the skull relatively broader than in either.

Color.—Winter pelage: Upper parts near bister, possibly a shade darker; underparts between bister and snuff brown; tail dark, darker than mummy brown or bister above, scarcely paler below. *Summer pelage:* Unknown.

Skull.—Relatively short and broad, noticeably broad through cranium and interorbital region, brain case rather flattened.

Measurements.—Type specimen (adult female): Total length, 114; tail vertebrae, 48; hind foot, 15. *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 18.2; palatal length, 7.3; cranial breadth, 9.0; interorbital breadth, 4.2; maxillary breadth, 5.6; maxillary tooth row, 6.7.

Remarks.—The type and only specimen available of *S. s. oaxacae* differs from all other subspecies of *S. saussurei* in its relatively wide and flattened skull. In color it is almost indistinguishable from *S. s. cristobalensis*, but it is darker than *S. s. veraecrucis*.

Specimen examined.—One, the type.

SOREX SAUSSUREI CRISTOBALENSIS Jackson

San Cristobal Shrew

(Pl. 3, s)

Sorex saussurei cristobalensis Jackson, Proc. Biol. Soc. Washington 38: 129, November 13, 1925.

Type specimen.—Number 75883, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected

September 19, 1895, by E. W. Nelson and E. A. Goldman. Original number 8429.

Type locality.—San Cristobal, altitude 8,400 feet, Chiapas, Mexico.

Geographic range.—Known only from type locality. (Fig. 17.)

Diagnostic characters.—Cranially essentially like *Sorex s. veraecrucis*, with dentition apparently heavier; color distinctly darker than in *veraecrucis*, and tail shorter. Color about as in *S. s. oaxacae*, but skull distinctly longer and narrower. Color a shade darker than *S. s. godmani*, tail shorter, and skull larger, relatively narrower, with heavier dentition.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts a shade darker than bister, possibly tending toward clove brown; underparts a trifle paler than upper parts; tail somewhat darker than clove brown above, very slightly paler below.

Skull.—Relatively narrow and elongate, particularly elongate in interorbital region (somewhat resembling that of *S. s. veraecrucis*); dentition heavy.

Measurements.—Type specimen (adult female): Total length, 116; tail vertebrae, 46.5; hind foot, 13.5. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.5; palatal length, 7.6; cranial breadth, 8.5; interorbital breadth, 4.0; maxillary breadth, 5.4; maxillary tooth row, 6.7.

Remarks.—This form, represented in collections only by the type specimen, is a dark-colored shrew with tail of medium length, and a skull somewhat like that of *S. s. veraecrucis* but with heavier dentition. In color, however, *S. s. cristobalensis* is darker than *veraecrucis*, being more like *S. s. oaxacae*, from which it differs cranially.

Specimen examined.—One, the type.

SOREX SAUSSUREI GODMANI Merriam

Godman Shrew

(Pl. 3, b)

Sorex godmani Merriam, Proc. Biol. Soc. Washington 11: 229, July 15, 1897.

[*Sorex*] *godmanni* Trouessart, Catal. Mamm. tam viventium quam fossilium Supplement, fasc. 1, 1904, p. 135, 1904.

Type specimen.—Number 77044, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected January 28, 1896, by E. W. Nelson and E. A. Goldman.

Type locality.—Volcano Santa Maria, altitude 9,000 feet, Quezaltenango, Guatemala.

Geographic range.—Known only from Todos Santos and Volcano Santa Maria, Guatemala. (Fig. 17.)

Diagnostic characters.—Color dark, almost as dark as *Sorex s. oaxacae* and *S. s. cristobalensis;* tail long. Skull in general proportions much like that of *S. s. saussurei*, somewhat smaller with relatively weaker dentition. Differs cranially from *oaxacae* and *cristobalensis.*

Color.—Winter pelage: Upper parts bister, tending slightly toward clove brown; underparts somewhat paler, darker than wood brown, paler than snuff brown; tail bister or darker above, slightly, if any, paler beneath. *Summer pelage:* Unknown.

Skull.—Dentition weak; medium in size, but apparently rather small in proportion to size of animal; somewhat smaller than that of *S. s. saussurei*, with weaker rostrum. Shorter and with relatively broader cranium and decidedly weaker dentition than in *S. s. cristobalensis.* Smaller, relatively narrower, and with less depressed brain case than in *S. s. oaxacae*, the dentition weaker.

Measurements.—Type specimen (adult female): Total length, 120; tail vertebrae, 57; hind foot, 15. Adult female from Todos Santos, Guatemala: Total

length, 124; tail vertebrae, 55; hind foot, 14.5. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 17.6; palatal length, 7.1; cranial breadth, 8.2; interorbital breadth, 3.7; maxillary breadth, 4.9; maxillary tooth row, 6.3. Skull of adult female (teeth slightly worn) from Todos Santos, Guatemala: Condylobasal length, 17.4; palatal length, 7.1; cranial breadth, 8.6; interorbital breadth, 4.0; maxillary breadth, 5.1; maxillary tooth row, 6.2.

Remarks.—The Godman shrew is a long-tailed and comparatively dark-colored form of *S. saussurei*, being almost as dark as *S. s. oaxacae* or *S. s. cristobalensis*, with a comparatively small skull and weak dentition. It is known only from a limited area in western Guatemala.

Specimens examined.—Total number, 3, as follows:

Guatemala: Todos Santos, 1; Volcano Santa Maria (altitude 9,000 feet) (type locality), 2.

SOREX SAUSSUREI SALVINI Merriam

Salvin Shrew

Sorex salvini Merriam, Proc. Biol. Soc. Washington 11: 229, July 15, 1897.

Type specimen.—Number 77035, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected January 12, 1896, by E. W. Nelson and E. A. Goldman.

Type locality.—Calel, altitude 10,200 feet, Totonicapan, Guatemala.

Geographic range.—Known only from type locality. (Fig. 17.)

Diagnostic characters.—Similar in color to *Sorex s. godmani*, smaller with decidedly shorter tail; skull heavier, particular rostral region, with larger teeth. Color decidedly darker, particularly ventrally, and tail shorter than in *S. s. saussurei*, the skull scarcely distinguishable (a trifle smaller).

Color.—Winter pelage: Scarcely distinguishable from corresponding pelage of *S. s. godmani*, upper parts possibly a shade darker, particularly posteriorly, and underside of tail paler. *Summer pelage:* Unknown.

Skull.—In general proportions essentially like that of *S. s. saussurei*, but a trifle smaller.

Measurements.—Type specimen (adult female): Total length, 104; tail vertebrae, 41; hind foot, 13.5. Adult female from type locality: Total length, 108; tail vertebrae, 43; hind foot, 14. *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 18.0; palatal length, 7.4; cranial breadth, 8.4; interorbital breadth, 4.2; maxillary breadth, 5.4; maxillary tooth row, 6.8. Skull of adult female (teeth moderately worn) from type locality: Condylobasal length, 18.0; palatal length, 7.3; cranial breadth, 8.8; interorbital breadth, 4.3; maxillary breadth, 5.6; maxillary tooth row, 6.9.

Remarks.—Although geographically nearer *S. s. godmani*, this subspecies in most characters more nearly resembles *S. s. saussurei*. It is darker than the subspecies *saussurei*, in this respect resembling more nearly *godmani*, but in size and proportions, both externally and cranially, it is more like *S. s. saussurei*.

Specimens examined.—Two, from the type locality.

SOREX EMARGINATUS Jackson

Zacatecas Shrew

(Pls. 3, t; 9, d)

Sorex emarginatus Jackson, Proc. Biol. Soc. Washington 38: 129, November 13 1925.

Type specimen.—Number 90847. U. S. Nat. Mus., Biological Survey collection; ♀ young adult (teeth unworn), skin and skull; collected

September 17, 1897, by E. W. Nelson and E. A. Goldman. Original number 11765.

Type locality.—Sierra Madre near Bolanos, altitude 7,600 feet, Jalisco, Mexico.

Geographic range.—Known only from Sierra Madre near Bolanos, Jalisco, and Plateado, Zacatecas, Mexico. (Fig. 17.)

Diagnostic characters.—Similar externally to *Sorex s. saussurei*, hind foot shorter; differs from *S. ventralis* and *S. oreopolus* and from all forms of the species *saussurei* in its narrow and peculiarly deeply emarginate first upper molariform tooth, and in having the fourth upper unicuspidate tooth distinctly smaller than the third.

Color.—Winter pelage: Unknown. *Summer pelage:* Indistinguishable from summer pelage of *S. s. saussurei.*

Skull.—Small; moderately depressed brain case, short rostrum; mesopterygoid space short and wide; weak dentition; fourth upper unicuspid distinctly smaller than third; first upper molariform tooth narrow, deeply emarginate posteriorly.

Measurements.—Type specimen (young adult female): Total length, 100; tail vertebrae, 42; hind foot, 12.5. Adult male from Plateado, Zacatecas, Mexico: Total length, 106; tail vertebrae, 41; hind foot, 13. *Skull:* Type specimen (young adult female; teeth unworn): Condylobasal length, 16.9; palatal length, 7.0; cranial breadth, 8.0; interorbital breadth, 4.0; maxillary breadth, 5.0; maxillary tooth row, 6.2. Skull of adult male (teeth much worn) from Plateado, Zacatecas, Mexico: Condylobasal length, 16.4; palatal length, 6.8; cranial breadth, 8.0; interorbital breadth, 3.9; maxillary breadth, 5.1; maxillary tooth row, 5.9.

Remarks.—The three specimens of this shrew examined are entirely inadequate to determine its relationship to *S. saussurei* and *S. ventralis*. The species is as small as *S. ventralis*, but the skull in general shape and proportions is more like that of *S. saussurei*. It seems quite within the range of probability that additional specimens may prove *S. emarginatus* to be a subspecies of *S. saussurei*.

Specimens examined.—Total number, 3, as follows:

Jalisco: Bolanos (altitude 7,600 feet) (type locality), 1.
Zacatecas: Plateado (altitude 7,600 to 8,500 feet), 2.

SOREX VENTRALIS Merriam

Cerro San Felipe Shrew

(Pls. 3, u; 9, e)

Sorex obscurus ventralis Merriam, North Amer. Fauna No. 10. p. 75, December 31, 1895.
Sorex ventralis Elliot, Field Columb. Mus. Publ. 71 (zool. series 3): 148, 1903.

Type specimen.—Number 68342, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth much worn), skin and skull; collected August 26, 1894, by E. W. Nelson and E. A. Goldman.

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

Geographic range.—Mountains of northern Puebla and central Oaxaca. (Fig. 18.)

Diagnostic characters.—Size small, tail rather short. Smaller and tail shorter than in any form of the *saussurei* group except *Sorex s. salvini*. Skull higher and less flattened than that of *S. saussurei* or *S. emarginatus;* shorter and broader than that of *S. oreopolus.*

Color.—Winter pelage: Upper parts between clove brown and sepia, nearer clove brown; underparts grayish densely tinged with between avellaneous and drab; tail mummy brown or darker above, distinctly paler below. *Summer pelage:* Upper parts usually near sepia, sometimes tending toward mummy

brown; underparts wood brown to avellaneous mixed with grayish of the base of hairs; tail sepia or sepia tending toward mummy brown above, decidedly paler beneath, sometimes almost cinnamon-buff.

Time of molting.—Of 3 specimens from the mountains near Ozolotepec, Oaxaca, Mexico, 2 are in worn winter pelage March 25 and 26, 1895, while the third, a male, shows indications of beginning molt on the flanks, rump, and back, March 27. Of the 9 specimens from 15 miles west of Oaxaca, Oaxaca, Mexico, 5 are in worn winter pelage September 12 to 14, and 17, 1894; 2 have the molt well begun September 15 and 17; and 2 have acquired the winter pelage on the back September 17 and 18.

Skull.—Small, high both rostrally and cranially, rostrum short, dentition weak, the third upper unicuspid smaller than fourth. Skull distinctly higher than that of any subspecies of *S. saussurei*, with shorter and weaker rostrum and smaller molariform teeth. Skull higher and dentition different from *S. emarginatus*. Actually and relatively shorter and broader than that of *S. oreopolus*, with shorter tooth row.

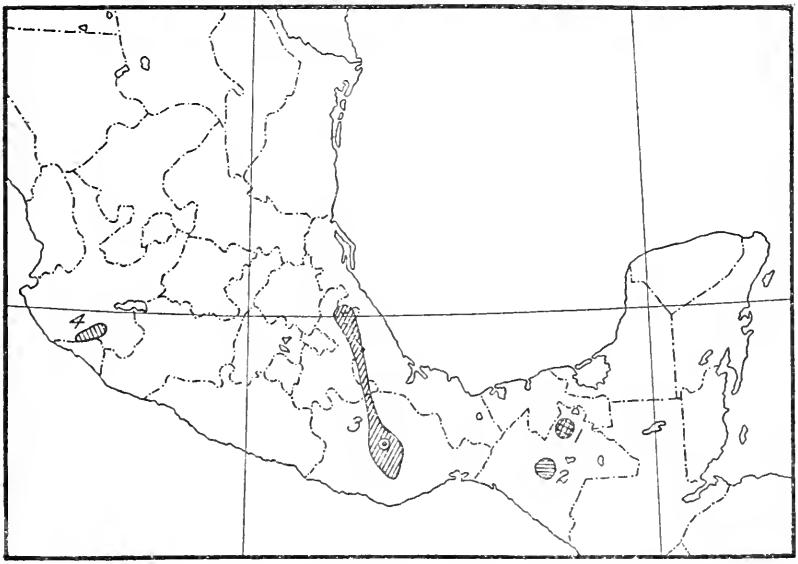

FIG. 18.—Geographic range of *Sorex sclateri, S. stizodon, S. ventralis,* and *S. orco polus*
1. *S. sclateri.* 2. *S. stizodon.* 3. *S. ventralis.* 4. *S. orcopolus.*

Measurements.—Type specimen (adult male): Total length, 104; tail vertebrae, 37; hind foot, 13. Two adult males from type locality: Total length, 112, 108; tail vertebrae, 43, 40; hind foot, 13, 12.5. Average of three adult females from 15 miles west of Oaxaca, Oaxaca, Mexico: Total length, 107.7 (103–112); tail vertebrae, 43.3 (41–46); hind foot, 13.7 (13.5–14). *Skull:* Type specimen (adult male; teeth much worn): Condylobasal length, 16.7; palatal length, 6.9; cranial breadth, 8.6; interorbital breadth, 4.0; maxillary breadth, 5.2; maxillary tooth row, 6.0. Two skulls of adult males (teeth much worn) from type locality: Condylobasal length, 17.0, 16.4; palatal length, 7.0, 6.9; cranial breadth, 8.7, 8.6; interorbital breadth, 3.9, 3.8; maxillary breadth, 5.1, 5.0; maxillary tooth row, 6.0, 6.1. Average of three skulls of adult females (teeth slightly worn) from 15 miles west of Oaxaca, Oaxaca, Mexico: Condylobasal length, 17.2 (17.1–17.3); palatal length, 7.0 (7.0–7.1); cranial breadth, 8.5 (8.5–8.6); interorbital breadth, 3.9 (3.8–4.0); maxillary breadth, 5.2 (5.0–5.4); maxillary tooth row, 6.1 (6.1–6.2).

Remarks.—In the original description of this form it was treated as a subspecies of *S. obscurus* (Merriam, 1895, p. 75). As a matter of fact, the species is not closely related to *S. obscurus* and differs

cranially in its shorter and broader mesopterygoid space and in lacking the distinct pigmented ridge extending from the apex to the interior border of the cingulum of each unicuspid. There is apparently close relationship between *S. oreopolus* and *S. ventralis*.

Specimens examined.—Total number, 23, as follows:

Oaxaca: Cajonos (near), 2; Cerro San Felipe (type locality), 7; Oaxaca (15 miles west), 9; Ozolotepec (mountains near), 3.
Puebla: Huachinango, 2.

SOREX OREOPOLUS MERRIAM

JALISCO SHREW

(PLS. 3, V; 9, F)

Sorex oreopolus Merriam, Proc. Biol. Soc. Washington 7: 173, September 29, 1892.

Type specimen.—Number $\frac{3366}{45698}$ U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth moderately worn), skin and skull; collected April 22, 1892, by E. W. Nelson.

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

Geographic range.—Known only from mountains of Jalisco, Mexico. (Fig. 18.)

Diagnostic characters.—Size small, tail short; skull relatively high, long and narrow; dentition weak. Skull distinctly higher with shorter palate and rostrum than in any form of *Sorex saussurei;* longer, higher, and narrower interorbitally than that of *S. emarginatus;* longer and narrower than that of *S. ventralis.*

Color.—Winter pelage: Upper parts most nearly clove brown or a trifle paler; underparts avellaneous mixed with grayish at base of hairs; tail between sepia and clove brown above, paler below, near buffy brown. *Summer pelage:* Unknown.

Time of molting.—The two adult males from the type locality still retain the full winter pelage on April 22, 1892. The specimen from Volcan de Nieve, Jalisco, is in extremely worn summer pelage September 12, 1905, and the condition of the skin indicates that molt is beginning.

Skull.—Relatively high, long, and narrow; teeth small; third upper unicuspid smaller than fourth. Similar in general appearance to that of *S. ventralis,* but actually and relatively longer and narrower, with longer tooth row. Higher both rostrally and cranially than that of any subspecies of *S. saussurei,* with shorter and weaker rostrum, and smaller teeth. Brain case and rostrum higher than in *S. emarginatus,* and teeth different.

Measurements.—Type specimen (adult male): Total length, 106; tail vertebrae, 36; hind foot, 13. *Skull:* Type specimen (adult male, teeth moderately worn): Condylobasal length, 17.8; palatal length, 6.9; cranial breadth, 8.3; interorbital breadth, 3.7; maxillary breadth, 5.0; maxillary tooth row, 6.4.

Remarks.—The affinities of *S. oreopolus* are clearly with *S. ventralis* rather than *S. saussurei,* with which it occurs at the type locality. The inadequacy of the material examined makes impossible definite assignment of its relationship with *S. ventralis,* but when more specimens are available it would not be surprising to find *S. oreopolus* only subspecifically distinct from *S. ventralis.*

Specimens examined.—Total number, 3, as follows:

Jalisco: Sierra Nevada de Colima (type locality), 2; Volcano de Nieve, 1.[12]

[12] Amer. Mus. Nat. Hist.

TABLE 11.—*Cranial measurements of adult specimens of* Sorex saussurei *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth-row	Wear of teeth	Remarks
S. s. saussurei:										
Jalisco—Sierra Nevada de Colima.	45702	♀	18.4	7.6	8.9	4.3	5.6	6.8	Moderate	Type specimen
Do	45701	♀	18.0	7.5±	8.8	4.2	5.6	6.8	do	Type locality.
Michoacan—Nahuatzin.	50766	♀	18.1	7.3	8.6	4.1	5.4	6.5	Slight	
Do	50768	♀	18.2	7.4	8.7	4.2	5.3	6.6	do	
S. s. veraecrucis:										
Vera Cruz—Xico	55106	♀	18.3	7.4	8.7	4.1	5.3	6.6	do	Type specimen.
Do	55105	♀	18.1	7.4	8.7	4.0	5.4	6.7	Unworn	Type locality.
Oaxaca—Mount Zempoaltepec.	68566	♀	18.2	7.5	8.7	4.0	5.3	6.9	Slight	
S. s. oaxacae:										
Oaxaca — Mountains near Ozolotepec.	71467	♀	18.2	7.3	9.0	4.2	5.6	6.7	Moderate	Type specimen.
S. s. cristobalensis:										
Chiapas—San Cristobal.	75883	♀	18.5	7.6	8.5	4.0	5.4	6.7	Slight	Do.
S. s. godmani:										
Guatemala—										
Volcano Santa Maria.	77044	♀	17.6	7.1	8.2	3.7	4.9	6.3	do	Do.
Todos Santos	77023	♀	17.4	7.1	8.6	4.0	5.1	6.2	do	
S. s. salvini:										
Guatemala—Calel	77035	♀	18.0	7.4	8.4	4.2	5.4	6.8	do	Do.
Do	77071	♀	18.0	7.3	8.8	4.3	5.6	6.9	Moderate	Type locality.
S. emarginatus:										
Jalisco—Sierra Madre, near Bolanos.	90847	♀	16.9	7.0	8.0	4.0	5.0	6.2	Unworn	Type specimen, young adult.
Zacatecas—Plateado	90846	♂	16.4	6.8	8.0	3.9	5.1	5.9	Much	
S. ventralis:										
Oaxaca—										
Cerro San Felipe	68342	♂	16.7	6.9	8.6	4.0	5.2	6.0	do	Type specimen.
Do	68343	♂	17.0	7.0	8.7	3.9	5.1	6.0	do	Type locality.
Do	68347	♂	16.4	6.9	8.6	3.8	5.0	6.1	do	Do.
15 miles west of Oaxaca.	68352	♀	17.1	7.0	8.5	3.8	5.1	6.2	Slight	
Do	68355	♀	17.3	7.1	8.5	3.9	5.4	6.1	do	
Do	68358	♀	17.2	7.0	8.6	4.0	5.0	6.1	do	
S. oreopolus:										
Jalisco—Sierra Nevada.	45698	♂	17.8	6.9	8.3	3.7	5.0	6.4	Moderate	Type specimen.

SOREX ORNATUS GROUP

The *ornatus* group includes seven species: *Sorex ornatus*, *S. sinuosus*, *S. juncensis*, *S. trigonirostris*, *S. myops*, *S. tenellus*, and *S. nanus*.

Geographic range.—Interior southwestern Oregon, California south of latitude 39° north, Lower California, and central Colorado. (Fig. 19.)

Diagnostic characters.—Size rather small, tail comparatively short; skull rather flattened through brain case, depressed interorbitally; foramen magnum placed dorsad, encroaching more into supraoccipital and less into basioccipital. Compared with any of the *trowbridgii* group, smaller, with shorter, more concolor tail; skull smaller than in *S. trowbridgii*, flatter, with narrower cranium and mesopterygoid space, and shorter tooth row. Compared with *vagrans-obscurus* group the skull is flatter, more depressed interorbitally, the foramen magnum located relatively more dorsad and encroaching more into supraoccipital and less into basioccipital; unicuspid teeth viewed laterally are relatively narrower and weaker; metacone of first upper molariform tooth (pm^4) relatively higher. (Fig. 20.)

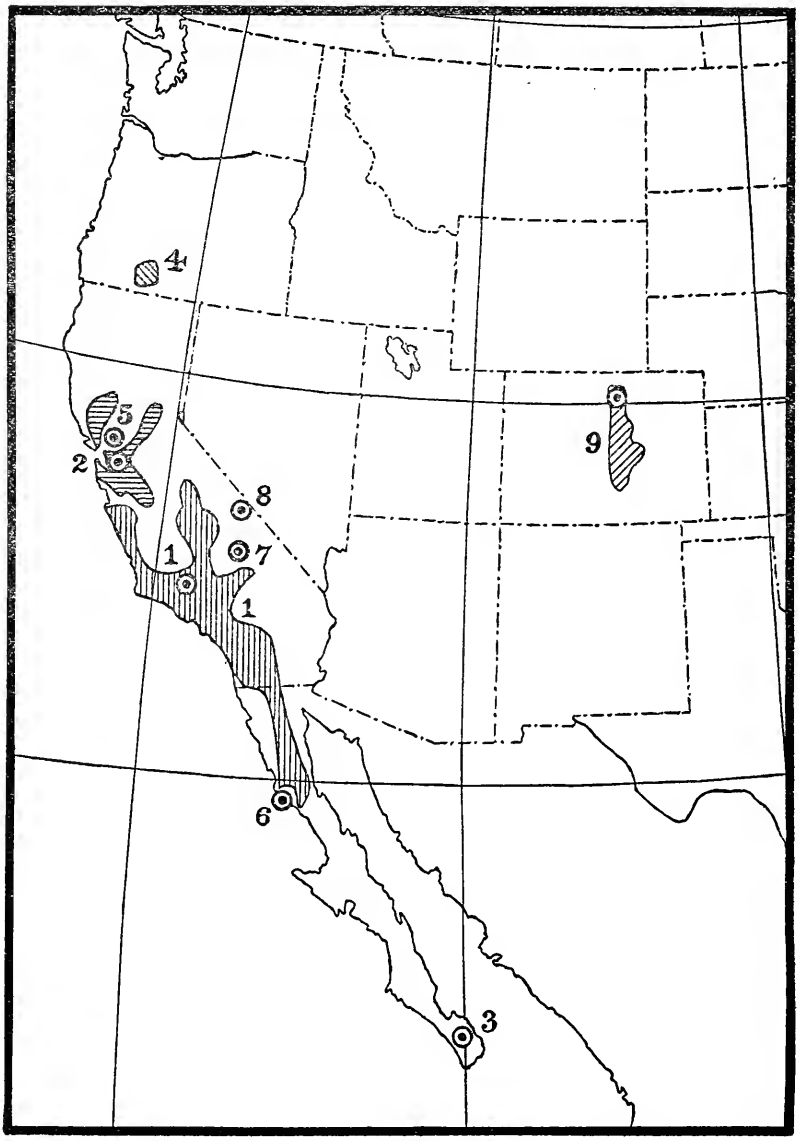

FIG. 19.—Geographic range of species and subspecies of the *Sorex ornatus* group

1. *S. ornatus ornatus.*
2. *S. o. californicus.*
3. *S. o. lagunae.*
4. *S. trigonirostris.*
5. *S. sinuosus.*
6. *S. juncensis.*
7. *S. tenellus.*
8. *S. myops.*
9. *S. nanus.*

Remarks.—The *ornatus* group has a comparatively limited distribution in western America, the center of abundance for the group appearing to be in southern California. The group is superficially like the *vagrans-obscurus* group in general external appearance, but is usually more grayish in color and with relatively shorter tail; the two groups are distinctively separate in cranial characters. The *ornatus* group is probably more nearly allied to the geographically widely separated *longirostris* group than to any other.

SOREX ORNATUS MERRIAM

[Synonymy under subspecies]

Geographic range.—California south of latitude 39° north, and Lower California. (Fig. 19.)

Diagnostic characters.—Larger than *Sorex tenellus*, *S. nanus* or *S. myops*, with skull distinctly larger in all proportions, the teeth decidedly heavier than in *S. tenellus* or *S. nanus*. Separable from *S. sinuosus* by color alone, it being contrastedly paler (grayish brown) as compared with the blackish of *S. sinuosus*. Skull decidedly flatter and relatively broader than that of *S. juncensis*. Compared with that of *S. trigonirostris* the skull of the species *ornatus*

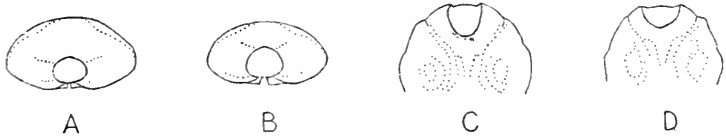

FIG. 20.—Foramina magna of *Sorex obscurus* and *S. ornatus*. A, *S. obscurus*, dorsal view; B, *S. ornatus*, dorsal view; C, *S. obscurus*, ventral view; D, *S. ornatus*, ventral view. Enlarged two diameters

has a relatively longer rostrum, the sides of which tend to be more convex (rounded), and the mastoidal region more prominent and angular, and weaker dentition.

Subspecies and geographic variation.—The species *ornatus* is divided into three subspecies: *ornatus*, *californicus*, and *lagunae*. The species, like most American shrews, displays considerable individual variation, particularly in the northern half of its range. There is a general tendency toward an increase in size and a darkening of the underparts from the northern part of the range southward. The subspecies *ornatus* is larger than *californicus* and averages a shade darker, particularly ventrally; while *lagunae* is about the size of the subspecies *ornatus*, but still darker.

Time of molting.—Specimens of the species *ornatus* are usually in full summer fur by May, though frequently the molt does not occur until late in June or even the middle of July, and again it may take place in March, or possibly late in February. The type specimen of *S. o. californicus* was in nearly complete molt February 15, and another male from Berkeley, Calif., was molting February 29, 1892. The latter specimen, however, bears some indication that it may have been gaining its winter coat, rather than the summer. A male collected July 18, at Dudley, Mariposa County, Calif., and one taken July 19, at Cuddy Canyon, Frazier Mountain, Ventura County, Calif., are assuming what appears to be summer fur.

The transition from summer to winter pelage occurs most frequently during September or early in October. Specimens are usually in full winter pelage by November, and often by late October. A male of the subspecies *californicus* from Stanford University, Calif., still retains summer fur October 28, 1900, while two from Pacheco Pass are in winter pelage October 11 and 13, 1907, and a female from the same locality has the molt nearly complete October 14. At Gilroy, Calif., a female had the molt progressed about one-half on October 29,

1907. A male of the subspecies *ornatus*, from San Jacinto Mountains, Calif., has the molt begun as early as August 7, 1907, and another from Big Pine Mountain has the fresh winter pelage coming in under the worn summer fur over its entire back, September 11, 1903. A female from San Diego Bay, Calif., was in summer pelage as late as November 5, 1899.

SOREX ORNATUS ORNATUS Merriam

Southern California Long-tailed Shrew

(Pls. 3, w; 5, n; 6, p; 9, g; 11, l; 13, b)

Sorex ornatus Merriam, North Amer. Fauna No. 10, p. 79, December 31, 1895.
Sorex oreinus Elliot, Field Columb. Mus. Publ. 74 (zool. series 3) : 172, April, 1903. Type locality, Aguaje de las Fresas, altitude 6,000 feet, San Pedro Martir Mountains, Lower California, Mexico.
Sorex orinus Elliot, Field Columb. Mus. Publ. 79 (zool. series 3) : 228, June, 1903.

Type specimen.—No. $\frac{31333}{43198}$, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth very slightly worn), skin and skull (skull with posterior and basal portions of cranium broken away); collected October 19, 1891, by E. W. Nelson.

Type locality.—Head of San Emidgio Canyon, Mount Pinos, Kern County, Calif.

Geographic range.—Coast region of California south of Monterey Bay, west slope of the Sierras south of latitude 38° north, south through southwestern California and northern Lower California to latitude 30° north. (Fig. 19.)

Diagnostic characters.—Larger than *Sorex o. californicus* and tending to be slightly darker in color ventrally; skull larger than that of *californicus*, higher, and with broader rostrum. Indistinguishable from *S. o. lagunae* in size and cranial characters, but paler, especially on ventral parts of both tail and body.

Color.—*Winter pelage:* General tone of upper parts varying from hair brown more or less mixed with, tinted by, or tending toward olive-brown, to almost fuscous or clove brown, sometimes paling slightly on the flanks, gradually merging with color of the underparts; underparts smoke gray or pale smoke gray, sometimes tinged with pale pinkish buff or cartridge buff; tail indistinctly bicolor, buffy brown to olive-brown above, avellaneous, wood brown, or buffy brown below, nearly to tip, darkening apically, sometimes almost pinkish buff or even pale pinkish buff below basally. *Summer pelage:* Upper parts hair brown, drabbish, or buffy brown; underparts smoke gray usually tinged with vinaceous-buff or between pinkish buff and cinnamon-buff; tail as in winter.

Skull.—Skull larger and relatively higher through the brain case than that of *S. o. californicus*, broader through rostrum and interorbitally, and dentition heavier. Scarcely distinguishable from the skull of *S. o. lagunae*, but usually a trifle higher through brain case. Somewhat similar to that of *S. sinuosus* but slightly wider interorbitally and with longer palate.

Measurements.—Type specimen (adult male): Total length, 108; tail vertebrae, 43; hind foot, 13. Adult male from Tehachapi, Calif.: Total length, 107; tail vertebrae, 39; hind foot, 12. Adult female (type specimen of *S. oreinus*) from Aguaje de las Fresas, Lower California, Mexico: Total length, 103; tail vertebrae, 43; hind foot, 12. Average of four adult males from El Portal, altitude 2,000 feet, Mariposa County, Calif.: Total length, 102.3 (101–104); tail vertebrae, 43.5 (43–44); hind foot, 12.5 (12–13). *Skull:* Type specimen (adult male; teeth very slightly worn): Palatal length, 6.9; interorbital breadth, 3.7; maxillary breadth, 5.0; maxillary tooth row, 6.2. Skull of adult male (teeth slightly worn) from Tehachapi, Calif.: Condylobasal length, 16.7; palatal length, 6.8; cranial breadth, 8.2; interorbital breadth, 3.6; maxillary breadth, 5.1; maxillary tooth row, 6.2. Skull of adult female (teeth slightly worn; type specimen of *S. oreinus*) from Aguaje de las Fresas, Lower California, Mexico; Condylobasal length, 16.5; palatal length, 6.8; cranial breadth, 8.2; interorbital breadth, 3.5; maxillary breadth, 4.7; maxillary tooth row, 6.0. Average of four skulls of adult males (teeth slightly worn) from El Portal, altitude 2,000 feet, Mariposa County, Calif.: Condylobasal length, 16.9 (16.5–17.1); palatal length,

6.8 (6.7–7.0); cranial breadth, 8.1 (8.0–8.2); interorbital breadth, 3.6 (3.4–3.8); maxillary breadth, 4.9 (4.8–5.0); maxillary tooth row, 6.0 (5.8–6.2).

Remarks.—The subspecies *ornatus* occupies a considerable area in southern California, and at several localities in the northern part of its range shows clearly intergradation with *S. o. californicus.* Specimens from Minkler, Calif., are essentially like typical *S. o. ornatus*, but a single specimen from Orosi, near by, could almost be referred to *californicus.* Certain of the specimens from Monterey, Calif., and immediate vicinity could with about equal propriety be referred to *californicus* as to *S. o. ornatus.* The three from Summit Lake, Calif., except for possibly a trifle shorter tails and scarcely paler underparts, are indistinguishable from typical *ornatus.* The series of specimens from El Portal, Yosemite National Park, is particularly interesting from the viewpoint of variation, the specimens showing almost perfect gradation from minimum to maximum size, one skull [13] being larger than normal. Two or three of the skulls from the San Jacinto Mountains, Calif., are larger and with broader rostra than those of typical specimens of *S. o. ornatus*, but the differences are too inconstant for subspecific recognition. The single specimen with broken skull from Little Lake, Inyo County, Calif., shows no characters whereby it can be separated from *S. o. ornatus.* Specimens from Summit Lake, Calif., collected June 27, 1907, are darker than normal specimens of *S. o. ornatus* but the writer is inclined to believe that this is due largely to their fresh unworn pelage. A female [14] collected January 20, 1924, 2 miles east of Playa del Rey, Los Angeles County, Calif., is provisionally referred to *S. o. ornatus.* The specimen, however, both externally and cranially, is scarcely distinguishable from typical *S. o. californicus*, but inasmuch as there is only the one from this locality, which lies near the known geographic range of true *ornatus*, it seems probable that this individual may be an abnormally small representative of that subspecies.

The type specimen of *S. oreinus* Elliot does not differ from true *ornatus.* Of three specimens from San Quintin, Lower California, Mexico, one, collected August 2, 1902, is typical *S. o. ornatus* in every respect; another, collected August 1, 1902, appears to be intermediate between the subspecies *ornatus* and *lagunae;* the third, collected July 31, 1902, is fully as dark ventrally, both on body and tail, as the type specimen of *lagunae.*

Specimens examined.—Total number, 109, as follows:

California: Bakersfield, 2 [15]; Big Bear Valley, San Bernardino County, 1 [16]; Big Pine Mountain, 1; Big Pines (Swartout Valley, altitude 6,900 feet), Los Angeles County, 1 [16]; Bluff Lake (altitude 7,500 feet), San Bernardino Mountains, 5 [17]; Buena Vista Lake (north side), 1; Cuddy Canyon, Frazier Mountain, Ventura County, 1 [15]; Dudley (altitude 3,000 feet), Mariposa County, 1 [15]; Dulzura, 6 [18]; El Monte (near San Gabriel River Bottom), 2 [15]; El Portal (altitude 1,800 to 2,500 feet), 18 [15]; Fort Tejon, Kern County, 2 [19]; Little Lake (altitude 3,100 feet), 1 [15]; Los Angeles, 3 [20]; Piute Mountains, 1 [21]; Lytle Creek, 2; Minkler,

[13] No. 21523, Mus. Vert. Zool.
[14] No. 9880, collection of Donald R. Dickey, Pasadena, Calif.
[15] Mus. Vert. Zool.
[16] D. R. Dickey coll., Pasadena, Calif.
[17] D. R. Dickey coll., 1; Mus. Vert. Zool., 2.
[18] D. R. Dickey coll., 2; Mus. Vert. Zool., 4.
[19] Mus. Vert. Zool., 4; Field Mus. Nat. Hist., 1.
[20] Field Mus. Nat. Hist.
[21] Mus. Comp. Zool.

2[15]; Monterey, 5[22]; Morro, 2[15]; Mount McGill, 1; Mount Pinos, 2[23]; Orosi, 1; Paraiso Springs, 1; Piru Creek (Bailey's Ranch), 3[20]; Piute, 2; Playa del Rey, Los Angeles County, 1[16]; Point Pinos, Pacific Grove, 1; San Bernardino, 1[24]; San Bernardino Mountains (altitude 7,400 to 7,500 feet), 2[15]; San Diego Bay, 1[15]; San Emigdio Canyon (type locality), 1; San Emigdio Creek (altitude 1,500 feet), 2[15]; San Jacinto Mountains (altitude 8,000 to 9,000 feet), 3; Santa Barbara, 1[16]; Santa Ysabel, 2; Seaside, 1; Strawberry Valley (altitude 6,000 feet), San Jacinto Mountains, 1[15]; Summit Lake (12 miles northwest of Lemoore), 3[25]; Tahquitz Valley (altitude 8,000 feet), San Jacinto Mountains, 3[15]; Tehachapi, 2; Trabuco Canyon (altitude 1,700 feet), Santa Ana Mountains, 1[15]; Ventura River, 1; Walker Basin, Kern County, 1[16];.

Lower California: Aguaje de las Fresas (type locality of *oreinus*), 1[20]; El Rosario, 9[20]; La Grulla, San Pedro Martir Mountains, 1[26]; San Quintin, 3.[20]

SOREX ORNATUS CALIFORNICUS Merriam

California Long-tailed Shrew

(Pls. 3, x; 9, h)

Sorex californicus Merriam, North Amer. Fauna No. 10, p. 80, December 31, 1892.
Sorex californicus californicus Miller, U. S. Nat. Mus. Bul. 79, p. 18, December 31, 1912.
Sorex ornatus californicus Jackson, Journ. Washington Acad. Sci. 12: 264, June 4, 1922.

Type specimen.—No. $\frac{32578}{4442\,6}$ U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected February 15 1892, by C. P. Streator.

Type locality.—Walnut Creek, Contra Costa County, Calif.

Geographic range.—Western and west-central California from latitude 39° north, south to somewhat beyond latitude 37° north (Mendota). (Fig. 19.)

Diagnostic characters.—Smaller in all dimensions than *Sorex o. ornatus*, with the skull usually flatter, rostrum narrower, and dentition weaker. About the size and color of *S. trigonirostris* but separable by specific characters. Skull larger than that of *S. myops*, and larger and with broader rostrum than that of *S. tenellus*.

Color.—Winter pelage: Upper parts varying in general hue from slightly darker than hair brown to chaetura drab or fuscous, sometimes almost olive-brown; underparts smoke gray, pale smoke gray, or grayish white, sometimes faintly tinged with pale pinkish buff, or rarely with vinaceous-buff; tail indistinctly bicolor, olive-brown, above, near avellaneous below, darkening toward apex. *Summer pelage:* Scarcely distinguishable from winter pelage, possibly a trifle paler and more brownish; upper parts most nearly hair brown, sometimes slightly darker, or tending toward drab or olive-brown, slightly paling on the sides and blending gradually with color of the underparts; underparts smoke gray or pale smoke gray tinged more or less with buffy; tail as in winter.

Skull.—Smaller than that of *S. o. ornatus*, more flattened through the brain case, narrower through rostrum and interorbitally, with weaker dentition. Smaller than the skull of *S. sinuosus*, somewhat flatter, with narrower rostrum. About the size of that of *S. trigonirostris*, or slightly larger, the mastoid region appearing less prominent and more rotund in dorsal aspect, the rostrum less angular.

Measurements.—Type specimen (adult male): Total length, 89; tail vertebrae, 32; hind foot, 12. Adult male from Berkeley, Calif.: Total length, 96;

[15] Mus. Vert. Zool.
[16] D. R. Dickey coll., Pasadena, Calif.
[20] Field Mus. Nat. Hist.
[22] D. R. Dickey coll., 4.
[23] Mus. Vert. Zool., 1.
[24] Acad. Nat. Sci. Philadelphia.
[25] Mus. Comp. Zool., 1.
[26] San Diego Nat. Hist. Mus., San Diego, Calif.

tail vertebrae, 38; hind foot, 12. *Skull:* Type specimen (adult male; teeth slightly worn): Condylobasal length, 16.0; palatal length, 6.3; cranial breadth, 7.8; interorbital breadth, 3.3; maxilliary breadth, 4.5; maxillary tooth row, 5.6. Skull of adult male (teeth slightly worn) from Berkeley, Calif.: Condylobasal length, 15.9; palatal length, 6.3; cranial breadth, 8.0; interorbital breadth, 3.3; maxillary breadth, 4.6; maxillary tooth row, 5.7.

Remarks.—Larger series of *S. o. californicus* from various localities are needed before a satisfactory determination of exact relationships within the subspecies, as at present recognized, can be reached. There are several specimens available from one or two localities, but the number properly measured and with perfect skulls is decidedly meager. Intergradation of *californicus* with *S. o. ornatus* is clearly indicated in specimens from Mendota and Pacheco Pass, Calif., which are referable to *californicus* but show tendencies toward *S. o. ornatus*. Likewise, one of the skulls from Hayward is broader and higher than in typical *californicus* and almost matches skulls of typical *S. o. ornatus;* another skull from Hayward is a trifle larger than that of true *californicus*, but in general proportions show no differences; while a third skull, although badly broken, appears to have been more nearly like typical skulls of *californicus*. The specimen [27] collected June 25, 1912, at Rumsey, Yolo County, Calif., is paler than ordinary *californicus*. This may be a seasonal variation, however, as the animal appears to be in worn winter pelage.

The skulls of specimens from Petaluma, Calif., seem to average a trifle larger and with broader rostra than in typical *S. o. californicus*, and the color of two of the skins is a shade darker than in normal individuals. This may possibly indicate a tendency toward *S. sinuosus*, but the contrast between the darkest specimens of *californicus* and the palest of *S. sinuosus* is so great that, on the basis of present material, one would hardly be warranted in calling them conspecific.

Specimens examined.—Total number, 49, as follows:

California: Auburn, 1; Berkeley, 11 [28]; Chalk Creek, Monterey County, 1 [29]; Concord (5 miles north), 1 [30]; Cordelia, 1 [30]; First Canyon (north of Strawberry Creek), 1 [29]; Gilroy, 1; Glen Ellen, 1; Hayward, 3 [29]; Los Banos (22 miles south), 1 [29]; La Honda, San Mateo County, 1 [31]; Mendota, 2; Pacheco Pass (summit), 3; Palo Alto, 1 [32]; Petaluma, 8 [33]; Redwood City, 4 [34]; Rumsey (altitude 500 feet), 1 [29]; Sunnyvale, 1 [29]; Stanford University, 1; Stonewall Creek (6.3 miles northeast of Soledad, altitude 1,300 feet), Monterey County, 1 [29]; Walnut Creek (type locality), 4.[35]

SOREX ORNATUS LAGUNAE Nelson and Goldman

Laguna Mountain Shrew

Sorex lagunae Nelson and Goldman, Proc. Biol. Soc. Washington 22: 27, March 10, 1909.

Type specimen.—No. 147119, U. S. Nat. Mus., Biological Survey collection; adult ♀ (teeth slightly worn), skin and skull (skull

[27] No. 18481, Mus. Vert. Zool.
[28] Acad. Nat. Sci. Philadelphia, 1; Mus. Vert. Zool., 6.
[29] Mus. Vert. Zool.
[30] D. R. Dickey coll., Pasadena, Calif.
[31] Amer. Mus. Nat. Hist.
[32] Mus. Comp. Zool.
[33] Mus. Vert. Zool., 5.
[34] Mus. Vert. Zool., 2; Univ. Wis. Zool. Mus., 2.
[35] Mus. Vert. Zool., 1.

broken across rostrum); collected January 29, 1906, by E. W. Nelson and E. A. Goldman.

Type locality.—La Laguna, altitude 5,500 feet, Sierra Laguna, Lower California, Mexico.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—Similar to *S. o. ornatus* in size and cranial characters, but decidedly darker on ventral parts of tail and body.

Color.—Winter pelage: Upper parts slightly darker and very slightly more brownish than hair brown; underparts a shade paler than upper parts, between drab and light drab; tail fuscous above, scarcely paler, if any, below. *Summer pelage:* Unknown.

Skull.—Indistinguishable from certain skulls of *S. o. ornatus.*

Measurements.—Type specimen (adult female): Total length, 98; tail vertebrae, 41; hind foot, 12.5. *Skull:* Type specimen (adult female, teeth slightly worn); Condylobasal length, 16.4±; cranial breadth, 7.8; interorbital breadth, 3.5; maxillary breadth, 4.8.

Remarks.—Except for darker color on the ventral parts of its tail and body, *S. o. lagunae* is closely similar to *S. o. ornatus.* The single specimen available for study furnishes rather unsatisfactory comparative material, but it seems probable additional material will substantiate recognition of the form.

Specimen examined.—One, the type.

SOREX TRIGONIROSTRIS Jackson

Oregon Dwarf Shrew

(Pl. 3, z)

Sorex trigonirostris Jackson, Journ. Washington Acad. Sci. 12: 264, June 12, 1922.

Type specimen.—No. 203608, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected May 5, 1914, by Luther J. Goldman.

Type locality.—Ashland, Jackson County, Oreg. (altitude 1,975 feet).

Geographic range.—Known only from near Ashland, Oreg. (Fig. 19.)

Diagnostic characters.—Similar in size and color to *Sorex o. californicus;* mastoid region of skull more angular and prominent than in *californicus* or any other of the *ornatus* group; rostrum shorter and more angular, the sides less outwardly curved; palate shorter than in *californicus.*

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts grayish, hair brown, becoming drab on the sides; underparts between pale smoke gray and pale olive-gray very faintly tinged with pale olive-buff; tail olive-brown above, avellaneous below nearly to tip.

Skull.—About the size of that of *S. o. californicus,* or slightly smaller; flat, with short, angular rostrum; mastoid region more angular and prominent in dorsal aspect than in any other of the *ornatus* group. Larger than that of *S. myops, S. tenellus,* or *S. nanus,* with actually and relatively broader cranium.

Measurements.—Type specimen (adult female): Total length, 95; tail vertebrae, 34; hind foot, 12. *Skull:* Type specimen (adult female, teeth slightly worn): Condylobasal length, 15.6; palatal length, 5.8; cranial breadth, 7.9; interobital breadth, 3.4; maxillary breadth, 4.5; maxillary tooth row, 5.5.

Remarks.—Consisting of only two specimens, one of which has an imperfect skull, the material representing this form in collections is too meager for satisfactory study. The species, however, seems

closely related to *S. ornatus* and additional material may prove intergradation with that species, probably through *S. o. californicus.*

Specimens examined.—Total number, 2, as follows:

Oregon: Ashland (altitude 1,975 feet) (type locality), 1; Ashland (west slope Grizzly Peak, altitude 3,500 feet), 1.

SOREX SINUOSUS GRINNELL

SUISUN SHREW

(PL. 3, Y)

Sorex sinuosus Grinnell, Univ. Calif. Publ. Zool. 10: 187, March 20, 1913.

Type specimen.—No. 16470, Mus. Vert. Zool., University of California; ♀ adult (teeth slightly worn), skin and skull; collected January 5, 1912, by Miss A. M. Alexander.

Type locality.—Grizzly Island, near Suisun, Solano County, Calif.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—Color distinctly darker than in any other of the *ornatus* group, almost black both dorsally and ventrally. About the size of *Sorex o. californicus*, head and body possibly averaging slightly larger. Skull somewhat larger, higher, and with broader rostrum than in *californicus;* more nearly like that of *S. o. ornatus.*

Color.—Winter pelage: Dark, almost black; upper parts fuscous-black, chaetura black, or even nearer black, usually with a metallic sheen, gradually paling to color of underparts; underparts hair brown to chaetura drab; tail fuscous-black or mummy brown above, scarcely paler ventrally. *Summer pelage:* Somewhat paler and more brownish (less blackish) than winter pelage; upper parts fuscous to chaetura drab, or slightly darker, the sides paler, almost like ventral parts; underparts hair brown or between hair brown and drab; tail as in winter.

Time of molting.—A single specimen, a male, collected September 6, 1912, is changing from summer to winter pelage and has the molt over half completed. Two females, collected August 25 and September 7, and a male, taken August 24, are in full summer fur. Six specimens, all sexed by the collector as females, and caught between November 25 and January 20, are in full winter pelage.

Skull.—Larger than that of *S. o. californicus*, somewhat higher, with broader rostrum. Not unlike the skull of *S. o. ornatus* but slightly narrower interorbitally, with shorter palate, and on the average, weaker dentition. Larger and heavier than any of the *ornatus* group except *S. o. ornatus* and *S. o. lagunae.*

Measurements.—Type specimen (adult female): Total length, 99; tail vertebrae, 37; hind foot, 12. Average of four adult females from type locality: Total length, 98.9 (92–105); tail vertebrae, 38.8 (37–41); hind foot, 12 (12–12). *Skull:* Type specimen (adult female; teeth slightly worn): Condylobasal length, 16.4; palatal length, 6.6; cranial breadth, 7.8; interorbital breadth, 3.6; maxillary breadth, 4.7; maxillary tooth row, 5.7. Average of four skulls of adult females (teeth slightly worn) from type locality: Condylobasal length, 16.8 (16.4–16.9); palatal length, 6.6 (6.5–6.6); cranial breadth, 8.0 (7.7–8.2); interorbital breadth, 3.5 (3.4–3.6); maxillary breadth, 4.9 (4.8–4.9); maxillary tooth row, 5.9 (5.8–6.0).

Remarks.—The almost black color of *S. sinuosus* makes the species easily distinguishable from any other member of the *ornatus* group. The species has a very local distribution, being restricted, as far as known, to the brackish marshes of Grizzly Island, bordering Suisun Bay, Solano County, Calif. Intergradation with *S. o. californicus* is not evident, although it is suggested in certain specimens of *californicus* from Petaluma, Calif.

Specimens examined.—Eleven from type locality.[36]

[36] Mus. Vert. Zool.

SOREX JUNCENSIS Nelson and Goldman

Tule Shrew

(Pl. 3, a′)

Sorex californicus juncensis Nelson and Goldman, Proc. Biol. Soc. Washington 22: 27, March 10, 1909.
Sorex californicus jucensis (sic) Elliot, Check-List Mammals N. Amer. Continent, the West Indies, and Neighboring Seas, Supplement Amer. Mus. Nat. Hist., New York, p. 146, 1917.

Type specimen.—No. 139594, U. S. Nat. Mus., Biological Survey collection; ♀ (?) young adult (teeth scarcely worn); collected September 1, 1905, by E. W. Nelson and E. A. Goldman.

Type locality.—Socorro, 15 miles south of San Quintin, Lower California, Mexico.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—About the color of *Sorex o. ornatus*, slightly smaller; skull relatively high and narrow for *ornatus* group; relatively much narrower than that of *S. ornatus* and subspecies.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Upper parts drab or slightly darker, the color or upper parts extending well down on sides; underparts smoke gray washed with between avellaneous and vinaceous-buff; tail indistinctly bicolor, between drab and wood brown above, pale ochraceous-buff beneath nearly to tip.

Skull.—About the size of that of *S. o. californicus;* relatively higher than any other of the *ornatus* group; relatively narrower than any other of the *ornatus* group, except those of *S. myops, S. tenellus,* and *S. nanus,* than which it is larger and contrastedly higher in all parts.

Measurements.—Type specimen (young adult female [?]): Total length, 101; tail vertebrae, 41; hind foot, 12.5. *Skull* of type specimen (young adult female [?], teeth scarcely worn): Condylobasal length, 15.6; palatal length, 6.2; cranial breadth, 7.4; interorbital breadth, 3.5; maxillary breadth, 4.5; maxillary tooth row, 5.6.

Remarks.—The distinctly higher and narrow skull of *S. juncensis* separates the species from other members of the *ornatus* group. Unfortunately the only specimen available besides the type is an imperfect skull of a senile individual from the type locality. This skull consists only of rostrum and mandibles but discloses no significant differences from the skull of the type specimen.

The species is closely related to true *ornatus*, specimens of which have been examined from localities only a few miles distant from the type locality of *S. juncensis.* Additional material may show that the two forms are specifically connected.

Specimens examined.—Two, from type locality.

SOREX TENELLUS Merriam

Owens Valley Dwarf Shrew

(Pls. 6, q; 9, i)

Sorex tenellus Merriam, North Amer. Fauna No. 10, p. 81, December 31, 1895.
Sorex tenellus tenellus Miller, U. S. Nat. Mus. Bul. 79, p. 18, December 31, 1912.

Type specimen.—No. $\frac{25083}{32495}$, U. S. Nat. Mus., Biological Survey collection; sex undetermined, adult (teeth slightly worn), skin and skull (posterior right-half of cranium broken away); collected December 22, 1890, by E. W. Nelson.

Type locality.—Along Lone Pine Creek, at upper edge of Alabama Hills at about 5,000 feet,[37] near Lone Pine, Owens Valley, Inyo County, Calif.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—Similar to *Sorex myops* in color; skull weaker than that of *S. myops*, with narrower rostral region and weaker dentition. Color paler than in *S. o. californicus*, with skull decidedly smaller in all dimensions and relatively narrower, the rostrum distinctly narrower and teeth smaller. Apparently closely related to *S. nanus*, color paler and hind foot larger; skull similar to that of *S. nanus* but larger and possibly proportionally broader.

Color.—Winter pelage: Upper parts drab; slightly paling on the flanks; underparts pale smoke gray tinged with pale olive-buff; tail olive-brown above, tilleul buff below, darkening toward tip. *Summer pelage:* Unknown.

Skull.—Small, flat, weak, with narrow rostrum and small teeth. Smallest in the *ornatus* group except that of *S. nanus* and possibly that of *S. myops*. Narrower interorbitally and rostrally than that of *S. myops*, with smaller teeth.

Measurements.—Type specimen (adult, sex unknown): Total length, 103; tail vertebrae, 42; hind foot, 12.5. *Skull:* Type specimen (adult, sex unknown; teeth slightly worn): Condylobasal length, 15.1; palatal length, 5.9; interorbital breadth, 3.1; maxillary breadth, 4.2; maxillary tooth row, 5.4.

Remarks.—Since this species is known only from the type specimen, its exact status is difficult to determine. It certainly has general affinities with the *ornatus* group, and in some respects it appears that it may be intermediate between *S. nanus* and *S. myops*. The suggestion, however, is too slight to warrant specific connection among these forms.

Specimen examined.—One, the type specimen.

SOREX MYOPS MERRIAM

WHITE MOUNTAINS DWARF SHREW

(PLS. 3, B'; 6, B)

Sorex tenellus myops Merriam, Proc. Biol. Soc. Washington 15: 76, March 22, 1902.

Type specimen.—No. $\frac{29559}{41634}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn); collected July 13, 1891, by E. W. Nelson.

Type locality.—Pipers Creek (Cottonwood Creek), near main peak of White Mountains, altitude 9,500 feet, Mono County, Calif.

Geographic range.—Known only from type locality. (Fig. 19.)

Diagnostic characters.—Color paler than other California members of the *ornatus* group, except *Sorex tenellus;* in size and color similar to *S. tenellus;* skull heavier, the rostrum noticeably broader, and the teeth larger than in either *S. tenellus* or *S. nanus*. Skull smaller than that of *S. o. californicus*, with shorter palate and narrower brain case.

Color.—Worn winter pelage: Upper parts and sides near drab, possibly slightly paler and inclining toward avellaneous; underparts pale smoke gray tinged with pale olive-buff; tail, above between buffy brown and tawny-olive, below near tilleul buff, darkening toward tip. *Summer pelage:* Upper parts drab, inclining toward hair brown; color of underparts and tail in summer, unknown.

Molting.—The type specimen of *S. myops*, collected July 13, 1891, shows transition from winter to summer pelage; the top of the head and anterior half or more of the back is in fresh summer fur; the remaining parts have the worn winter hair. A topotype, a male, collected one day earlier than the type specimen, is in worn winter pelage.

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[37] Not "summit of Alabama Hills," as stated by Merriam (1895, p. 81). See also Howell, A. B., Journ. Mamm. 4: 266, November, 1923.

Skull.—Small, flat, and relatively narrow. Smaller than the skull of any of the *ornatus* group except that of *S. tenellus* and *S. nanus*. Skull heavier, distinctly broader interorbitally and through rostrum, and with heavier dentition than in *S. tenellus* or *S. nanus*.

Measurements.—Type specimen (adult female): Total length, 98; tail vertebrae, 41; hind foot, 12. Adult male from type locality: Total length, 98; tail vertebrae, 41; hind foot, 12.5. *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 15.2; palatal length, 6.0; cranial breadth, 7.0; interorbital breadth, 3.3; maxillary breadth, 4.4; maxillary tooth row, 5.6. Skull of adult male (teeth moderately worn) from type locality: Condylobasal length, 15.2; palatal length, 5.9; cranial breadth, 7.0; interorbital breadth, 3.4; maxillary breadth, 4.4; maxillary tooth row, 5.6.

Remarks.—The two specimens of *S. myops*, the only ones known, are very uniform in characters and differ chiefly from *S. tenellus*, their nearest ally, in the skulls, which are noticeably broader interorbitally and through the rostra, and have heavier dentition. This species is probably confined to the White Mountains, Calif., where it is seemingly rare and may even be exterminated by the destruction of its habitat through sheep grazing.

Specimens examined.—Two from type locality.

SOREX NANUS Merriam

Rocky Mountain Dwarf Shrew

(Pls. 3, c'; 9, j)

Sorex tenellus nanus Merriam, North Amer. Fauna No. 10, p. 81, December 31, 1895.

Type specimen.—No. 73773, U. S. Nat. Mus., Biological Survey collection; ♀ young adult (teeth unworn), skin and skull (occipital and supraoccipital region of skull broken away); collected August 3, 1895, by Edward A. Preble.

Type locality.—Estes Park, Larimer County, Colo.

Geographic range.—Known only from the mountains of central and north-central Colorado. (Fig. 19.)

Diagnostic characters.—Smallest of the *ornatus* group. Most nearly like *Sorex tenellus*, but apparently darker. Skull smaller than that of *S. tenellus* and possibly relatively narrower. Skull distinctly narrower, particularly rostrum, than in *S. myops*, the teeth smaller.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Upper parts between hair brown and olive-brown, extending well down over sides where it merges with color of ventral parts; underparts smoke gray rather densely mixed and washed with between avellaneous and vinaceous buff; tail indistinctly bicolor, drab above, pale ochraceous buff below nearly to tip.

Skull.—Smallest of the *ornatus* group. In general proportions like that of *S. tenellus*, but smaller and possibly relatively narrower.

Measurements.—Type specimen (young adult female): Total length, 105; tail vertebrae, 42; hind foot, 10. *Skull:* Type specimen (young adult female; teeth unworn): Palatal length, 5.3; cranial breadth, 6.6; interorbital breadth, 3.0; maxillary breadth, 4.0; maxillary tooth row, 5.1. Skull of adult (sex unknown; teeth slightly worn), from West Cliff, Colo., altitude 8,300 feet; Condylobasal length, 14.5; palatal length, 5.4; cranial breadth, 6.7; interorbital breadth, 3.0; maxillary breadth, 4.0; maxillary tooth row, 5.2.

Remarks.—With the possible exception of *S. preblei*, *S. nanus* is the smallest member of the genus. Specimens have been examined only from the mountains of central Colorado, although Merriam records one from Fort Custer, Mont. (Merriam, 1895, p. 82.) The

author has been unable to locate the Montana specimen or to find any record of it other than that published by Merriam.

Specimens examined.—Total number, 2, as follows:

Colorado: Estes Park (type locality), 1; West Cliff (altitude 8,300 feet), 1.

TABLE 12.—*Cranial measurements of adult specimens of* Sorex ornatus *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. o. ornatus:										
California—										
San Emigdio Canyon.	43198	♂	.....	6.9	.....	3.7	5.0	6.2	Very slight	Type specimen.
Tehachapi	135947	♂	16.7	6.8	8.2	3.6	5.1	6.2	Slight	
El Portal	[1] 21522	♂	17.1	7.0	8.1	3.6	5.0	6.1	do	
Do	[1] 21525	♂	16.8	6.7	8.0	3.4	4.8	6.0	do	
Do	[1] 21533	♂	17.1	6.8	8.2	3.8	5.0	6.2	do	
Do	[1] 21534	♂	16.5	6.7	8.1	3.4	4.9	5.8	do	
Lower California—Aguaje de las Fresas.	[2] 10842	♀	16.5	6.8	8.2	3.5	4.7	6.0	do	Type specimen of *S. oreinus.*
S. o. californicus:										
California—										
Walnut Creek	44426	♂	16.0	6.3	7.8	3.3	4.5	5.6	do	Type specimen.
Berkeley	44679	♂	15.9	6.3	8.0	3.3	4.6	5.7	do	
S. o. lagunae:										
Lower California—La Laguna.	147119	♀	16.4±	.....	7.8	3.5	4.8	.....	do	Do.
S. trigonirostris:										
Oregon—Ashland	203608	♀	15.6	5.8	7.9	3.4	4.5	5.5	do	Do.
S. sinuosus:										
California—Grizzly Island.	[1] 16470	♀	16.4+	6.6	7.8	3.6	4.7	5.7	do	Do.
Do	16468	♀	16.9	6.5	8.0	3.5	4.9	5.8	do	Type locality.
Do	[1] 16469	♀	16.8	6.6	7.7	3.4	4.8	6.0	do	Do.
Do	[1] 16471	♀	16.4	6.6	8.2	3.6	4.9	5.9	do	Do.
Do	[1] 20790	♀	16.9	6.6	8.2	3.5	4.9	5.9	do	Do.
S. juncensis:										
Lower California—Socorro.	139594	♀?	15.6	6.2	7.4	3.5	4.5	5.6	Very slight	Type specimen young adult.
S. tenellus:										
California—Owens Valley.	32495	.....	15.1	5.9	.....	3.1	4.2	5.4	Slight	Type specimen.
S. myops:										
California—White Mountains.	41634	♀	15.2	6.0	7.0	3.3	4.4	5.6	Moderate	Do.
Do	41633	♂	15.2	5.9	7.0	3.4	4.4	5.6	do	Type locality.
S. nanus:										
Colorado—										
Estes Park	73773	♀	.....	5.3	6.6	3.0	4.0	5.1	Unworn	Type specimen young adult.
West Cliff	174655	.....	14.5	5.4	6.7	3.0	4.0	5.2	Slight	

[1] Mus. Vert. Zool. [2] Field Mus. Nat. Hist.

Subgenus NEOSOREX Baird

Neosorex Baird, Report Pacific R. R. Survey 8: part 1, Mammals, p. 11, 1857.

Type species.—*Neosorex navigator* Baird.

Geographic range.—Northern British Columbia, southern Alaska (Glacier Bay), central Northwest Territories (lat. 64° N.), south in the mountains to southern California, Arizona, and northern New Mexico; east to northern Manitoba and southeastern Quebec, south to northeastern South Dakota, central Minnesota, northern Wisconsin and Michigan, and northeastern Pennsylvania.

Diagnostic characters.—Size rather large, the largest form (*S. p. palustris*) about equal in size to the smallest form (*S. b. bendirii*) of the subgenus Atophyrax; feet more conspicuously fringed with hair than in Atophyrax or Sorex proper. Skull smaller than in Atophyrax; rostrum, particularly anterior portion, comparatively short, scarcely curved ventrally anteriorly; anterior end of premaxilla scarcely narrower dorsoventrally than middle portion; dorsoventral diameter of rostrum measured at third unicuspid equal about half the diameter between anterior border of infraorbital foramen and posterior border of i^1; anterior-posterior diameter of basal portions of upper unicuspids (particularly fifth or last unicuspid) less than in Atophyrax, effecting a relatively short unicuspid tooth row with cusps less widely separated; posterior end of interior cutting edge of anterior portion of internal basal shelf of m^1 and m^2 usually without cusplike lobe; pigmentation of anterior portion of internal basal shelf of m^1 and m^2 less extended posteriorly than in Atophyrax.

Remarks.—The water shrews of the *S. palustris* type form a rather compact group very different from the marsh shrews of the *S. bendirii* type in its extreme form and readily differentiated by the characters designated. In southern British Columbia, however, the two groups approximate each other in certain cranial characters and the cranial differences between them are more of degree than of absoluteness. The relationship of the two subgenera, Neosorex and Atophyrax, is further discussed under the subgenus Atophyrax (p. 192).

Neosorex at best is a poorly characterized subgenus, which differs from the subgenus Sorex solely in the accentuation of the fimbriation on the feet. It differs from the subgenus Atophyrax in this same character as well as cranially.

KEY TO THE SPECIES AND SUBSPECIES OF THE SUBGENUS NEOSOREX

a^1. Skull with highly developed sagittal and lambdoidal crests; condylobasal length less than 19.3 mm ..... *alaskanus* (p. 189).

a^2. Skull smooth, without developed sagittal and lambdoidal crests; condylobasal length 19.3 mm. or more.

b^1 Underparts in summer pelage pale, almost whitish (usually smoke gray)

c^1. Condylobasal length of skull 20.5 mm. or more; maxillary breadth of skull more than 6.1 mm ..... *palustris* (p. 178).

c^2. Condylobasal length of skull less than 20.5 mm.; maxillary breadth of skull 6.1 mm. or less.

d^1. Range east of the Great Plains (confined to Nova Scotia and southeastern Quebec) ..... *gloveralleni* (p. 183).

d^2. Range west of the Great Plains (Sierra Nevada, and Rocky and Cascade Mountains) ..... *navigator* (p. 184).

b^2. Underparts in summer pelage dark, almost blackish (usually fuscous).

c^1. Tail usually bicolor nearly to tip in any pelage; underparts in winter pelage pale, almost whitish (pale smoke gray) ..... *hydrobadistes* (p. 180).

c^2. Tail usually not bicolor in any pelage; underparts in winter pelage dark, never distinctly whitish (usually hair brown) ..... *albibarbis* (p. 181).

SOREX PALUSTRIS GROUP

The *palustris* group includes two species: *Sorex palustris* and *S. alaskanus.*

Geographic range.—That of the subgenus Neosorex.

Diagnostic characters.—Those of the subgenus Neosorex.

SOREX PALUSTRIS RICHARDSON

[Synonymy under subspecies]

Geographic range.—That of the subgenus Neosorex except Point Gustavus, Glacier Bay, Alaska. (Fig. 21.)

Diagnostic characters.—The species *S. palustris* may be separated from *S. bendirii* by group characters. The smaller forms (*navigator* and *gloveralleni*) are essentially like *S. alaskanus* in size and color. The geographically nearer *navigator* differs from *S. alaskanus* in its longer and less angular skull, with relatively longer rostrum and longer mesopterygoid space, and without the highly developed sagittal and lambdoidal crests, and inframaxillary ridge of *S. alaskanus*.

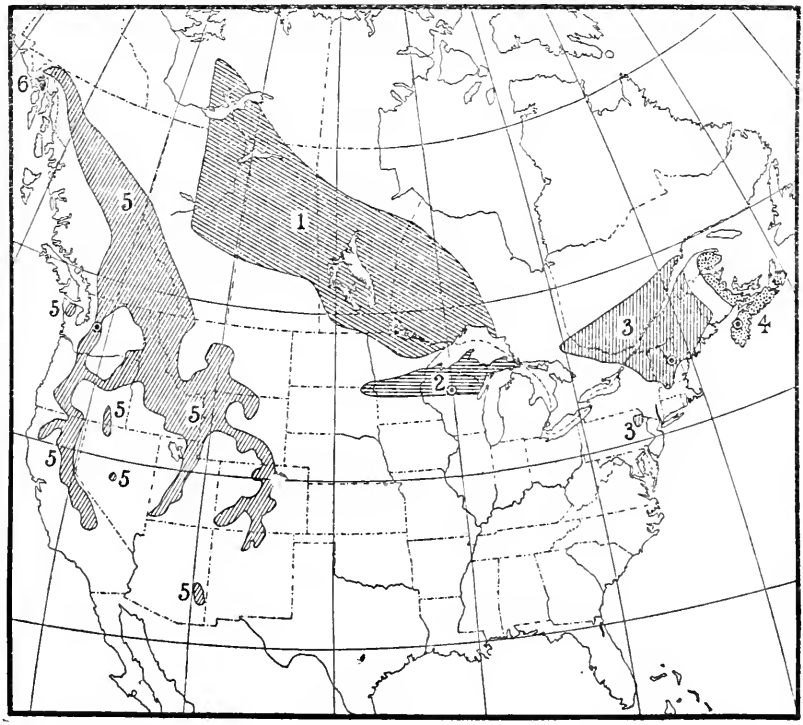

FIG. 21.—Geographic range of species and subspecies of the *Sorex palustris* group

1. *S. p. palustris.*
2. *S. p. hydrobadistes.*
3. *S. p. albibarbis.*
4. *S. p. gloveralleni.*
5. *S. p. navigator.*
6. *S. alaskanus.*

Subspecies and geographic variation.—Under the species *palustris* are included five subspecies: *palustris, hydrobadistes, albibarbis, gloveralleni,* and *navigator.*

Considering the wide geographic range of this species, it shows comparatively little geographic variation. The typical form *palustris* is the largest. The size of individuals decreases rather abruptly toward the west of the range of the subspecies *palustris* into *navigator,* which retains its characters with remarkable constancy over a very extensive range. Southeasterly from the range of *S. p. palustris* there is a gradual decrease in size and in intensity of color of underparts. The extreme accentuation of the dark underparts reaches maximum in specimens of *albibarbis* from eastern New York, Vermont, and New Hampshire, and decreases again northeasterly into the form *acadicus,* which also gives the minimum in size of the eastern forms of *S. palustris.*

Time of molting.—The change from winter to spring pelage seems to occur usually during May or early June, but unfortunately only a few specimens collected at that time of the year are available. An adult male of *S. p. palustris* collected June 8, 1895, at Tower, Minn., has complete summer pelage on the back, but the sides and underparts are in worn winter fur. Specimens of the subspecies *palustris* collected the last week of June in northeastern Manitoba appear to be in summer pelage. Four males of *S. p. navigator* from Sierra Nevada, Calif., are apparently in fresh summer pelage the last week of May, while a female collected at the same time and place is in fresh pelage except on the nose and face. A breeding female taken June 19, 1910, at 5,500 feet altitude in the Warner Mountains, Calif., is in full summer pelage on the back; the head and ventral parts of this animal are in worn winter pelage, but show the new hair growth under the old.

The fall molt is evident in a large number of specimens and seems to occur most frequently during the last half of August and early in September, but not infrequently may begin early in August. In the extreme southern part of the range (New Mexico and southern Sierra Nevada in California) the winter pelage may not appear till considerably later than it does in the north; still on the whole the variation in the time of the fall molt does not appear to be greatly influenced by geographical position. A female of *S. p. palustris* from northeastern Manitoba shows no indication of molting September 15, 1900, yet another female collected in the same region one day earlier seems to be in full winter fur. The latest date at which the writer has noted the incoming winter pelage is in a female collected October 14, 1911, at Big Pine Creek (8,000 feet altitude), Sierra Nevada, Calif.; superficially this animal appears to be in worn summer pelage, but examination shows the new pelage under the old over the entire back, head, sides, and abdomen.

SOREX PALUSTRIS PALUSTRIS Richardson

American Water-shrew

(Pls. 3, d'; 5, o; 6, s; 10, a)

Sorex palustris Richardson, Zool. Journ. 3, no. 12 (January to April, 1828), p. 517, April, 1828.

Amphisorex palustris Gray, Proc. Zool. Soc. London, pt. 5, 1837, p. 125, May, 1838.

Crossopus palustris Reichenbach, Praktische Naturgesch. Menchen und Saugth., p. 161, 1847.

G[alemys] (Cross[opus]) palustris Pomel, Arch. Sci. Phys. et Nat. 9:249, 1848.

Neosorex palustris Verrill, Proc. Boston Soc. Nat. Hist. 9:167, February, 1863.

Sorex (Neosorex) palustris Merriam, North Amer. Fauna No. 10, p. 91, December 31, 1895.

Neosorex palustrius (sic) Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 378 (fig. 72), 1901.

Neosorex palustris palustris G. M. Allen, Proc. Biol. Soc. Washington 28:17, February 12, 1915.

Sorex palustris palustris Jackson, Journ. Mamm. 7:57, February 15, 1926.

Type specimen.—No. 42.10.7.1, British Museum (Natural History), presented by Sir John Richardson. On the label is written "No. 15. Large Shrew Mouse. *Sorex palustris*—Drummond." Stuffed specimen, now dismounted, but not made down into a proper skin; skull imperfect, no brain case.[38]

Type locality.—Marshy places, from Hudson's Bay to the Rocky Mountains.

Geographic range.—Central Northwest Territories (lat. 64° N.), south to east-central Alberta, east and south across Manitoba to northeastern Minnesota and eastern Ontario (Fig. 21.)

Diagnostic characters.—Size largest of the species (total length usually about 160 mm.); color of underparts pale (much paler than in *S. p. albibarbis*, both

[38] For this information the writer is indebted to Oldfield Thomas, who also supplies the following measurements: "Hind foot, c. u. 19 (not quite trustworthy); upper tooth series, 9.8; breadth of palate across molars, 5.6."

in summer and winter pelage; in winter pelage about as in corresponding pelage of *S. p. hydrobadistes*, but much paler in summer), sharply defined from upper parts in all pelages; upper parts in winter about as in *hydrobadistes*, paler and more brownish than corresponding pelage of *albibarbis;* upper parts in summer pelage paler and more brownish than in either *albibarbis* or *hydrobadistes;* tail distinctly bicolor; skull large with relatively heavy rostrum and maxillary region; dentition heavy, particularly second upper premolar, which in this form is largest of the species; posterior border of molariform teeth deeply emarginate; unicuspids relatively large and broad.

Color.—Winter pelage: Upper parts usually fuscous-black to dark fuscous-black or chaetura drab, sometimes tending toward chaetura black or blackish mouse gray, usually with a scarcely perceptible sprinkling of whitish hair bands, and with greenish and purplish iridescence; underparts usually pale smoke gray or between pale smoke gray and smoke gray, sometimes pale olive-gray, more or less glossy or silvery, occasionally stained with Isabella color; color of underparts extending onto upper lip and underparts of limbs; flanks slightly paler than back, more mixed with grayish hairs of underparts; tail bicolor, fuscous-black above, whitish below nearly to tip. *Summer pelage:* Upper parts slightly paler and more brownish than in winter, fuscous-black or chaetura-drab; underparts darker than in winter, smoke gray, pale hair brown or mouse gray; chin and lips about same color as underparts or slightly paler; tail as in winter.

Skull.—Size large, brain case broad, rostrum and maxillary region relatively heavy; dentition heavy, particularly second upper premolar, which in this form reaches maximum size for the species; posterior border of molariform teeth deeply emarginate; unicuspids relatively large and broad; inner sides of cusps of molariform teeth and cusps of unicuspids and first incisors deeply pigmented with mahogany red.

Measurements.—Average of three adult females from Robinson Portage, Manitoba: Total length, 160 (160–160); tail vertebrae, 72 (72–73); hind foot, 20 (19–20). *Skull:* Average of three skulls of adult females (teeth slightly worn) from Robinson Portage, Manitoba: Condylobasal length, 21.0 (20.7–21.5); palatal length, 8.9 (8.8–9.1); cranial breadth, 10.4 (10.2–10.6); interorbital breadth, 4.3 (4.2–4.4); maxillary breadth, 6.2 (6.2–6.2); maxillary tooth row, 7.7 (7.5–7.9).

Remarks.—Although *S. palustris* has been placed in various genera by different workers, it is one of the few of the early described shrews that has not received several synonymous specific names. The subspecies *palustris* has a comparatively wide range throughout central Canada, and intergrades with *S. p. hydrobadistes* in northern Minnesota. A skin of *S. p. palustris* in early summer pelage, without skull, from Tower, Minn., indicates a tendency toward *hydrobadistes*, and an alcoholic specimen from Itasca County in the same State, the color of which can not be definitely ascertained, shows in cranial characters a decided approach toward *hydrobadistes.*

A skull unaccompanied by a skin, from Michipicoten Island, in Lake Superior, Ontario, is provisionally referred to *S. p. palustris.* It is somewhat smaller than skulls of typical *S. p. palustris*, showing in this respect an approach toward *S. p. albibarbis;* but in general shape of the skull and size of the teeth it is like that of *S. p. palustris*, and shows no tendency toward the relatively broad and flat skull of *hydrobadistes.*

Specimens examined.—Total number, 21, as follows:

Alberta: Athabaska Landing (35 miles south), 1; Ranfurly, 1[39]; South Edmonton, 1.

Manitoba: Aweme, 1[40]; Echimamish River, 1; Fort Garry, 1; Hill River (near Swampy Lake), 1; Nelson River, 1; Norway House, 1; Robinson Portage, 5; Winnipeg, 2.

Minnesota: Itasca County (T. 61 N., R. 26 W.), 1; Tower, 1.

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[39] Mus. Comp. Zool. [40] Stuart Criddle coll., Treesbank, Manitoba.

Northwest Territories: Fort Rae, Great Slave Lake, 1; Grandin River, 1. Ontario: Michipicoten Island, 1.

SOREX PALUSTRIS HYDROBADISTES Jackson

Wisconsin Water-shrew

(Pls. 4, a; 11, m)

Sorex palustris hydrobadistes Jackson, Journ. Mamm. 7:57, February 15, 1926.

Type specimen.—No. 229061, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth much worn), skin and skull; collected July 23, 1918, by Hartley H. T. Jackson.

Type locality.—Withee, Clark County, Wis.

Geographic range.—Extreme northeastern South Dakota (Fort Sisseton), central Minnesota, easterly across northern Wisconsin and the upper peninsula of Michigan. (Fig. 21.)

Diagnostic characters.—Size averaging very slightly smaller than *Sorex p. palustris;* color in winter pelage, particularly of underparts, pale, about as in *S. p. palustris;* color in summer pelage, particularly of underparts, dark, about as in *S. p. albibarbis;* skull slightly smaller than that of *S. p. palustris,* flatter, with relatively and actually shorter rostrum; skull larger and heavier than that of *albibarbis;* second upper premolar intermediate in size between that of *S. p. palustris* and *albibarbis;* emargination of posterior borders of molariform teeth about intermediate between that in *S. p. palustris* and *albibarbis.*

Color.—Winter pelage: Similar to winter pelage of *S. p. palustris.* Upper parts usually chaetura drab or fuscous-black, sometimes tending toward chaetura black or blackish mouse gray, usually with a scarcely perceptible sprinkling of whitish hair bands, and sometimes with greenish and purplish iridescence; underparts usually pale smoke gray or between pale smoke gray and smoke gray, sometimes pale olive-gray, more or less glossy or silvery, occasionally stained with Isabella color; color of underparts extending onto upper lip and underparts of limbs; flanks slightly paler than back, more mixed with grayish hairs of underparts; tail bicolor, fuscous-black above, whitish below nearly to tip. *Summer pelage:* Similar to summer pelage of *S. p. albibarbis.* Upper parts slightly more brownish and less glossy than in winter, usually fuscous-black, dark fuscous-black, or chaetura drab; underparts much darker than in winter, scarcely paler than upper parts, fuscous, hair brown, or chaetura drab; chin and lips very slightly paler, more whitish than general color of underparts; tail as in winter.

Skull.—Slightly smaller than that of *S. p. palustris,* flatter, with relatively and actually shorter rostrum, and relatively broader brain case; larger and heavier than that of *S. p. albibarbis,* with relatively wider rostrum; second upper premolar intermediate in size between that of *S. p. palustris* and *albibarbis,* averaging nearer to that of *S. p. palustris;* posterior borders of molariform teeth less deeply emarginate than in *S. p. palustris,* more deeply emarginate than in *albibarbis.*

Measurements.—Type specimen (adult male): Total length, 150; tail vertebrae, 63; hind foot, 20. *Skull:* Skull of type specimen (adult male; teeth much worn): Condylobasal length, 20.5; palatal length, 8.2; cranial breadth, 10.2; interorbital breadth, 4.3; maxillary breadth, 6.1; maxillary tooth row, 7.4. Average of six skulls of adult males (teeth slightly to moderately worn) from Elk River, Minn.: Condylobasal length, 20.6 (20.2–21.0); palatal length, 8.6 (8.0–9.0); cranial breadth, 10.4 (10.0–10.9); interorbital breadth, 4.4 (4.3–4.6); maxillary breadth, 6.4 (6.2–6.5); maxillary tooth row, 7.6 (7.4–7.8).

Remarks.—Although geographically and in most of its cranial characters *S. p. hydrobadistes* is intermediate between *S. p. palustris* and *S. p. albibarbis,* and superficially resembles *S. p. palustris* in color in winter and *albibarbis* in summer, it is strikingly different in color from the subspecies *palustris* in summer and from *albibarbis* in winter. It intergrades with *S. p. palustris* in northern Minne-

sota, and probably also with *albibarbis* in the Great Lakes region of southwestern Ontario, though material examined from that region has been insufficient to establish this point. Specimens from the Upper Peninsula of Michigan are referable to *hydrobadistes*. One collected August 17, 1914, in Chippewa County, Mich., matches typical specimens of *hydrobadistes* both in cranial characters and color except that it is heavily stained with Prout's brown on the throat.

Specimens examined.—Total number, 35, as follows:

Michigan: Chippewa County, 1[41]; Merriweather, Gogebic Lake, 3[41]; Michigamme, 2.
Minnesota: Elk River, 6.
South Dakota: Fort Sisseton, 3; Fort Wadsworth, 1.
Wisconsin: Basswood Lake (10 miles southeast, Iron River), 1; Danbury, 2; Lac Vieux Desert, 3[42]; Lake St. Germain, Vilas County, 1; Marinette County, 1[43]; Mercer, 1; Rhinelander, 4[44]; Sayner, 1[42]; Solon Springs, 4[42]; Withee (type locality), 1.

SOREX PALUSTRIS ALBIBARBIS (Cope)

White-lipped Water-shrew

(Pls. 1; 4, B; 10, B)

Neosorex albibarbis Cope, Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 188, 1862.
Sorex albibarbis Merriam, Proc. Biol. Soc. Washington 7: 25, April, 1892.
Sorex (*Neosorex*) *albibarbis* Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1894, part 3, October–December, p. 395, January, 1895.
Sorex palustris albibarbis Rhoads, Mammals of Pennsylvania and New Jersey, p. 191, 1903.
Neosorex palustris albibarbis G. M. Allen, Proc. Biol. Soc. Washington 28: 17, February 12, 1915.

Type specimen.—No. $\frac{11239}{38743}$, U. S. Nat. Mus., ♀ adult (teeth slightly worn), alcoholic with skull removed; collected in September, 1859, by E. D. Cope.

Type locality.—Profile Lake, Franconia Mountains, Grafton County, N. H.

Geographic range.—Southern Quebec, western New Brunswick, western Ontario, Vermont, eastern New York, south to northeastern Pennsylvania. (Fig. 21.)

Diagnostic characters.—Slightly smaller than *Sorex p. palustris* (total length usually less than 150 mm.); underparts very dark, scarcely defined from upper parts (particularly in summer pelage), much darker than in *S. p. hydrobadistes* in winter pelage; tail usually not bicolor, or indistinctly so; skull smaller than that of *S. p. palustris*, slightly smaller than that of *hydrobadistes;* second upper premolar smaller than in *S. p. palustris* or *hydrobadistes*, slightly larger than in *S. p. gloveralleni* or *S. p. navigator;* posterior borders of molariform teeth less deeply emarginate than in *S. p. palustris* or *hydrobadistes*, and unicuspids relatively narrower.

Color.—Winter pelage: Upper parts dark fuscous-black, chaetura black, or blackish mouse gray to nearly black, frequently with pronounced greenish or purplish iridescence; underparts paler than upper parts, more mixed with whitish, the general tone in typical specimens being mouse gray or hair brown, not infrequently almost fuscous-black or chaetura drab; chin and lips usually paler (more whitish) than general color of underparts; tail usually monochromatic (near fuscous-black), frequently indistinctly bicolor, rarely distinctly bicolor (whitish beneath) nearly to tip. *Summer pelage:* Upper parts

[41] Univ. Mich.
[42] Field Mus. Nat. Hist.
[43] Public Mus. Milwaukee.
[44] E. R. Warren coll., Colorado Springs, Colo., 1; Univ. Wis. Zool. Mus., 3.

averaging slightly paler and more brownish than in winter, fuscous, fuscous-black, or chaetura drab, with less tendency toward iridescence; underparts darker than in winter, with less suffusion of whitish, scarcely paler than upper parts, occasionally as dark as upper parts, fuscous, hair brown, or chaetura drab; chin and lips paler, more whitish, than general color of underparts; tail as in winter.

Skull.—Slightly smaller than that of *S. p. hydrobadistes*, with somewhat weaker dentition; second upper premolar relatively and actually much smaller than in *S. p. palustris*, slightly smaller than in *hydrobadistes*, slightly larger than in *S. p. gloveralleni* or *S. p. navigator;* posterior borders of molariform teeth much less deeply emarginate than in *S. p. palustris*, slightly less than in *hydrobadistes;* unicuspids relatively narrower and dental pigmentation usually less than in *S. p. palustris.*

Measurements.—Type specimen (adult female, measured from alcoholic by the writer) : Total length, 144; tail vertebrae, 68; hind foot, 19. Adult male and old adult male from East Wallingford, Vt.: Total length, 145, 151; tail vertebrae, 63, 68; hind foot, 19, 18. *Skull:* Type specimen (adult female, teeth slightly worn) : Condylobasal length, 20.0; palatal length, 8.3; cranial breadth, 10.1; interorbital breadth, 4.3; maxillary breadth, 6.1; maxillary tooth row, 7.3. Skulls of adult male (teeth slightly worn) and old adult male (teeth moderately worn) from East Wallingford, Vt.: Condylobasal length, 20.2, 19.9; palatal length, 8.4, 8.0; cranial breadth, 9.9, 10.4; interorbital breadth, 4.1, 4.5; maxillary breadth, 6.0, 6.4; maxillary tooth row, 7.2, 7.4.

Remarks.—The type specimen of *S. p. albibarbis* was caught under a stone on the shore of Profile Lake, N. H. (Cope, 1862, p. 188.) Specimens from Vermont and southern Maine are typical; those from the Adirondack Mountains, N. Y., appear to have more blackish tails than those from the type region, but do not differ in other respects. One from Bushkill Creek, Monroe County, Pa., collected September 28, 1894, in fresh winter pelage except on the throat, is inseparable in color from *albibarbis*, but, unfortunately, the skull seems to have been lost. Two skins collected late in July, 1902, on Mount Katahdin, Me., are like *albibarbis* in color; one of them is much smaller than typical *albibarbis* and is accompanied by a skull that is correspondingly smaller and weaker than typical skulls of that subspecies; it is probably abnormal, however, because the other skin, which is without a skull, has measurements in keeping with true *albibarbis.* The most southerly New England record is Warwick, Mass., from which place Verrill (1863a, p. 165) records a specimen taken in July, 1862.

Intergradation with *S. p. gloveralleni* is indicated in specimens from eastern Quebec (Godbout and St. Rose), which have weaker dentition than typical *S. p. albibarbis.* As far as the reviser is able to judge from the three specimens from Godbout, which are alcoholics, the ventral parts are somewhat paler than in typical *albibarbis*, in this respect approaching *gloveralleni.* The St. Rose specimen, however, is identical in color with *albibarbis.* A specimen from Lake Edward, Quebec, the skull of which is too imperfect for critical study, is in fresh winter pelage, except on the upper chest and throat; the summer pelage of the chest and throat and of the ventral portion of the tail is dark, as in specimens of *albibarbis* from the type region; the fresh winter pelage of the underparts, however, is almost as pale as that of *S. p. palustris.* A skin in summer pelage, without skull, from North Bay, Ontario, matches *albibarbis* in color and is provisionally referred to that form.

Specimens examined.—Total number, 35, as follows:

Maine: Basin Pond, Mount Katahdin, 1; Brunswick, 8[45]; Chimney Pond (altitude 3,000 feet), Mount Katahdin, 1; Norway, 1; Upton, 1.[45]
New Hampshire: Intervale, 1[46]; Profile Lake (type locality), 1.
New York: Tupper Lake, 3.[47]
Ontario: North Bay, 1.[48]
Pennsylvania: Bushkill Creek (7 miles east of Cresco), Monroe County, 1.[49]
Quebec: Godbout, 3; Lac aux Sables, 2[49]; Lake Edward, 1[48]; St. Rose, Temiscouata District, 1.
Vermont: East Wallingford, 4[50]; Mendon, 2[51]; Sherburne, 2[51]; West Bridgewater, 1.[51]

SOREX PALUSTRIS GLOVERALLENI JACKSON

NOVA SCOTIAN WATER-SHREW

(PLS. 4, C; 6, T)

Neosorex palustris acadicus G. M. Allen, Proc. Biol. Soc. Washington 28: 15, February 12, 1915. Not *Sorex acadicus* Gilpin, qui *Sorex cinereus* Kerr.
Sorex palustris gloveralleni Jackson, Journ. Mamm. 7: 57, February 15, 1926.

Type specimen.—No. 2046, Mus. Comp. Zool., Harvard Univ., Bangs collection; ♀ adult (teeth slightly worn), skin and skull; collected July 26, 1894, by Outram Bangs.

Type locality.—Digby, Digby County, Nova Scotia.

Geographic range.—Nova Scotia and extreme eastern Quebec (Gaspé Peninsula) south of the St. Lawrence River. (Fig. 21.)

Diagnostic characters.—Size about that of *Sorex p. albibarbis* or slightly smaller; underparts (summer pelage) pale, about as in *S. p. palustris;* upper parts usually slightly paler and more grizzled and finely speckled with whitish hairbands than in *S. p. palustris* or *albibarbis;* in general color much like many specimens of *S. p. navigator;* tail bicolor; skull distinctly smaller than that of *S. p. palustris* or *S. p. hydrobadistes*, slightly smaller, weaker, and less massive than that of *albibarbis;* second upper premolar much smaller than in the subspecies *palustris* or *hydrobadistes*, slightly smaller than in *albibarbis;* posterior borders of molariform teeth about as emarginate as in *albibarbis*, unicuspids slightly smaller.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts chaetura drab or slightly paler, somewhat suffused with whitish hairtips and hairbands; underparts much paler than upper parts, usually pale smoke gray or smoke gray, rarely hair brown; chin and lips more whitish than general tone of underparts; tail bicolor, fuscous-black above, whitish below nearly to tip.

Skull.—Small, much smaller than that of *S. p. palustris* or *S. p. hydrobadistes;* slightly smaller than that of *S. p. albibarbis*, weaker and less massive; about equal in size to that of *S. p. navigator* but higher through brain case and wider interorbitally; dentition relatively weak; second upper premolar much smaller than in *S. p. palustris* or *hydrobadistes*, slightly smaller than in *albibarbis;* posterior borders of molariform teeth less deeply emarginate than in the subspecies *palustris* or *hydrobadistes*, about as in *albibarbis;* unicuspids slightly smaller than in *albibarbis* with similar pigmentation.

Measurements.—Type specimen (adult female) and topotype (old adult female): Total length, 150.5, 158; tail vertebrae, 66.5, 70; hind foot, 20, 19. *Skull:* Skull of type specimen (adult female, teeth slightly worn) and topotype (old adult female, teeth much worn): Condylobasal length, 19.8, 19.5; palatal length, 8.2, 8.0; cranial breadth, 10.0, 10.1; interorbital breadth, 4.3, 4.4; maxillary breadth, 5.5, 5.6; maxillary tooth row, 7.1, 7.1.

Remarks.—Specimens that can be satisfactorily referred to *S. p. gloveralleni* have been examined only from Nova Scotia and the Gaspé Peninsula region of extreme southeastern Quebec, though

[45] Lee Mus. Biol., Bowdoin College.
[46] Univ. Mich.
[47] Univ. Mich., 1; Mus. Comp. Zool., 2.
[48] Mus. Comp. Zool.
[49] Acad. Nat. Sci. Philadelphia.
[50] D. E. Kent coll., Rutland, Vt., 1; G. L. Kirk coll., Rutland, Vt., 3.
[51] G. L. Kirk coll.

certain individuals of *S. p. albibarbis* from eastern Quebec approach *gloveralleni* in dental characters and possibly in color. Superficially *gloveralleni* is often similar to *S. p. navigator*, but the skull is higher through the brain case and wider interorbitally. It is, however, widely separated geographically from *navigator*, two other divergent forms intervening between the two subspecies.

Specimens examined.—Total number, 14, as follows:

Nova Scotia: Aylesford, 1; Digby (type locality), 5[52]; Halifax, 4[53]; James River, 1.
Quebec: Mount Albert, 3.[54]

SOREX PALUSTRIS NAVIGATOR (BAIRD)

MOUNTAIN WATER-SHREW

(PLS. 4, D, E, F, G, H; 10, C, D; 13, C, D)

Neosorex navigator Baird, Report Pacific R. R. Survey 8: pt. 1, Mammals, p. 11, 1857.
Sorex navigator Verrill, Proc. Boston Soc. Nat. Hist. 9: 167, February, 1863. (In synonymy.)
Sorex (Neosorex) palustris navigator Merriam, North Amer. Fauna No. 10, p. 92, December 31, 1895.
[*Neosorex*] [*palustris*] *navigator* Elliot, Field Columb. Mus., Publ. 45 (zool. series 2): 379, March, 1901.
Sorex palustris navigator Stephens, California Mammals, p. 254, June, 1906.
Neosorex navigator navigator Miller, U. S. Nat. Mus. Bul. 79, p. 21, December 31, 1912.

Type specimen.—No. $\frac{629}{1780}$, U. S. Nat. Mus.; sex unknown, adult (teeth slightly worn); imperfect skin (from alcoholic) and skull, with posterior part of brain case broken away; collected about August 31, 1853, by J. G. Cooper.

Type locality.—Near head of Yakima River, Cascade Mountains, Wash.

Geographic range.—Extreme northwestern British Columbia and adjacent part of Alaska (Haines), south through eastern British Columbia and southwestern Alberta to the Olympic Mountains, Wash., and through the Cascade Mountains, and in the Sierra Nevada to Mount Whitney (about lat. 36° N.), Calif., south through Washington, Idaho, and eastern Oregon to central Nevada and southern Utah, and in the Rocky Mountains to northern New Mexico and west-central Arizona.

Diagnostic characters.—Average specimens very similar in superficial appearance to *Sorex p. gloveralleni*. Smaller than *S. p. palustris;* about equal in size to *gloveralleni*, but with tail averaging longer; color much as in *S. p. palustris*, but upper parts more grizzled and flecked with whitish-tipped hairs; skull much smaller and flatter than that of *S. p. palustris*, with much weaker dentition; skull about the size of that of *gloveralleni*, but flatter through brain case, usually narrower interorbitally, with rostrum relatively slightly longer and posterior border of molariform teeth more deeply emarginate.

Color.—Winter pelage: Upper parts chaetura drab or slightly darker, dark mouse gray or blackish mouse gray with a brownish tinge, a sprinkling of whitish hair tips and hair bands producing a pronounced grizzled effect and sometimes frosted appearance, usually with a delicate greenish or purplish iridescence; underparts usually pale smoke gray or between pale smoke gray and smoke gray, sometimes whitish pale olive-gray, more or less glossy and silvery,

[52] Mus. Comp. Zool., 4.
[53] Mus. Comp. Zool., 3; E. R. Warren coll., Colorado Springs, Colo., 1.
[54] Amer. Mus. Nat. Hist.

frequently tinged with pale olive-buff; color of underparts extending onto lips and chin; tail bicolor, fuscous-black or chaetura black above, whitish beneath nearly to tip. *Summer pelage:* Upper parts usually more brownish than in winter, chaetura-drab or slightly paler, sometimes almost fuscous-black or chaetura black, somewhat suffused and finely flecked with whitish hair tips and hair bands; underparts variable, depending much upon wear of the pelage, usually pale smoke gray, smoke gray, or light grayish olive, sometimes almost drab to hair brown, or mouse gray; chin and lips more whitish than general tone of underparts; tail as in winter.

Skull.—Much smaller and flatter than that of *S. p. palustris*, with much weaker dentition; about the size of that of *S. p. gloveralleni*, but flatter and usually narrower interorbitally, and posterior border of molariform teeth more emarginate.

Measurements.—Adult male from Mount Rainier, Wash.: Total length, 152; tail vertebrae, 78; hind foot, 19. Average of 4 adult males from Pahaska, Wyo.: Total length, 149 (145–151); tail vertebrae, 74 (72–76); hind foot, 20.3 (20–21). *Skull:* Type (adult, sex unknown, teeth slightly worn): Condylobasal length, 19.8; palatal length, 8.3; cranial breadth, 9.8; interorbital breadth, 4.1; maxillary breadth, 5.4[65]; maxillary tooth row, 7.3. Skull of adult male (teeth slightly worn) from Mount St. Helens, Wash.: Condylobasal length, 19.9; palatal length, 8.1; cranial breadth, 9.9; interorbital breadth, 4.1; maxillary breadth, 5.9; maxillary tooth row, 7.1. Skull of adult male (teeth slightly worn) from Paradise Creek, Mount Rainier, Wash.: Condylobasal length, 19.6; palatal length, 8.3; cranial breadth, 9.8; interorbital breadth, 4.1; maxillary breadth, 5.8; maxillary tooth row, 7.2. Average of 4 skulls of adult males (teeth slightly worn) from Pahaska, Wyo.: Condylobasal length, 19.7 (19.4–20.0); palatal length, 8.1 (7.9–8.3); cranial breadth, 9.6 (9.5–9.6); interorbital breadth, 4.1 (4.1–4.1); maxillary breadth, 5.7 (5.6–5.8); maxillary tooth row, 7.2 (7.1–7.3). Skull of adult female (teeth moderately worn) from Bennett, British Columbia: Condylobasal length, 20.2; palatal length, 8.3; cranial breadth, 10.1; interorbital breadth, 4.2; maxillary breadth, 5.9; maxillary tooth row, 7.4. Average of 6 skulls of adult males (teeth slightly worn) from Mount Whitney, Calif.: Condylobasal length, 19.8 (19.4–20.0); palatal length, 8.2 (8.0–8.4); cranial breadth, 9.8 (9.6–9.9); interorbital breadth, 4.1 (4.0–4.2); maxillary breadth, 5.8 (5.6–6.0); maxillary tooth row, 7.1 (6.9–7.2). Average of 4 skulls of old adult males (teeth much worn) from Mount Whitney, Calif.: Condylobasal length, 19.8 (19.3–20.4); palatal length, 7.8 (7.4–8.0); cranial breadth, 10.2 (10.0–10.4); interorbital breadth, 4.2 (4.1–4.2); maxillary breadth, 5.9 (5.8–6.0); maxillary tooth row, 7.2 (7.0–7.3).

Remarks.—The type specimen of *Neosorex navigator* Baird is an imperfect skin made from an alcoholic. The skull, however, except that a portion of the right posterior part of the brain case is broken away, is in fairly good condition. The specimen was collected by J. G. Cooper, the locality on the front of the label being given as Fort Vancouver, Columbia River, Wash.; on the back of the label is written, apparently in Baird's handwriting: "According to Dr. Cooper, found in lake near summit of Cascade Mts., Aug. 31, '53," a remark evidently taken from Cooper, who states that "this [specimen], according to the label now attached, was found at Fort Vancouver, but I am inclined to consider this a mistake, and that it was really taken while swimming under water in a lake near the summit of the Cascade Mountains, August 31, 1853" (Cooper, 1860b, p. 73). Merriam at the time of his revision of the genus Sorex (Merriam, 1895) had seen none of this form from the Cascade Mountains, and remarks in a footnote:

> It is evident that the type specimen, like many other alcoholic mammals collected in the early days, was not labeled until long after its capture, and that little dependence can be placed on either of the alleged localities. Furthermore, since the subgenus Neosorex is unknown from the Cascade region, and prob-

[65] Post maxillary processes broken; actual maxillary breadth was probably about 5.7.

ably does not inhabit western Oregon or Washington, which region is occupied by the allied subgenus Atophyrax, it is highly improbable that the specimen came from either of the alleged localities. It agrees closely with specimens from western Montana, and probably came from some point in northern Idaho or the mountains east of Fort Colville, in extreme northeastern Washington, which region was visited by Dr. Cooper during the same expedition (Merriam, 1895, p. 92).

Since the time Merriam wrote as above, however, several specimens of this shrew have been collected in the Cascade Mountains and even in the Olympic Mountains. In view of the aforementioned statement quoted from Doctor Cooper, supported by his additional statement that "aquatic mammalia * * * abound in the fresh waters; and one seems to be peculiar to the Territory, the water shrew (*Neosorex navigator*) caught while swimming a foot below the surface of one of the lakes at the head of the Yakima River, and at least 2,500 feet above the ocean" (Cooper, 1860a, p. 36), it seems necessary to fix the type locality as near the head of the Yakima River, Cascade Mountains, Wash. This lake may not be one of the so-called "Sneeze" lakes, which include Lakes Keechelus, Kachess, and Clealum, but more probably it is one of the smaller lakes farther up the valley. Stevens remarks:

> The pass at the head of the main Yakima, some 20 miles north of the Nachess Pass, is but 3,466 feet above Vancouver. On the lowest point of the summit is a shallow lake, about 200 yards long, from which the water runs both ways * * * Toward the east the descent in the distance of about three-quarters of a mile is 530 feet, to another lake, about half a mile long. (Stevens, 1855, p. 141.)

It is probable that one of these two small lakes is the actual type locality. The next lake farther down would be the upper of the "Sneeze" lakes, Lake Keechelus.

Although subject to minor individual variations, which in some cases appear to be in a measure geographical, this subspecies retains its characters with comparative uniformity throughout its extensive range. These variations are most noticeable in size and in the depth of emargination of the posterior borders of the molariform teeth, but the differences are too inconstant and their averages too slight for subspecific separation. Thus, in a series from near South Yolla Bolly Mountain, Calif., are specimens that are indistinguishable from typical *S. p. navigator*, while a few others have skulls a little larger than typical specimens and have wider crania. The indentation of the posterior margins of the molariform teeth seems to average less in the series from Toyabe Mountains, Nev., than in typical specimens, but the difference is slight and can be matched by occasional specimens from points throughout the range of *navigator;* in no other respects do the Toyabe Mountain specimens differ from typical *navigator*. A specimen in full summer pelage collected July 10, 1915, at Horseshoe Cienega, 8,300 feet altitude, near the headwaters of White River, White Mountains, Ariz., has a skull inseparable from those of *navigator* from the Cascade or more northern Rocky Mountains; in color, however, it is distinctly different from any other specimens of *navigator* examined, being very dark ventrally, the tail scarcely if at all bicolored, even at the base, but tipped with a small white pencil. In fact, the White Mountains, Ariz., specimen in color resembles more nearly the summer pelage of *S. p. albibarbis* or *S. p. hydrobadistes*,

or even *S. b. bendirii*, than it does typical *navigator*. Unfortunately there are no other specimens available from the White Mountains, Ariz., but one from a few miles south collected at 9,000 feet altitude on Prieto Plateau at the south end of the Blue Range, Ariz., does not differ from *navigator* when in corresponding worn pelage.

The three specimens from Poison Creek, altitude 9,500 feet, in the White Mountains, Calif., seem to average larger and paler than typical *navigator*. The paleness, however, may in a measure be due to the way the specimens are made up, since the fur appears to have been saturated with arsenic. Moreover, many other specimens from the White Mountains, Calif., do not differ to any degree from typical *navigator*.

The series from Highwood Mountains, Mont., while clearly referable to *navigator*, shows an approach toward *S. p. palustris* in the skulls, which are somewhat larger and heavier than in average *navigator*. Specimens from Banff and Henry House, Alberta, are distinctly *navigator*, as are also those from Bennett and Telegraph Creek, British Columbia, and Haines, Alaska, the ones from British Columbia and Alaska showing no approach toward the essential characters of *S. alaskanus*.

Specimens examined.—Total number, 614, as follows:

Alaska: Haines, Lynn Canal, 1.

Alberta: Banff, 2; Brazeau Valley, 1; Henry House, 1; Smoky Valley (50 miles north of Jasper House), 1.

Arizona: Prieto Plateau (south end of Blue Range, altitude 9,000 feet), Greenlee County, 1; White River (Horseshoe Cienega, altitude 8,300 feet), White Mountains, 1.

British Columbia: Bennett, 1; Cariboo (Cottonwood Creek), 1; Chilliwack Valley, 2 [56]; Cranbrook, 3 [57]; Faulder, 2 [58]; Hope (14 miles east, Lake House), 1 [59]; Hot Springs, Atlin, 1 [57]; Nelson (6 miles south of), 3; Seton Creek, Lillooet, 4 [57]; Telegraph Creek, 3 [60]; Telegraph Creek (25 miles east), 1.

California: Aspen Valley, Yosemite National Park (altitude 6,400 feet), 2 [61]; Big Pine Creek (10 miles west Big Pine, altitude 8,000 feet), 2 [62]; Blue Canyon (altitude 4,700 to 5,000 feet), Placer County, 3 [62]; Canyon Creek, Trinity County, 1; Chinquapin (altitude 6,200 feet), Yosemite National Park, Mariposa County, 2 [62]; Cottonwood Lakes (altitude 11,000 feet), Sierra Nevada, 1 [62]; Donner (altitude 7,900 feet), 2; Hat Creek (head), Mount Lassen, 1; Independence Creek (altitude 6,000 feet), Sierra Nevada, 2; Independence Lake, 1 [62]; Kearsarge Pass, Sierra Nevada, 4; Laws (7 miles east, Silver Canyon, altitude 4,600 to 7,000 feet), White Mountains, 9 [62]; Little Onion Valley, Sierra Nevada, 5 [62]; Lone Pine, 5; Lone Pine Creek (altitude 4,500 feet), Inyo County, 2 [62]; Mammoth, 6 [63]; Merced Grove, Big Trees (altitude 5,400 feet), Mariposa County, 6 [62]; Mill Creek (altitude 5,000 feet), Mount Lassen, 2; Mount Lassen (south base), 7; Mount Lassen (southeast side), 1; Mount Lyell (Timberline meadow, north side), 1; Mount Shasta (altitude 7,000 feet), 1 [62]; Mount Shasta (south side, timberline), 1; Mount Unicorn (altitude 8,600 feet, Tuolumne Meadows), 1 [62]; Mount Unicorn (Tuolumne Meadows), Yosemite Park, 1; Mount Whitney, 9; Parker Creek, Warner Mountains, 1 [62]; Porcupine Flat (altitude 8,100 feet), Yosemite Park, 2 [62]; Sequoia National Park (Halsted Meadows), 3; South Yolla Bolly Mountain (one-half mile south, altitude 6,000 feet), Trinity County, 3 [62]; South Yolla Bolly Mountain (2 miles south, altitude 7,500 feet), Tehama

[56] Nat. Mus. Canada.
[57] Provincial Mus. British Columbia.
[58] Stuart Criddle coll., Treesbank, Manitoba.
[59] Mus. Comp. Zool.
[60] Amer. Mus. Nat. Hist., 2.
[61] Mus. Vert. Zool., 1.
[62] Mus. Vert. Zool.
[63] D. R. Dickey coll., Pasadena, Calif., 5; G. G. Cantwell coll., Palms, Calif., 1.

County, 10[62]; Upper Ash Creek, Mount Shasta, 1; Vogelsang Lake (altitude 10,100 to 10,350 feet), Yosemite National Park, 7[62]; Wagon Camp, Mount Shasta, 1; Walker Lake, Mono County, 2[62]; Walker Lake (Warren Fork of Leevining Creek, altitude 9,200 feet), Mono County, 5[62]; White Mountains (McAfee Meadows, altitude 11,600 feet), Mono County, 2[62]; White Mountains (Poison Creek, altitude 9,500 feet), Mono County, 3[64]; White Mountains (Roberts Ranch, Weyman Creek, altitude 8,250 feet), Inyo County, 1[62]; Whitney Creek (altitude 10,650 feet), Sierra Nevada, 5[62]; Whitney Meadows, Mount Whitney, 19[65]; Williams Butte (1 mile south Walker Lake), Mono County, 1[62]; Yosemite National Park (altitude 7,300 feet), Mariposa County, 3.[62]

Colorado: Almont, 2; Blackhawk (Dory Hill Pond), 3[66]; Boulder, 6[67]; Boulder County, 1; Cochetopa Pass, 1; Coventry (Maverick Canyon, altitude 6,400 to 6,800 feet), 4[68]; Crested Butte (Deckers Ranch), 1[69]; Culebia Canyon (altitude 9,100 feet), Costilla County, 1[69]; Elkhorn, 1; Gold Hill, 3; Hermit, 3; Lake Moraine, El Paso County, 11[70]; Marvine, 1; Midde Park, 2; Nederland, 4[71]; Rico, 1; Saguache Park, Cochetopa National Forest, 2; St. Elmo (altitude 10,100 feet), 4.

Idaho: Albion, 2; Birch Creek, 6; Bitterroot Mountains, 1; Cedar Mountains, 2[72]; Crow Creek (head of, altitude 7,500 feet), 1; Fort Hall, 1; Irwin (10 miles southeast), 1; Malad, 13; Salmon River Mountains, 5; Sawtooth City, 1; Sawtooth Lake, 3; Thompson Pass, 1; Warren, 1; Wood River (head of), 1.

Montana: Bear Tooth Mountains, 1; Big Hole Basin, Beaverhead County, 2[73]; Big Timber, 1; Crazy Mountains, 2; Emigrant Gulch (3 miles southeast Chico), 6; Flathead Lake, 5; Florence, 2; Highwood Mountains, 6; Moccasin Mountains (5 miles northwest of Hilger), 1; Paola, 1; Pryor Mountains, 7; Red Lodge, 3; St. Marys Lake, 1; Sheep Creek (16 miles north White Sulphur Springs), Little Belt Mountains, 1; Stanford (20 miles southwest, Dry Wolf Creek), Little Belt Mountains, 8; Thompson Pass, 1; Tyler (10 miles west North Fork at Willow Creek), 1; Upper Stillwater Lake, 1; Ward Peak (altitude 6,000 feet, Washington Creek), Madison National Forest, 2; west fork of West Gallatin River, Gallatin National Forest, 1; Willow Creek (4 miles east of White Sulphur Springs), Castle Mountains, 1.

Nevada: Big Creek (head of, altitude 8,000 feet), Pine Forest Range, 2[62]; Jet Canyon, Toyabe Mountains, 1; Pine Forest Range, 2; South Twin River, Toyabe Mountains, 8.

New Mexico: Costilla Pass (east slope, altitude 9,000 feet), 1; Hopewell (6 miles west, altitude 9,900 feet), 1; Pecos Baldy, 1; Santa Clara Canyon, 1; Taos Mountains (east slope, 8,000 feet), 2; Twining (altitude 10,700 feet), 1; Willis, 1.

Oregon: Anna Creek (altitude 6,000 feet), Mount Mazama, 1; Anthony, 16[74]; Beech Creek, 2; Bourne, 16; Cornucopia, 7; Crater Lake, 5; Disaster Peak (altitude 7,000 feet), Malheur County, 1; Drews Creek (near), Lake County, 1; Fort Klamath, 1; Haycreek, 1; Howard, 1; Kieger Gorge (altitude 6,900 feet), Steen Mountains, 1; McKenzie Bridge, 1; Permilia Lake (west base Mount Jefferson), 1; Prospect, Jackson County, 1[64]; Steen Mountains, 1; Strawberry Butte, 3; Strawberry Mountains, 6; Three Sisters, 1; Wallowa Lake (altitude 5,000 to 8,000 feet), 2; Warmspring (20 miles west, Mill Creek), 2.

Utah: Barclay, 2; Clear Creek, 1; Currant Creek (Uinta Forest), 1; Fish Lake Plateau, 2; Parowan Mountains (Brian Head), 4; Park City, 1; Pine Valley, 1; Puffer Lake, 12; Salt Lake City (City Creek Canyon, 1½ miles east from Salt Lake), 1; Wasatch Mountains, 6.

Washington: Bauerman Ridge (Tungsten Mine, altitude 6,800 feet), Okanogan County, 1; Buck Creek Pass (7 miles east of Glacier Peak, altitude 5,500 feet), 1; Calispell Peak (9 miles west Locke, altitude

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[62] Mus. Vert. Zool.
[64] D. R. Dickey coll.
[65] Mus. Vert. Zool., 10; Field Mus. Nat. Hist., 6.
[66] Acad. Nat. Sci. Philadelphia, 1.
[67] Acad. Nat. Sci. Philadelphia, 2; Field Mus. Nat. Hist., 3.
[68] E. R. Warren coll., Colorado Springs, Colo., 1.
[69] E. R. Warren coll.
[70] E. R. Warren coll., 7; Mus. Comp. Zool., 2; Mus. Vert. Zool., 2.
[71] Field Mus. Nat. Hist., 3; Acad. Nat. Sci. Philadelphia, 1.
[72] State Coll. Wash.
[73] Colo. State Coll., 1; Mont. State Coll., 1.
[74] Amer. Mus. Nat. Hist.

3,500 feet), 1; Canyon Creek (3 miles south Soleduck River, altitude 3,550 feet), 22[75]; Carson (15 miles north, Government Springs, altitude 1,300 feet), 1; Cascade Tunnel (altitude 3,350 feet), 1[72]; Cat Creek (headwaters, altitude 4,500 feet), 4[76]; Clover Lake (altitude 5,700 feet, White River Park), Mount Rainier, 1; Elwha, 1; "Fort Vancouver, Columbia River" (lake near summit of Cascade Mountains), (type locality), 1; Gifford (altitude 1,000 feet), 1; Glacier Basin (altitude 5,900 feet), Mount Rainier, 1[72]; Gotchen Creek (near Lava Spring), Mount Adams, 1; Hindoo Creek, Mount Aix, 1[72]; Hoh River (2 miles southeast Olympus Ranger Station, altitude 2,100 feet), 1; Hompeg Falls, Blue Mountains, Columbia County, 1[62]; Lake James (altitude 4,350 feet), Mount Rainier, 1; Longmire (altitude 2,700 feet), Mount Rainier, 1; Longmires Spring (about 3,000 feet), Mount Rainier, 1; Meslers Rranch (1 mile west Mount Rainier National Park, altitude 2,000 feet), 1; Mount Baker, 2[72]; Mount St. Helens (altitude 5,500 feet), 1; Mount Stewart (6 miles south, north fork Teanaway River, altitude 3,500 feet), 2; Owyhigh Lake (altitude 5,100 feet), Mount Rainier, 4[75]; Paradise Creek (altitude 5,200 feet), Mount Rainier, 1; Paradise Park (altitude 5,400 feet), Mount Rainier, 2; Pasayten River (mouth, east fork, altitude 3,900 feet), 1; Pasayten River (west fork, altitude 4,700 feet), 1; Quinault River (head north fork, altitude 4,000 feet), 2; Reflection Lake (4,900 feet), Mount Rainier Park, 1; Rockport, 3; Scenic, 1[72]; Signal Peak, 2; Simcoe Mountains (15 miles north of Goldendale, near Potato Hill), 1[72]; Suiattle River (Chiwawa Mountain Fork, altitude 4,500 feet), 1; Tahoma Creek (altitude 2,500 feet), Mount Rainier, 1; Wallowa Lake (altitude 4,000 feet), 3; Whatcom Pass (altitude 5,200 feet), Whatcom County, 2.

Wyoming: Afton (10 miles north, altitude 6,200 feet, Salt River), 5; Afton (10 miles southeast, Salt River Mountains, altitude 7,500 feet), 2; Bighorn Mountains (altitude 8,400 feet), 1; Black Mountains (northeast base, Pat O'Hara Creek), 5; Casper (7 miles south, Casper Mountains, altitude 6,000 feet), 3; Dubois (3 miles south, Jackeys Creek), 3; Evanston, 2; Ferris Mountains (altitude 7,800 to 8,500 feet), 9; Glen Creek (altitude 7,000 feet), 2[77]; Jackson Hole, 1; Lake Emma Matilda, 4; Lake Fork, Wind River Mountains (altitude 9,600 feet), 1; Laramie, 2; Laramie Mountains (north slope, altitude 8,000 feet), 1; Laramie Mountains (10 miles east of Laramie, altitude 8,500 feet), 3; Mammoth Hot Springs, 5; Medicine Bow Mountains (Headquarters Park, altitude 10,200 feet), 1; Moose Creek, Teton Mountains (altitude 6,800 feet), 1; Moran, 3; Pacific Creek, 1; Palaska (mouth Grinnell Creek, altitude 6,300 to 7,000 feet), 8; Rattlesnake Mountains (altitude 7,000 feet), 1; Rongis (8 miles east, altitude 8,000 feet), 3; Shirley Mountains (altitude 7,600 feet), 3; South Pass City, 1; Teton Pass (above Fish Creek, altitude 7,200 feet), 11; Trappers Creek (head, altitude 8,500 feet), Big Horn Mountains, 4; Valley (altitude 7,000 to 7,500 feet), 3; Wolf (Eatons Ranch), 5; Yellowstone Park (northwest corner), 1.

SOREX ALASKANUS Merriam

Glacier Bay Water-shrew

(Pls. 4, 1; 5, p; 10, e)

Sorex navigator alaskanus Merriam, Proc. Washington Acad. Sci. 2: 18, March 14, 1900.

[*Neosorex*] [*palustris*] *alaskanus* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 379, March, 1901.

Sorex (*Neosorex*) *palustris alaskanus* Allen, Bul. Amer. Mus. Nat. Hist. 19: 567, 1903.

Neosorex navigator alaskanus Miller, U. S. Nat. Mus. Bul. 79: 21, December 31, 1912.

Sorex alaskanus Jackson, Journ. Mamm. 7: 58, February 15, 1926.

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[62] Mus. Vert. Zool.
[72] State Coll. Wash.
[75] State Coll. Wash., 2.
[76] State Coll. Wash., 1.
[77] Mus. Comp. Zool., 1.

Type specimen.—No. 97713, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth slightly worn), skin and skull; collected June 12, 1899, by A. K. Fisher.

Type locality.—Point Gustavus, Glacier Bay, Alaska.

Geographic range.—Known only from type locality. (Fig. 21.)

Diagnostic characters.—Essentially like *Sorex p. navigator* in size and color; skull shorter than that of *navigator*, heavier and more angular, with relatively shorter rostrum and shorter mesopterygoid space; sagittal and lambdoidal crests very much developed; a distinct inframaxillary ridge extending above base of unicuspids.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts a trifle paler than chaetura-drab, distinctly flecked and grizzled with whitish hair tips and hair bands; underparts pale smoke gray tinged with pale olive-buff; color of underparts extending onto lips and chin; tail bicolor, fuscous-black above, whitish beneath nearly to tip.

Time of molting.—The type specimen, collected June 12, appears to be in complete summer pelage except on parts of the flank, which show indications of incompleted molt.

Skull.—Shorter, heavier, and more angular than that of *S. p. navigator*, with relatively shorter rostrum and shorter mesopterygoid space; mandible shorter than that of *navigator*, with slightly weaker and relatively lower molariform teeth. Differs from those of all other forms of the subgenus Neosorex in the greatly developed sagittal and lambdoidal crests, which are much more highly developed in comparatively young adults of *S. alaskanus* than in old adults of other forms, and in the well-developed inframaxillary ridge extending the length of the unicuspid row.

Measurements.—Two adult males, type specimen and topotype: Total length, 145, 160; tail vertebrae, 65, 72; hind foot, 18.5, 19. *Skull:* Skulls of two adult males (teeth slightly worn), type specimen and topotype: Condylobasal length, 18.4, 19.2; palatal length, 7.3, 7.9; cranial breadth, 9.5, 9.7; interorbital breadth, 4.1, 4.1; maxillary breadth, 5.3, 5.5; maxillary tooth row, 6.8, 7.2.

Remarks.—Although *S. alaskanus* resembles *S. p. navigator* very closely in superficial external appearance, it differs conspicuously from it and all other forms of the subgenus Neosorex in its highly ridged skull, which apparently is not due to age, and shows little, if any, tendency toward intergradation with *navigator* from the comparatively near-by regions of Alaska and British Columbia. Moreover, *S. alaskanus* is partly, if not completely, isolated on a peninsula cut off by Muir and Davidson Glaciers from the regions known to be inhabited by other forms of the subgenus. It seems best, therefore, to recognize it as a distinct species.

Specimens examined.—Two, from the type locality.

TABLE 13.—*Cranial measurements of adult specimens of* Sorex palustris *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. p. palustris:										
Manitoba—Robinson Portage.	107042	♀	20.9	8.8	10.2	4.2	6.2	7.5	Slight	
Do	107043	♀	20.7	8.8	10.4	4.4	6.2	7.7	do	
Do	107044	♀	21.5	9.1	10.6	4.4	6.2	7.9	do	
S. p. albibarbis:										
New Hampshire—Profile Lake.	38743	♀	20.0	8.3	10.1	4.3	6.1	7.3	do	Type specimen.
Vermont—East Wallingford.	[1] 94	♂	20.2	8.4	9.9	4.1	6.0	7.2	do	
Do	[2] 128	♂	19.9	8.0	10.4	4.5	6.4	7.4	Moderate	
S. p. gloveralleni:										
Nova Scotia—										
Digby	[3] 2046	♀	19.8	8.2	10.0	4.3	5.5	7.1	Slight	Do.
Do	[3] 2049	♀	19.5	8.0	10.1	4.4	5.6	7.1	Much	
Halifax	[4] 3864	♀	19.8	8.0	9.8	4.4	5.7	7.0	Slight.	
Do	[3] 2053	♂	19.9	8.0	10.3	4.5	5.9	7.0	Moderate	
S. p. hydrobadistes:										
Wisconsin—Withee	229061	♂	20.5	8.2	10.2	4.3	6.1	7.4	Much	Do
Minnesota—Elk River.	186887	♂	20.7	8.3	10.4	4.3	6.5	7.6	Slight	
Do	186888	♂	20.3	8.6	10.3	4.4	6.5	7.4	Moderate	
Do	186889	♂	20.6	8.8	10.3	4.6	6.5	7.8	Slight	
Do	186890	♂	21.0	8.8	10.9	4.4	6.3	7.8	do	
Do	186891	♂	20.2	8.0	10.0	4.4	6.2	7.5	do	
Do	186892	♂	21.0	9.0	10.5	4.5	6.3	7.6	do	
S. p. navigator:										
Washington—										
Head Yakima River.	1780	.....	19.8	8.3	9.8	4.1	[5] 5.4	7.3	do	Do.
Mount Rainier	89583	♂	19.6	8.3	9.8	4.1	5.8	7.2	do	
Mount St. Helens	90751	♂	19.9	8.1	9.9	4.1	5.9	7.1	do	
Wyoming—Pahaska	169763	♂	19.4	7.9	9.5	4.1	5.6	7.3	do	
Do	169969	♂	19.6	8.2	9.6	4.1	5.7	7.2	do	
Do	169970	♂	20.0	8.3	9.6	4.1	5.8	7.1	do	
Do	169972	♂	19.7	8.1	9.6	4.1	5.7	7.2	do	
Nevada—Toyabe Mountains.	208921	♀	19.5	8.2	9.5	4.1	5.7	7.2	do	
Do	208922	♀	19.5	8.0	9.6	4.2	5.8	7.1	do	
Do	208924	♀	19.8	8.1	9.7	4.1	5.8	7.2	do	
Arizona—Prieto Plateau.	205367	♂	19.9	8.3	9.8	4.2	5.9	7.2	do	
California—Mount Whitney.	42540	♂	19.4	8.0	9.6	4.0	5.6	6.9	do	Adult.
Do	42543	♂	20.0	8.3	9.7	4.2	5.8	7.2	do	Do.
Do	42545	♂	19.9	8.2	9.8	4.2	5.8	7.0	do	Do.
Do	[6] 16286	♂	19.8	8.4	9.8	4.1	6.0	7.2	do	Do.
Do	[6] 16287	♂	20.0	8.1	9.8	4.1	5.9	7.1	do	Do.
Do	[6] 16297	♂	19.4	8.0	9.9	4.1	5.7	7.1	do	Do.
Do	42413	♂	19.3	7.4	10.0	4.2	5.8	7.0	Much	Old adult.
Do	42547	♂	20.4	7.9	10.4	4.1	5.9	7.3	do	Do.
Do	[6] 16288	♂	19.6	8.0	10.0	4.2	5.9	7.1	do	Do.
Do	[6] 16289	♂	19.7	7.9	10.3	4.2	6.0	7.3	do	Do.
British Columbia—Bennett.	128585	♀	20.2	8.3	10.1	4.2	5.9	7.4	Moderate	
S. alaskanus:										
Alaska—Point Gustavus.	97712	♂	19.2	7.9	9.7	4.1	5.5	7.2	Slight	Topotype.
Do	97713	♂	18.4	7.3	9.5	4.1	5.3	6.8	do	Type specimen.

[1] D. E. Kent coll., Rutland, Vt.
[2] G. L. Kirk coll., Rutland, Vt.
[3] Mus. Comp. Zool.
[4] E. R. Warren coll., Colorado Springs, Colo.
[5] Postmaxillary processes broken; actual maxillary breadth was probably about 5.6 or 5.7.
[6] Mus. Vert. Zool.

Subgenus ATOPHYRAX Merriam

Atophyrax Merriam, Trans. Linnaean Soc. New York 2: 217, August 28, 1884.

Type species.—*Atophyrax bendirii* Merriam.

Geographic range.—Pacific coast region from extreme southwestern British Columbia (Port Moody) south through western Washington, western Oregon, and northwestern California nearly to Bodega Bay.

Diagnostic characters.—Size large, the smallest form (*Sorex b. bendirii*) about equal to the largest form (*S. p. palustris*) of the subgenus Neosorex; feet large, decidedly less conspicuously fimbriate than in subgenus Neosorex. Skull largest of the genus, that of the smallest form (*S. b. bendirii*) being about equal to or slightly larger than that of the largest form (*S. p. palustris*) of the subgenus Neosorex; rostrum, particularly anterior portion, comparatively long, distinctly curved ventrally anteriorly; anterior end of premaxilla decidedly narrower dorso-ventrally than middle portion, thus producing in lateral view a more acute aspect to the rostrum than in Neosorex; dorso-ventral diameter of rostrum measured at third unicuspid less than half the diameter between anterior border of infraorbital foramen and posterior border of i^1; anteroposterior diameter of basal portions of upper unicuspids (particularly fifth or last unicuspid) greater than in subgenus Neosorex, effecting a relatively long unicuspid tooth row with cusps more widely separated; posterior end of interior cutting edge of anterior portion of internal basal shelf of m^1 and m^2 usually with distinct cusplike lobe; pigmentation of anterior portion of internal basal shelf of m^1 and m^2 more extended posteriorly than in subgenus Neosorex.

Remarks.—In the original description, Merriam (1884b, p. 217) gave Atophyrax full generic rank under the name *Atophyrax bendirii*. Later he treated Atophyrax as a subgenus under Sorex (Merriam, 1895, p. 95). In the extreme form represented in *S. b. palmeri*, the differences between the subgenera Atophyrax and Neosorex are well marked. Certain characters, however, are only relative; and in certain specimens of *S. b. bendirii* from southern British Columbia these characters show a decided approach toward certain specimens of the subgenus Neosorex in all essential features, although there is no actual intergradation. This approach is not only in size and proportions of the skull, but in the weakened development of the cusplike lobe on the posterior end of the interior cutting edge of the anterior portion of the internal basal shelf of the first and second upper molars. Moreover, certain specimens of the subgenus Neosorex show this cusplike lobe developed to a considerable degree.[78] There are, however, enough fundamental differences between the two to warrant the recognition of each as a subgenus.

Representatives of both subgenera in the forms *S. b. bendirii* and *S. p. navigator* occur at Fort Klamath, Oreg., Longmire's Spring, Wash., and Chilliwack, British Columbia, although the two may occupy different habitats at these localities; and the range of *S. p. navigator* overlaps that of *S. b. albiventer* in the Olympic Mountains, Wash. Additional specimens of both groups from western British Columbia may throw more light on the relationships of Neosorex to Atophyrax.

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[78] Among the skulls showing this are the following of *Sorex p. navigator* (all U. S. Nat. Mus., Biological Survey collection):
No. 81513. Fifty miles north of Jasper House, Alberta.
No. 160588. Ferris Mountains, Wyo.
No. 170006. Highwood Mountains, Mont.
No. 209559. Beech Creek, Oreg.

KEY TO THE SPECIES AND SUBSPECIES OF THE SUBGENUS ATOPHYRAX

a[1]. Underparts dark, not whitish in any pelage.
b[1] Condylobasal length of skull less than 22.6 mm.; cranial breadth less than 10.7 ..... *bendirii* (p. 194).
b[2]. Condylobasal length of skull 22.6 mm. or more; cranial breadth 10.7 or more ..... *palmeri* (p. 197).
a[2]. Underparts whitish, particularly in winter pelage ..... *albiventer* (p. 198).

SOREX BENDIRII GROUP

The *bendirii* group includes a single species, *Sorex bendirii*.

Geographic range.—That of the subgenus *Atophyrax*. (Fig. 22.)

Diagnostic characters.—Those of the subgenus *Atophyrax*.

SOREX BENDIRII (MERRIAM)

[Synonymy under subspecies]

Geographic range.—That of the subgenus *Atophyrax*. (Fig. 22.)

Diagnostic characters.—Those of the subgenus *Atophyrax*.

Subspecies and geographic variation.—The species *bendirii* includes three subspecies: *bendirii*, *palmeri*, and *albiventer*. The extreme accentuation of the characters of the species is found in specimens of *palmeri* from northwestern Oregon. Radiating from this region as a center there is a gradual reduction in the size of the animal and its skull; in the length, acuteness, and decurvature of the rostrum; and in other essential characters. This reduction is most marked toward the north and reaches its climax in specimens of *S. b. bendirii* from Sumas and Port Moody, British Columbia. The subspecies *albiventer* is a color-phase form intermediate in most other respects between the subspecies *bendirii* and *palmeri*.

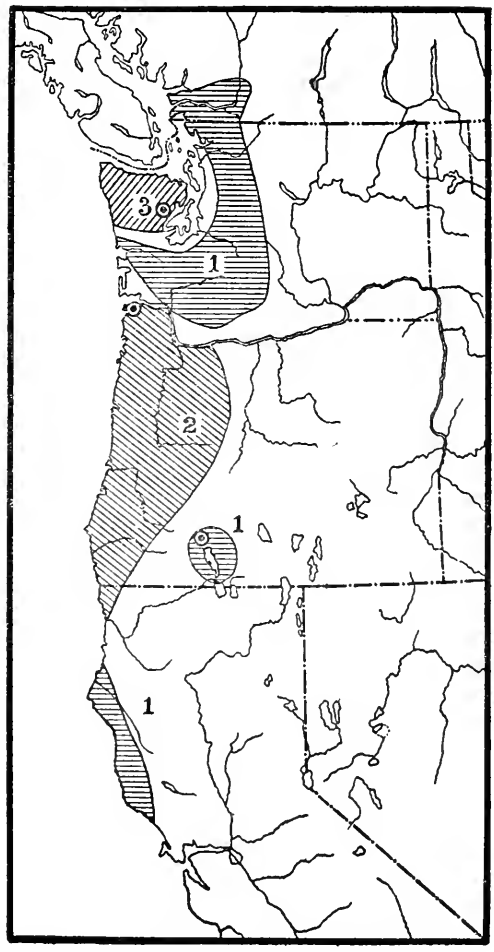

FIG. 22.—Geographic range of subspecies of *Sorex bendirii*

1. *S. b. bendirii*. 2. *S. b. palmeri*. 3. *S. b. albiventer*

Time of molting.—The evidence that there is both a spring and fall molt, and, if there is, which is the spring and which the fall one is not in every case clear. There certainly is a fall molt, however, and specimens of *S. b. albiventer* from Neah Bay, Wash., and one of *S. b. palmeri* from Portland, Oreg., satisfactorily show there is a spring molt.

The transition from the winter pelage to the summer pelage is usually obscure. This is due largely to the wear and fading of the winter pelage, which in this worn and faded condition approaches the summer pelage in

length and color. The molt as a rule is also less regular and defined than in the fall. Specimens of *S. b. bendirii* from the coast region of California show the molt in various stages of completion from June 19 to July 18. A specimen from Gualala, Calif., has the molt completed July 3; another on the same date has it about half completed; while a female collected July 14 is apparently still in worn winter pelage. Most of the skins from Easton, Wash., are in the summer pelage the first week of July, although a male still shows traces of the winter pelage July 3. Some of the specimens from Port Moody, British Columbia, collected July 22 to 28, appear to be in full summer pelage; three males, however, have the molt only about half complete. Specimens of *palmeri* from Crescent City, Calif., are with one exception in summer pelage the first week of July; an adult male collected July 5, 1899, has obtained the summer pelage only on the posterior half of the back, the rest of the animal being in worn winter pelage. A male from Portland, Oreg., collected May 30, 1905, has the summer pelage except on the abdomen. Specimens of *albiventer* from Neah Bay, Wash., are for the most part in winter pelage May 21 to June 7, although four males are in process of molting May 27 to June 7.

The earliest indication of the incoming of the winter pelage is in a male of *S. b. palmeri* collected August 29, 1901, at Requa, Calif.; in this specimen the beginning of the winter pelage is disclosed in the posterior part of the back. Another male from Gasquit, Calif., is in almost the same condition October 29, 1897. A male from Goldbeach, Oreg., is about half molted September 26, 1901, while a female collected September 27 of the same year has only a beginning of the molt on the rump. One from Oregon City, Oreg., is in complete winter pelage except the throat, chest, and sides of the head, October 21, 1893. A specimen of *S. b. bendirii* from near Mount Hood, Oreg., shows first indications of winter pelage under the summer pelage on the back September 6, 1896. A female from Steilacoom, Wash., is in complete winter pelage except on the head, October 13, and one from Puyallup in the same State at essentially the same date has full winter fur. One from Port Moody, British Columbia, is only about half through the molt October 26, 1895.

SOREX BENDIRII BENDIRII (MERRIAM)

BENDIRE MARSH SHREW

(PLS. 4, J; 5, Q; 6, U; 10, F; 11, N; 13, E)

Atophyrax bendirii Merriam, Trans. Linnaean Soc. New York 2: 217, August 28, 1884.

Atophyrax bendirei True. Proc. U. S. Nat. Mus. 7 (1884): 606, 1885.

Sorex bendirii Dobson, Monograph Insectivora, part 3, fasc. 1, pl. 23, fig. 17, and explanation, 1890.

Sorex (*Atophyrax*) *bendirii* Merriam, North Amer. Fauna No. 10, p. 95, December 31, 1895.

[*Atophyrax*] *bendiri* Trouessart, Catalogus Mammalium, supplement, fasc. 1, p. 135, 1904.

Sorex bendirei Stephens, California Mammals, p. 255, June, 1906.

Neosorex bendirii bendirii Miller, U. S. Nat. Mus. Bul. 79, p. 22, December 31, 1912.

Sorex bendirii bendirii Jackson, Journ. Mamm. 7: 58, February 15, 1926.

Type specimen.—No. 186442, U. S. Nat. Mus., Merriam collection; ♂ adult (teeth slightly worn), skin (made from alcoholic specimen) and skull; collected August 1, 1882, by Charles E. Bendire.

Type locality.—About 1 mile from Williamson River, 18 miles southeast of Fort Klamath, Klamath County, Oreg.

Geographic range.—Extreme southwestern British Columbia (Port Moody), south through western Washington east and south of Puget Sound; interior southwestern Oregon; coast region of California from about latitude 41° north south nearly to Bodega Bay. (Fig. 22.)

Diagnostic characters.—Size smallest of the species (total length about 150 mm. to 160 mm.); color of underparts both in summer and winter pelages dark, about as in *Sorex b. palmeri*, scarcely defined from upper parts, darker than in summer specimens of *S. b. albiventer* and strikingly in contrast with whitish underparts of winter specimens of *albiventer;* tail not bicolor in any pelage; skull smallest of the species, slightly smaller than that of *albiventer*, and much smaller than that of *palmeri;* dentition relatively and actually weaker than that of *albiventer*, much weaker than that of *palmeri*.

Color.—Winter pelage: Upper parts dark mouse gray to blackish mouse gray or chaetura black to almost black, indistinctly flecked with whitish hair tips, and sometimes with slight purplish and greenish iridescence; underparts scarcely paler than upper parts, usually slightly more brownish, fuscous black or chaetura black, occasionally hair brown; usually narrow touch of whitish on lips; tail fuscous black both above and below. *Summer pelage:* More brownish than in winter; upper parts fuscous to fuscous-black; underparts hair brown or chaetura drab, sometimes drab; throat sometimes stained with Isabella color; occasionally inconspicuously whitish on lips; tail fuscous to fuscous-black both above and below.

Skull.—Smallest of the species (condylobasal length usually about 21 mm.); much smaller than that of *S. b. palmeri*, somewhat smaller than that of *S. b. albiventer;* mesopterygoid space relatively broader than in *palmeri* or *albiventer;* dentition relatively and actually much weaker than that of *palmeri*, somewhat weaker than that of *albiventer*.

Measurements.—Type specimen (adult male)[79]: Total length, 150; tail vertebrae, 68; hind foot, 20. Adult male from Fort Klamath, Oreg.: Total length, 155; tail vertebrae, 71; hind foot, 20. Average of 4 adult females from Gualala, Calif.: Total length, 149.5 (147–153); tail vetebrae, 67 (61–76); hind foot, 19.1 (18.5–20). Average of 5 adult males from Easton, Wash.: Total length, 156.8 (148–163); tail vertebrae 74.4 (71–78); hind foot, 20.2 (20–21). Average of 6 adult females from Sumas, British Columbia: Total length, 151.7 (148–155); tail vertebrae, 67.8 (63–70); hind foot, 19.7 (19–20.5). *Skull:* Type specimen (adult male; teeth very slightly worn); Condylobasal length, 21.4; palatal length, 9.2; cranial breadth, 10.4; interorbital breadth, 4.4; maxillary breadth, 6.3; maxillary tooth row, 8.1. Skull of adult male (teeth very slightly worn) from Fort Klamath, Oreg.: Condylobasal length, 20.9; palatal length, 9.1; cranial breadth, 10.4; interorbital breadth, 4.3; maxillary breadth, 6.4; maxillary tooth row, 8.1. Skulls of 2 adult females (teeth slightly worn) from Gualala, Calif.: Condylobasal length, 21.0, 21.4; palatal length, 9.0, 9.0; cranial breadth, 10.5, 10.5; interorbital breadth, 4.4, 4.4; maxillary breadth, 6.5, 6.4; maxillary tooth row, 8.0, 8.2. Average of 4 skulls of adult males (teeth very slightly worn) from Easton, Wash.: Condylobasal length, 21.3 (21.0–21.7); palatal length, 9.1 (9.0–9.2); cranial breadth, 10.4 (10.3–10.5); interorbital breadth, 4.3 (4.2–4.4); maxillary breadth, 6.3 (6.1–6.4); maxillary tooth row, 8.1 (8.0–8.2). Average of 6 skulls of adult females (teeth very slightly worn) from Sumas, British Columbia: Condylobasal length, 20.9 (20.7–21.0); palatal length, 9.0 (8.9–9.1); cranial breadth, 10.3 (10.0–10.5); interorbital breadth, 4.2 (4.1–4.3); maxillary breadth, 6.2 (6.0–6.3); maxillary tooth row, 7.8 (7.6–8.0).

Remarks.—The uniformity both in color and cranial characters of specimens of *S. b. bendirii* from the widely separated regions of southwestern British Columbia and northern Washington, the Klamath Basin of Oregon, and the coast region of Mendocino County, Calif., is astonishing. Although there are at present no specimens of *S. b. bendirii* available from localities connecting the three distinct regions known to be inhabited by this form, nevertheless it seems probable that with additional specimens its range will be shown to be more or less continuous along the foothills of the Cascade Mountains from southwestern British Columbia to the Klamath

[79] Measurements given by Merriam (1884, p. 222) as measured from the alcoholic.

Basin in Oregon, and thence southwesterly along Klamath Canyon and southerly to the coast region of southern Mendocino County, Calif.

As has already been noted by Merriam (1895, p. 10), two specimens [80] from Gualala, Calif., have the fifth upper unicuspids (first premolars) unusually large and each with a double cusp; these two specimens also have the second upper premolars and the first upper molars more emarginate posteriorly than in average specimens. Three other specimens,[81] however, collected more recently, do not have the first upper premolars bicuspidate and in all essentials agree with typical *S. b. bendirii.* Northward along the coast of California a gradual increase in the size of the animals is noticed until from Requa and Crescent City, Calif., and Goldbeach, Oreg., specimens are intermediate in size between *S. b. bendirii* and *palmeri* though apparently nearer the latter form, to which they are referred. One skull [82] from Crescent City, however, is considerably smaller than the others from that place and is almost as small as *S. b. bendirii.*

Intergradation with *S. b. albiventer* is evident in specimens from the south end of Puget Sound. Specimens from Nisqually River, Puyallup, Oakville, and Steilacoom, Wash., have skulls somewhat larger than those of typical *S. b. bendirii*, and the specimens from Oakville and Steilacoom show an approach toward *albiventer* in color.

Specimens examined.—Total number, 133, as follows:

British Columbia: Chilliwack, 4 [83]; Chilliwack Valley, 1 [84]; Port Moody, 9; Sumas, 39.[85]

California: Eureka, 2 [86]; Gualala, 5 [87]; Carson Camp, Mad River, Humboldt Bay, 3; Mendocino, 2 [88]; Point Arena, 1.[89]

Oregon: Fort Klamath, 1; Prospect, 1 [90]; Williamson River (near, 18 miles southeast of Klamath) (type locality), 1.

Washington: Ashford (near, Nisqually River, altitude 1,800 feet), 1; Cathlamet, 1; Chehalis (8 miles west), 4; Easton, 8; Ilwaco, 2; Keechelus Lake, 1; Kirkland, 1; Longmire Springs, Mount Rainier, 4; Mesler's Ranch (1 mile west Mount Rainier Park, altitude 2,000 feet), 3; Mountain Meadows (altitude 4,000 feet), Mount Rainier, 1; Mount Vernon, 2; Ohanapecosh Springs (altitude 2,000 feet), Mount Rainier, 2; Oakville, 3; Oso (altitude 550 feet), 1; Pacific County, 1 [91]; Puyallup, 19 [92]; Signal Peak (altitude 4,000 feet), 1; Snoqualmie Pass (altitude 3,000 feet), King County, 2 [85]; Steilacoom, 1; Tacoma (6 miles south), 1; Tacoma (5 miles east), 3 [90]; Toledo, 1; Trout Lake (15 miles south Mount Adams, altitude 1,900 feet), Klickitat County, 1.

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[80] Nos. 68163 and 68164, U. S. Nat. Mus., Biological Survey collection. Collected July 14, 1894.
[81] Nos. 19695–19697, Mus. Vert. Zool. Collected July 3, 1913.
[82] No. 97606, U. S. Nat. Mus., Biological Survey collection. Collected July 5, 1899.
[83] Acad. Nat. Sci. Philadelphia.
[84] Nat. Mus. Canada.
[85] Acad. Nat. Sci. Philadelphia, 1; Field Mus. Nat. Hist., 1; Mus. Vert. Zool., 1; Mus. Comp. Zool., 13.
[86] Mus. Comp. Zool., 1; Mus. Vert. Zool., 1.
[87] Mus. Vert. Zool., 3.
[88] Field Mus. Nat. Hist., 1.
[89] Mus. Vert. Zool.
[90] D. R. Dickey coll., Pasadena, Calif.
[91] Amer. Mus. Nat. Hist.
[92] D. R. Dickey coll., 4; G. G. Cantwell
[92] D. R. Dickey coll., 4; G. G. Cantwell coll., Palms, Calif., 8.

SOREX BENDIRII PALMERI Merriam

Palmer Marsh Shrew

(Pls. 4, k; 5, r; 6, v; 10, g)

Sorex (*Atophyrax*) *bendirii palmeri* Merriam, North Amer. Fauna No. 10, p. 97, December 31, 1895.

[*Atophyrax*] [*bendirii*] *palmeri* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 381, March, 1901.

Neosorex bendirii palmeri Miller, U. S. Nat. Mus. Bul. 79, p. 22, December 31, 1912.

Type specimen.—No. $\frac{17338}{24263}$, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull; collected July 29, 1889, by T. S. Palmer.

Type locality.—Astoria, Clatsop County, Oreg.

Geographic range.—Northwestern Oregon west of the Cascade Mountains, southwestern Oregon west of longitude 123° west, and extreme northwestern California north of the mouth of the Klamath River. (Fig. 22.)

Diagnostic characters.—Size large (total length usually over 170 mm.), largest of the subgenus; color about as in *Sorex b. bendirii*, possibly slightly darker above in winter pelage; underparts dark, scarcely defined from upper parts both in summer and winter; tail not bicolor in any pelage; skull large, larger than that of *S. b. albiventer*, much larger than that of *S. b. bendirii;* dentition relatively and actually much heavier than that of *S. b. bendirii*, somewhat heavier than that of *albiventer*.

Color.—Winter pelage: Upper parts rich fuscous-black or chaetura black, sometimes blackish mouse gray, scantily flecked with whitish hair tips, sometimes with indistinct purplish and greenish iridescence; underparts scarcely paler than upper parts, chaetura drab, fuscous, to fuscous black; sometimes with a trace of whitish on the lips; tail fuscous or fuscous-black, not bicolor. *Summer pelage:* More brownish than in winter; about as in *S. b. bendirii;* upper parts fuscous to fuscous-black; underparts hair brown or chaetura drab; lips sometimes slightly whitish; tail as in winter.

Skull.—Large, largest of the genus (condylobasal length usually 23 mm. or more); much larger than that of *S. b. bendirii* with relatively narrower mesopterygoid space; larger than that of *S. b. albiventer;* dentition heavy, relatively and actually much heavier than that of *S. b. bendirii*, heavier than that of *albiventer;* cusplike development of posterior end of interior edge of anterior portion of internal basal shelf of first and second upper molars more developed than in *S. b. bendirii*.

Measurements.—Type specimen and topotype (adult females): Total length, 165, 170; tail vertebrae 73, 78; hind foot, 20, 21. Average of 3 adult males from Crescent City, Calif.: Total length, 172 (168–174); tail vertebrae, 77 (75–80); hind foot, 21 (21–21). *Skull:* Type specimen (adult female; teeth moderately worn): Condylobasal length, 23.8; palatal length, 10.0; cranial breadth, 11.6; interorbital breadth, 4.8; maxillary breadth, 7.2; maxillary tooth row, 9.0. Skull of adult male (teeth slightly worn) from Oregon City, Oreg.: Condylobasal length, 22.6; palatal length, 9.7; cranial breadth, 11.1; interorbital breadth, 4.8; maxillary breadth, 7.0; maxillary tooth row, 8.9. Average of 3 skulls of adult females (teeth slightly worn) from Eugene, Oreg.: Condylobasal length, 23.3 (23.0–23.5); palatal length, 9.9 (9.6–10.1); cranial breadth, 11.2 (11.0–11.3); interorbital breadth, 4.7 (4.6–4.8); maxillary breadth, 7.0 (6.9–7.1); maxillary tooth row, 9.1 (9.0–9.2). Average of 3 skulls of adult males (teeth slightly worn) from Crescent City, Calif.: Condylobasal length, 22.9 (22.8–23.0); palatal length, 9.7 (9.6–9.8); cranial breadth, 11.0 (10.8–11.2); interorbital breadth, 4.7 (4.7–4.7); maxillary breadth, 6.8 (6.6–6.9); maxillary tooth row, 8.8 (8.6–9.0).

Remarks.—There is some individual variation in the actual size and relative breadth of skulls and even more in the length of rostra and unicuspid tooth rows of this form, but none of these variations can be segregated geographically. Judged from the small number of specimens available from a country comparatively well combed for small mammals, the animal appears to be either rare or local. In its typical form it can be identified easily by its long hind foot and its large, heavy skull.

Specimens examined.—Total number, 32, as follows:

California: Crescent City, 7; Crescent City (4 miles north), 3[93]; Requa, 1.[94]
Oregon: Astoria (type locality), 2; Beaverton, 1; Camas Prairie (east base Cascade Mountains), 1; Eugene, 4[95]; Goldbeach, 2[94]; McKenzie Bridge, 2[96]; Marshfield, 1[94]; Mulino, 3[96]; Oregon City, 1; Portland, 1; Tillamook, 1[93]; Vida, 2[97].

SOREX BENDIRII ALBIVENTER Merriam

White-bellied Marsh Shrew

(Pl. 4, l)

Sorex (*Atophyrax*) *bendirii albiventer* Merriam, North Amer. Fauna No. 10, p. 97, December 31, 1895.

[*Atophyrax*] [*bendirii*] *albiventer* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 381, March, 1901.

Neosorex bendirii albiventer Miller, U. S. Nat. Mus. Bul. 79, p. 22, December 31, 1912.

Type specimen.—No. 66198, U. S. Nat. Mus., Biological Survey collection; ♂ adult (teeth very slightly worn), skin and skull; collected July 7, 1894, by C. P. Streator.

Type locality.—Lake Cushman, Mason County, Olympic Mountains, Wash.

Geographic range.—Northwestern Washington west of Puget Sound and north of latitude 45 degrees north (Olympic region). (Fig. 22.)

Diagnostic characters.—Intermediate in size between *Sorex b. bendirii* and *S. b. palmeri*, but radically different from either in the color of the underparts, which in winter are distinctly whitish and sharply contrasted with blackish of upper parts; underparts in summer slightly paler than in *S. b. bendirii* or *palmeri*, paler and more mixed with whitish than upper parts; tail in winter distinctly bicolor nearly to tip, in summer not bicolor; skull intermediate in size between that of *S. b. bendirii* and that of *palmeri;* dentition heavier than in *S. b. bendirii*, weaker than in *palmeri*.

Color.—Winter pelage: Upper parts fuscous-black or between fuscous-black and chaetura black, inconspicuously sprinkled with a few whitish hair tips; occasionally with indistinct purplish or greenish iridescence; underparts whitish, sharply contrasted from upper parts, pale olive-gray tinged with pale olive-buff extending well up on flanks, usually stained on throat with cream-buff; lips whitish; tail distinctly bicolor, fuscous-black above, narrowly whitish below nearly to tip. *Summer pelage:* Upper parts slightly paler and more brownish than in winter, fuscous to fuscous-black; underparts much darker than in winter, drab, perceptibly lightened by admixture of whitish hairs which extend onto the chin and lips; tail fuscous, scarcely paler below than above, not distinctly bicolor.

Skull.—Size medium (condylobasal length usually about 22 mm.); intermediate in size and proportions between the skull of *S. b. bendirii* and that of *S. b. palmeri*.

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[93] D. R. Dickey coll., Pasadena, Calif.
[94] Field Mus. Nat. Hist.
[95] Oreg. State Game Dept., 3.
[96] Oreg. State Game Dept.
[97] Oreg. State Game Dept., 1.

Measurements.—Type specimen (adult male): Total length, 166; tail vertebrae, 78; hind foot, 20.5. Average of 3 adult males (including type) from type locality: Total length, 160.3 (151–166); tail vertebrae, 73.3 (64–78); hind foot, 20.5 (20–21). Average of 4 adult males from Neah Bay, Wash.: Total length, 166.3 (160–169); tail vertebrae, 72.3 (71–73); hind foot, 19.8 (19–20). *Skull:* Type specimen (adult male; teeth very slightly worn): Condylobasal length, 22.1; palatal length, 9.3; cranial breadth, 10.8; interorbital breadth, 4.6; maxillary breadth, 6.6; maxillary tooth row, 8.3. Skulls of 2 adult males (teeth very slightly worn) from type locality: Condylobasal length, 21.9, 22.0; palatal length, 9.3, 9.3; cranial breadth, 10.5, 10.8; interorbital breadth, 4.6, 4.6; maxillary breadth, 6.4, 6.6; maxillary tooth row, 8.3, 8.4. Average of 4 skulls of adult males (teeth slightly worn) from Neah Bay, Wash.: Condylobasal length, 22.1 (22.0–22.2); palatal length, 9.2 (9.0–9.4); cranial breadth, 11.1 (10.8–11.2); interorbital breadth, 4.7 (4.6–4.8); maxillary breadth, 6.6 (6.4–6.7); maxillary tooth row, 8.4 (8.3–8.4).

Remarks.—In full winter pelage with the whitish underparts typical specimens of *S. b. albiventer* are so radically different from *S. b. bendirii* or *S. b. palmeri* that critical comparison with them is unnecessary. In summer pelage, however, the colors of the three forms are more nearly alike, typical *albiventer*, nevertheless, still averaging considerably paler ventrally than *S. b. bendirii* or *palmeri*. In size, *albiventer* on the average is intermediate between *S. b. bendirii* and *palmeri*, though usually nearer the size of *S. b. bendirii*.

A specimen of *S. b. albiventer* collected during the winter of 1890 at Shelton, Wash., shows an approach toward *S. b. bendirii* in color and has a skull slightly smaller than typical *albiventer;* and three skins from the same locality in April, 1918, show a slight tendency toward the subspecies *bendirii* in color. A single specimen from Duckabush, Wash., collected January 24, 1919, is as dark ventrally as most specimens of *S. b. bendirii* and is referred to *albiventer* purely on geographical grounds. It seems probable that if more specimens were available from this locality the majority of them would be of the *albiventer* tone of coloration. More material is needed, however, to form a definite decision. Specimens referred to the subspecies *bendirii* from the south end of Puget Sound also indicate intergradation between *S. b. bendirii* and *albiventer*. The subspecies *albiventer* does not intergrade with *S. b. palmeri*, being separated from it by *S. b. bendirii*, two specimens of which, from Ilwaco and Cathlamet, Wash., are essentially like typical *S. b. bendirii*, although another from Ilwaco shows a very slight approach toward *albiventer* in color.

Specimens examined.—Total number, 38, as follows:

Washington: Canyon Creek (3 miles south Soleduck River, altitude 3,550 feet), 1; Duckabush, 1; Harstine Island, 2; Lake Cushman (type locality), 5[98]; Lapush, 2; Neah Bay, 18; Potlatch, 2[99]; Quinault Lake, 2. Shelton, 4[1]; Soleduck Hot Springs (altitude, 1,750 feet), 1.

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[98] Univ. Mich., 2.
[99] D. R. Dickey coll., Pasadena, Calif.
[1] Acad. Nat. Sci. Philadelphia, 1.

TABLE 14.—*Cranial measurements of adult specimens of* Sorex bendirii *group*

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
S. b. bendirii:										
Oregon—										
Williamson River	186442	♂	21.4	9.2	10.4	4.4	6.3	8.1	Very slight	Type specimen.
Fort Klamath	79941	♂	20.9	9.1	10.4	4.3	6.4	8.1	do	
British Columbia—Sumas.	62966	♀	20.9	8.9	10.5	4.3	6.1	7.8	do	
Do	62968	♀	20.7	9.0	10.0	4.2	6.0	7.6	do	
Do	62971	♀	21.0	9.1	10.0	4.2	6.3	7.8	do	
Do	62974	♀	20.8	9.0	10.4	4.1	6.0	7.7	do	
Do	62975	♀	20.8	8.9	10.3	4.3	6.3	7.6	do	
Do	62977	♀	21.0	9.0	10.4	4.2	6.3	8.0	do	
Washington—Easton	41612	♂	21.2	9.2	10.4	4.2	6.1	8.2	do	
Do	41615	♂	21.3	9.1	10.4	4.4	6.4	8.1	do	
Do	41616	♂	21.7	9.1	10.5	4.3	6.4	8.0	do	
Do	41617	♂	21.0	9.0	10.3	4.3	6.2	8.1	do	
California—Gualala	[1] 19696	♀	21.0	9.0	10.5	4.4	6.5	8.0	Slight	
Do	68164	♀	21.4	9.0	10.5	4.4	6.4	8.2	do	
S. b. palmeri:										
Oregon—										
Astoria	24263	♀	23.8	10.0	11.6	4.8	7.2	9.0	Moderate	Do.
Oregon City	56898	♂	22.6	9.7	11.1	4.8	7.0	8.9	Slight	
Eugene	[2] 917	♀	23.0	9.6	11.0	4.6	6.9	9.0	do	
Do	[2] 918	♀	23.5	10.1	11.3	4.8	7.1	9.2	do	
Do	[2] 919	♀	23.3	10.1	11.2	4.7	6.9	9.1	do	
California—Crescent City.	97601	♂	22.8	9.6	10.8	4.7	6.6	8.6	do	
Do	97603	♂	23.0	9.7	11.2	4.7	6.8	8.9	do	
Do	97604	♂	23.0	9.8	11.0	4.7	6.9	9.0	do	
S. b. albiventer:										
Washington—										
Lake Cushman	66196	♂	21.9	9.3	10.5	4.6	6.4	8.3	Very slight	
Do	66197	♂	22.0	9.3	10.8	4.6	6.6	8.4	do	
Do	66198	♂	22.1	9.3	10.8	4.6	6.6	8.3	do	Do.
Neah Bay	88504	♂	22.2	9.3	11.0	4.8	6.5	8.3	Slight	
Do	88509	♂	22.1	9.4	11.2	4.6	6.4	8.4	do	
Do	88513	♂	22.2	9.0	10.8	4.7	6.7	8.4	do	
Do	88515	♂	22.0	9.2	11.2	4.7	6.7	8.3	do	

[1] Mus. Vert. Zool. [2] Oreg. State Game Dept.

Genus MICROSOREX Coues

Microsorex Coues, Bul. U. S. Geol. and Geog. Sur. Territories 3: 646, May 15, 1877

Type species.—*Sorex hoyi* Baird.

Geographic range.—Northern Quebec, northern Ontario, Northwest Territories, central and western Alaska, south in the northern United States to District of Columbia, Ohio, Wisconsin, Minnesota and northwestern Washington. (Fig. 23.)

Generic characters.—Externally very similar to Sorex, but with tail shorter than in most species of Sorex. Skull in general similar to that of Sorex usually relatively flatter and narrowed, with short, broad rostrum; infraorbital foramina comparatively small; mandible short and heavy. Dentition simple; first upper incisor large, elongate, two-lobed, the anterior (primary) lobe relatively long and narrow, the length more than twice the width and more than twice the length of secondary lobe; first and second unicuspid teeth (i^2 and i^3) peglike with distinct ridge from cusp to cingulum, distinctly and sharply curved caudad toward terminus, with a pronounced secondary cusp near terminus of ridge on cingulum; third unicuspid disklike, antero-posteriorly flattened; fourth unicuspid (pm^1) normal, peglike; fifth unicuspid (pm^2) minute; molariform teeth not essentially different from those of Sorex. Bases of lower incisor and premolar closely approximated, separated by space equal about one-fourth the antero-posterior diameter of canine. (Fig. 24.)

Dentition: i., $\frac{3}{1}$; c., $\frac{1}{1}$; pm., $\frac{3}{1}$; m., $\frac{3}{3}$; total, 32.

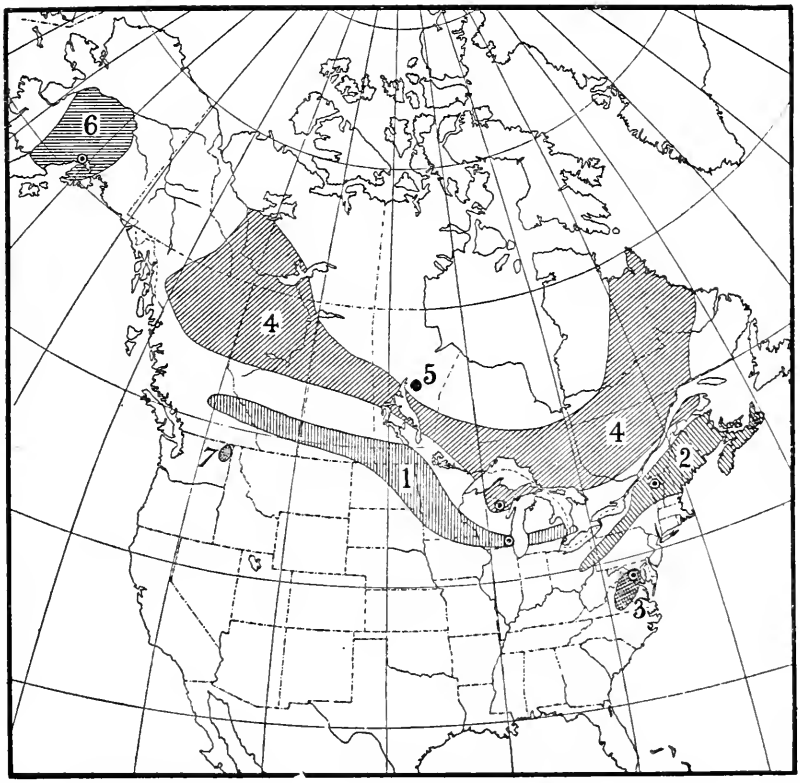

FIG. 23.—Geographic range of subspecies of *Microsorex hoyi*

1. *M. h. hoyi.*
2. *M. h. thompsoni.*
3. *M. h. winnemana.*
4. *M. h. intervectus.*
5. *M. h. alnorum.*
6. *M. h. eximius.*
7. *M. h. washingtoni.*

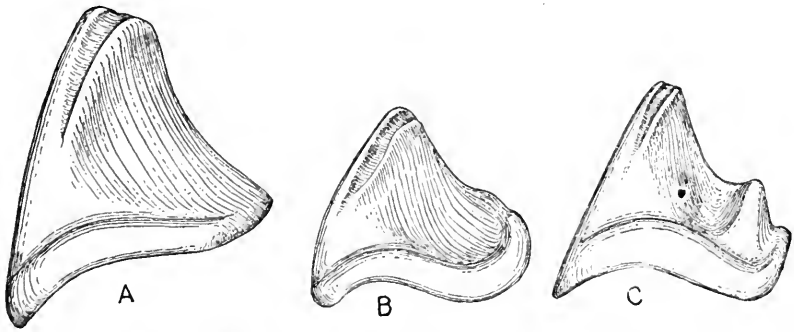

FIG. 24.—Dorsal view of right third upper incisors; A, *Sorex araneus;* B, *S. cinereus cinereus;* C, *Microsorex hoyi hoyi.* Enlarged about 20 diameters

KEY TO THE SUBSPECIES OF MICROSOREX

a^1. Condylobasal length 14.3 or more.
  b^1. Cranial breadth less than 6.7 ..... *hoyi* (p. 202).
  b^2. Cranial breadth more than 6.7.
    c^1. Condylobasal length more than 15.7; cranial breadth 7.3 or more ..... *alnorum* (p. 208).
    c^2. Condylobasal length less than 15.7; cranial breadth less than 7.3.
      d^1. Condylobasal length usually less than 15.3; maxillary tooth row usually less than 5; color more grayish ..... *intervectus* (p. 206).
      d^2. Condylobasal length more than 15.3; maxillary tooth row more than 5; color more brownish ..... *eximius* (p. 208).
a^2. Condylobasal length less than 14.3.
  b^1. Known geographic range confined to Washington ..... *washingtoni* (p. 209).
  b^2. Known geographic range eastern United States or eastern Canada.
    c^1. Condylobasal length more than 13.5; cranial breadth more than 6.2 ..... *thompsoni* (p. 204).
    c^2. Condylobasal length less than 13.5; cranial breadth less than 6.2 ..... *winnemana* (p. 206).

MICROSOREX HOYI GROUP

The *hoyi* group includes a single species—*Microsorex hoyi*. All necessary group comparisons are made under the genus *Microsorex* (p. 200).

MICROSOREX HOYI (BAIRD)

[Synonymy under subspecies]

Geographic range.—That of the genus Microsorex (p. 200). (Fig. 23.)

Diagnostic characters.—Those of the genus Microsorex (p. 200).

Subspecies and geographic variation.—The species *Microsorex hoyi* is divided into seven subspecies, namely: *hoyi*, *thompsoni*, *winnemana*, *intervectus*, *alnorum*, *eximius*, and *washingtoni*. The species reaches its maximum size in the north, where also there appears to be a correlation in the increased height of the brain case. Toward the south there is a gradual diminution in size, which reaches a climax in the forms *winnemana*, *thompsoni*, and *washingtoni*. Westward there is a tendency for the color to become somewhat more reddish-brown, noticeable in the subspecies *eximius* and *washingtoni*.

Time of molting.—The only molting specimens of Microsorex examined are of *M. h. thompsoni*. A female of this form from Brunswick, Me., has the new fur well advanced under the old only over the posterior two-thirds of the back on April 28, 1912. Another female from the same locality had acquired her complete but fresh summer fur May 17, 1922.

A female from Trousers Lake, New Brunswick, has the new fur coming in under the old over the entire upper parts, October 8, 1894. Another specimen of undetermined sex was in about the same condition of molt November 9, 1903.

MICROSOREX HOYI HOYI (BAIRD)

AMERICAN PIGMY SHREW

(PLS. 4, M, T; 6, W; 10, H; 13, I)

Sorex hoyi Baird, Rept. Pacific R. R. Survey, vol. 8, pt. 1, Mammals, p. 32, 1857.

Sorex (*Microsorex*) *hoyi* Merriam, North Amer. Fauna No. 10, p. 89, December 31, 1895.

[*Microsorex*] *hoyi* Elliot, Field Columb. Mus. Publ. 45 (zool. series 2): 377, March, 1901.

Microsorex hoyi hoyi Jackson, Proc. Biol. Soc. Washington 38: 125, November 13, 1925.

Type specimen.—Lectotype, No. $\frac{6\,3\,2}{1\,7\,8\,3}$, U. S. Nat. Mus.; ♂ adult, poorly made and faded skin, and fragment of skull consisting of base of cranium; collected by P. R. Hoy (no date), entered in museum catalogue April 19, 1855.

Type locality.—Racine, Racine County, Wis.

Geographic range.—Southeastern British Columbia, southern Alberta, southern Manitoba, southeast through eastern North Dakota, northeastern South Dakota, southern Minnesota, and southern Wisconsin, to extreme southern Ontario. (Fig. 23.)

Diagnostic characters.—Size medium, smaller than *Microsorex h. alnorum* or *M. h. eximius*, slightly larger than *M. h. thompsoni*, about the size of *M. h. intervectus*. Color in summer pelage slightly more reddish than in *intervectus* or *thompsoni*. Skull relatively long and narrow, much depressed; longer than that of *thompsoni* with slightly heavier dentition; much more flattened than that of *intervectus*, with narrower brain case.

Color.—*Winter pelage:* General tone of upper parts between hair brown and olive-brown, sometimes tending toward clove brown; underparts smoke gray or between pale smoke gray and smoke gray, sometimes slightly tinged with pinkish buff or warm buff; tail indistinctly bicolor, mummy brown or Prout's brown above, buffy brown or between buffy brown and drab below, darkening toward tip. *Summer pelage:* Upper parts between sepia and bister; underparts smoke gray, tinged with light buff; tail as in winter.

Skull.—Relatively long, narrow, much depressed; anterior and posterior borders of cranium gently rounded, not angular or truncate; dentition moderate. Longer than the skull of *M. h. thompsoni*, with slightly heavier dentition. Cranium less angular, narrower, and more depressed than in *M. h. intervectus*.

Measurements.—Average of three adults[2] (sex undetermined), alcoholic specimens, from Elk River, Minn., measured by the writer: Total length, 81.3 (80–82); tail vertebrae, 30.7 (30–31); hind foot, 10.5 (10–11). *Skull:* Average of three skulls of adult females (teeth slightly to moderately worn) from Elk River, Minn.: Condylobasal length, 14.7 (14.3–15.0); palatal length, 5.3 (5.2–5.3); cranial breadth, 6.5 (6.4–6.6); interorbital breadth, 3.1 (3.0–3.1); maxillary breadth, 4.3 (4.2–4.3); maxillary tooth row, 4.9 (4.8–4.9).

Remarks.—In the original description of this form Baird (1857, p. 32) listed and described two specimens from Racine, Wis., an alcoholic with skull inside (No. 1688, U. S. Nat. Mus.) and a skin with skull (No. $\frac{6\,3\,2}{1\,7\,8\,3}$, U. S. Nat. Mus.). As has already been pointed out by Preble (1910, p. 102), No. 1688 proves to be a specimen of *Sorex cinereus*. Baird's illustration of the external parts (1857, pl. 28) on close scrutiny would also indicate this. The skull figured by Baird (1857, pl. 28) undoubtedly belongs to his other specimen (No. $\frac{6\,3\,2}{1\,7\,8\,3}$) since he gives a description and measurements of it (op. cit., p. 33) and does not mention the skull of No. 1688. Preble (1910, p. 102) therefore regards the skull No. 1783 as the type of *S. hoyi* Baird. Inasmuch as Baird (1857, p. 32–33), however, describes the skin, which is still in the United States National Museum collection, it must also be considered with the specimen. The present reviser therefore designates skin and skull No. $\frac{6\,3\,2}{1\,7\,8\,3}$, United States National Museum, the lectotype of *Sorex hoyi* Baird.

Unfortunately, since the time of Baird, the skull of the lectotype has become so badly damaged that now all that remains is a fragment of the base of the cranium and a portion of the parietals. This fragment, however, together with Baird's description and illustrations

[2] Nos. 187002, 187003, and 187004, U. S. Nat. Mus. Apparently these same specimens were measured by Merriam (1895, p. 90) with a slight variation from the measurements of the writer.

(1857, p. 32–33, pl. 28) seems to establish the identity of the form Topotypes would be a welcome asset toward strengthening our knowledge, but it is hardly probable that additional specimens can ever be obtained at the type locality, which has undergone marked physiographic and ecological changes under so-called civilization. The skull is of the flat type quite in contrast with the skulls of *M. h. intervectus* from northern Wisconsin, and similar to skulls from Elk River, Minn.

The subspecies *hoyi* intergrades with both *M. h. thompsoni* and *M. h. intervectus*. Specimens from Locust Grove, N. Y., which are referred to *thompsoni*, show a strong tendency toward *M. h. hoyi*. Two of the specimens from Red River Settlements, Manitoba, are easily referable to *M. h. hoyi*, while a third [3] has a skull that is as broad as that of typical *intervectus*, but tends to be depressed as in the subspecies *hoyi*. Specimens from Aweme, Manitoba, are indistinguishable from those from Elk River, Minn.

Specimens examined.—Total number 31, as follows:

Alberta: Blindman and Red Deer River (forks of), 1 [4]; Red Deer River, 1.[4]
British Columbia: Cariboo, 1.
Manitoba: Aweme, 3 [5]; Red River Settlement, 3.
Minnesota: Elk River, 14; Steele County, 1.[6]
North Dakota: Devils Lake, 1; Pembina, 2.
Ontario: Coldstream, 2.[7]
South Dakota: Fort Sisseton, 1.
Wisconsin: Racine (type locality), 1.

MICROSOREX HOYI THOMPSONI (BAIRD)

THOMPSON PIGMY SHREW

(PL. 4, N)

Sorex thompsoni Baird, Rept. Pacific R. R. Survey 8: pt. 1, Mammals, p. 34, 1857.
Sorex thomsoni Gilpin, Proc. and Trans. Nova Scotian Inst. Nat. Sci. 1: pt. 2, p. 1, 1867.
Microsorex hoyi thompsoni Jackson, Proc. Biol. Soc. Washington 38: 126, November 13, 1925.

Type specimen.—Lectotype, No. $\frac{16886}{38838}$, U. S. Nat. Mus.; ♂ adult (teeth slightly worn); alcoholic with skull removed (skull badly crushed, incomplete, and in several pieces; practically useless for comparative purposes except for rostrum, mandibles, and denition); collected by Zadock Thompson (no date), and entered in Museum catalogue, October 23, 1856.

Type locality.—Burlington, Chittenden County, Vt.

Geographic range.—Prince Edward Island, Nova Scotia, New Brunswick, southwesterly across Maine, Vermont, northern New York to eastern Ohio. (Fig. 23.)

Diagnostic characters.—Slightly smaller than *Microsorex h. hoyi*, color averaging a shade more grayish in summer pelage, skull and palate shorter, dentition weaker. Larger than *M. h. winnemana*, the skull larger and with more depressed brain case.

Color.—Averaging somewhat paler than in *M. h. hoyi*, and in summer pelage a trifle more grayish. *Winter pelage:* Upper parts hair brown or slightly

[3] No. $\frac{607.5}{368823}$, U. S. Nat. Mus.
[4] Mus. Comp. Zool.
[5] Stuart Criddle coll., Treesbank, Manitoba.
[6] Acad. Nat. Sci. Philadelphia.
[7] Royal Ontario Mus. Zool.

darker; underparts pale smoke gray, or between pale smoke gray and smoke gray, tinged slightly with light buff; tail as in *M. h. hoyi*. *Summer pelage:* Upper parts between hair brown and clove brown, sometimes tending toward olive-brown; underparts about as in winter, a shade more buffy; tail as in winter.

Skull.—Relatively small, depressed, with narrow rostrum and rather weak dentition. Shorter and with narrower rostrum and somewhat smaller teeth than in *M. h. hoyi;* larger in all dimensions than that of *M. h. winnemana*, with more depressed brain case and noticeably longer tooth row.

Measurements.—Two adult males from Brunswick, Me.: Total length, 84, 87; tail vertebrae, 28, 30; hind foot, 9.5, 9.0. Two adult females from Brunswick, Me.: Total length, 81.5, 83.5; tail vertebrae, 27, 31; hind foot, 8.5, 9.5. *Skull:* Type specimen (adult male, teeth slightly worn): Maxillary tooth row, 4.6.[8] Skulls of two adult males (teeth moderately worn) from Brunswick, Me.: Condylobasal length, 14.0, 14.2; palatal length, 5.1, 5.1; cranial breadth, 6.3, 6.3; interorbital breadth, 3.1, 3.1; maxillary breadth, 3.9, 4.0; maxillary tooth row, 4.9, 4.7. Skulls of two adult females (teeth respectively much worn and moderately worn) from Brunswick, Me.: Condylobasal length, 14.2, 13.6; palatal length, 5.0, 5.0; cranial breadth, 6.4, 6.3; interorbital breadth, 3.0; maxillary breadth, 4.1, 4.0; maxillary tooth row, 4.6, 4.8.

Remarks.—In the original description of *Sorex thompsoni* Baird (1857, p. 34–35) listed and described three specimens from the United States National Museum collection, namely, No. 1686, an alcoholic, which has since then had the skull removed, from Burlington, Vt.; No. $\frac{247}{3099}$, a skin with skull from Zanesville, Ohio; and No. $\frac{2062}{3098}$, a skin with skull, from Halifax, Nova Scotia. He gave measurements and rather detailed descriptions of the first two specimens, and illustrated the external characters of the Burlington specimen (Baird, 1857, pl. 27), the illustration of the skull (Baird, 1857, pl. 27) apparently being that of the Zanesville specimen, since the Burlington skull was in the alcoholic and the Halifax skull, even to-day, is more complete than Baird indicates in his drawing. Lyon and Osgood (1909, p. 250) considered No. 1686 the type. It, with its removed skull number 38838, is herewith made the lectotype of *Sorex thompsoni* Baird.

Intergradation of *M. h. thompsoni* with *M. h. hoyi* is clearly indicated. The skulls from Locust Grove, N. Y., can about as well be referred to the subspecies *hoyi* as to *thompsoni*. One [9] is almost like typical *M. h. hoyi*, with even slightly broader skull; another [10] is somewhat intermediate between *M. h. hoyi* and *thompsoni;* while a third [11] is like typical *thompsoni*. Intergradation of *thompsoni* with *M. h. winnemana* is suggested in the skull of *winnemana* from Alta Vista, Va.

Specimens examined.—Total number, 33, as follows:

Maine: Brassua Lake, 3 [12]; Brunswick, 9 [13]; East Andover, 1 [14]; Grace Pond, Somerset County, 1 [12]; Norway 1; Waterville, 1.
New Brunswick: Bathurst (15 miles from Miramichi Road), 1 [15]; Trousers Lake, 1.[16]
New York: Canton, 1 [17]; Locust Grove, 3; Northwood, 1.[18]
Nova Scotia: Digby, 1 [18]; Halifax, 2; Ingonish Centre, Cape Breton Island, 1 [15]; Little River, Digby Neck, 1.
Ohio: Zanesville, 1.
Prince Edward Island: Alberton, 1 [19]; Georgetown, 2.[20]
Vermont: Burlington (type locality), 1.

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[8] The only measurement available.
[9] No. 186995, U. S. Nat. Mus.
[10] No. 186994, U. S. Nat. Mus.
[11] No. 186993, U. S. Nat. Mus.
[12] E. C. and A. S. Pope coll., Chicago, Ill.
[13] Lee Mus. Biol., Bowdoin College, 3; Manton Copeland coll., Brunswick, Me., 6.
[14] Manton Copeland coll.
[15] Nat. Mus. Canada.
[16] Amer. Mus. Nat. Hist.
[17] Lee Mus. Biol.
[18] Mus. Comp. Zool.
[19] Field Mus. Nat. Hist.
[20] Field Mus. Nat. Hist., 1; Amer. Mus. Nat. Hist., 1.

MICROSOREX HOYI WINNEMANA Preble

Winnemana Pigmy Shrew

(Pl. 4, o)

Microsorex winnemana Preble, Proc. Biol. Soc. Washington 23: 101, June 24, 1910.

Microsorex hoyi winnemana Jackson, Proc. Biol. Soc. Washington 38: 126, November 13, 1925.

Type specimen.—No. 126320. U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected April 25, 1903, by Edward A. Preble.

Type locality.—Bank of Potomac River near Stubblefield Falls, 4 miles below Great Falls of the Potomac, Fairfax County, Va.

Geographic range.—Maryland in the vicinity of the District of Columbia to south-central Virginia.[a] (Fig. 23.)

Diagnostic characters.—Smallest of the genus; most nearly like *Microsorex h. thompsoni*, but smaller, the skull with relatively higher and more rotund brain case.

Color.—*Winter pelage:* Unknown. *Summer pelage:* Upper parts between sepia and olive-brown; underparts and tail as in *M. h. thompsoni*.

Skull.—Smallest of the genus; compared with that of *M. h. thompsoni* smaller, with higher and more rotund brain case, and distinctly shorter palate and tooth row.

Measurements.—Type specimen (adult female): Total length, 78; tail vertebrae, 28; hind foot, 9. *Skull:* Type specimen (adult female, teeth slightly worn): Condylobasal length, 13.0; palatal length, 4.8; breadth of cranium, 6.1; interorbital breadth, 2.7; maxillary breadth, 3.8; maxillary tooth row, 4.1.

Remarks.—The Winnemana pigmy shrew is the smallest American mammal known and, with the possible exception of *Pachyura etrusca* Savi, is the smallest known mammal in the world. Apparently it is about the same size as *P. etrusca* of Italy; but compared with *Sorex minutus* Linnaeus of Europe, another midget species, it averages about 10 per cent less in both condylobasal length of skull and in external total length, and in head and body length is about equal to the smallest specimens of *S. minutus*. Only three specimens of this shrew have been examined: The type specimen, and one from Berwyn, Md., which closely resembles the type specimen; and the third from Alta Vista, Va., which has a broken skull, but appears to approach *M. h. thompsoni* in size.

Specimens examined.—Total number, 3, as follows:

Maryland: Berwyn, 1.
Virginia: Alta Vista, 1; Stubblefield Falls, 4 miles below Great Falls of the Potomac, Fairfax County (type locality), 1.

MICROSOREX HOYI INTERVECTUS Jackson

Northwestern Pigmy Shrew

(Pls. 4, p; 6, x; 10, i; 11, o; 13, f, h)

Microsorex hoyi intervectus Jackson, Proc. Biol. Soc. Washington 38: 125, November 13, 1925.

Type specimen.—No. 226979, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected August 17, 1917, by Hartley H. T. Jackson. Original number 820.

Type locality.—Lakewood, Oconto County, Wis.

[a] Since this was written, a male (skin with fragmentary skull) was collected April 23, 1928, by A. H. Howell, at Bent Creek Experiment Station, Pisgah National Forest, N. C.

Geographic range.—Northwest territories (Fort Franklin), northern British Columbia, southeasterly to western Ontario, thence east and north to Labrador and northern Quebec.

Diagnostic characters.—Size about that of *Microsorex h. hoyi*, averaging very slightly more grayish in summer pelage; skull more angular than that of *M. h. hoyi*, with distinctly higher and broader brain case. Smaller, somewhat darker and more grayish than *M. h. eximius*, with smaller skull, relatively shorter rostrum and palate, and weaker dentition. Smaller than *M. h. alnorum*, with brain case less inflated, palate shorter, and teeth smaller.

Color.—Winter pelage: Essentially like that of *M. h. hoyi*. *Summer pelage:* Essentially like that of *M. h. thompsoni*.

Skull.—Medium size, relatively high through brain case, with moderately broad rostrum, and medium dentition. More angular, higher and broader brain case than in the skull of *M. h. hoyi*, with on the average slightly heavier dentition. Smaller than that of *M. h. eximius* or *M. h. alnorum* with relatively shorter rostrum and palate, and weaker dentition; brain case less inflated than in *alnorum*.

Measurements.—Type specimen and topotype (adult females): Total length, 92, 97; tail vertebrae, 31, 30; hind foot, 10, 10. *Skull:* Type specimen and topotype (adult females, teeth slightly worn): Condylobasal length, 14.8, 14.3; palatal length, 5.3, 5.2; cranial breadth, 7.1, 6.8; interorbital breadth, 3.1, 2.9; maxillary breadth, 4.4, 4.2; maxillary tooth row, 4.9, 4.7. Skull of adult male (teeth very slightly worn) from Fort Chimo, Quebec: Condylobasal length, 15.4; palatal length, 5.8; cranial breadth, 7.2; interorbital breadth, 3.3; maxillary breadth, 4.5; maxillary tooth row, 5.1.

Remarks.—Externally *M. h. intervectus* is scarcely distinguishable from *M. h. hoyi*, but cranially it displays considerable contrast. It intergrades with the subspecies *hoyi* in Manitoba, as it also probably does in other regions from which specimens are lacking. It also intergrades with *M. h. eximius* as is indicated by certain specimens of *eximius* from interior Alaska. The specimen from Cumberland District, Saskatchewan, shows a tendency toward *M. h. hoyi* in the flatness of its skull; however, it has the broad cranium of *intervectus* and on the whole is nearer to this form. The fragmentary skull from Echimamish River, Manitoba, referred with some doubt to *M. h. alnorum* by Preble (1902, p. 72–73) seems more clearly referable to *intervectus;* the cranium is entirely gone, but the rostrum and palate are shorter than in *alnorum* and the molariform teeth are smaller.

The skull extracted from the alcoholic specimen from Fort Chimo, Quebec, is larger than that of typical *M. h. intervectus*, and has a longer palate and tooth row and heavier dentition. In some respects it inclines toward that of *M. h. alnorum* from Robinson Portage, Manitoba; but, until more specimens are available from these localities and the intervening region, the meaning of these variations can only be conjectured.

Specimens examined.—Total number, 58, as follows:

Alberta: Fort Chipewyan, 1; Muskeg Creek (15 miles from mouth), 1; Smith Landing, Slave River, 1.

British Columbia: Fort St. James, 1; Hazelton (altitude 950 feet), 1[21]; McDame Post, Dease River, 1; Telegraph Creek (near, Sawmill Lake), 1.[21]

Labrador: Hopedale, 1.[22]

Manitoba: Echimamish River, 1.

Michigan: Fish Hawk Lake, Gogebic County, 2[23]; Porcupine Mountains (T. 51 N., R. 43 W., S. 14), Ontonagon County, 2.[23]

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[21] Mus. Vert. Zool. [22] Mus. Comp. Zool. [23] Univ. Mich.

Northwest Territories: Big Island, Great Slave Lake, 1; Fort Franklin, Great Bear Lake, 1; Fort Rae, 1; Fort Resolution, 6; Fort Simpson, 1; Fort Smith, 5.
Ontario: Algonquin Park, 1[24]; Macdiarmid, Lake Nipigon, 1.[25]
Quebec: Fort Chimo, 1; Godbout, 9; Grand Cascapedia, 1[24]; Lake Edward, 1[22]; Ste. Anne des Monts, Gaspé, 9.[26]
Saskatchewan: Cumberland District, 1.
Wisconsin: Crescent Lake, 1; Lac Vieux Desert, 2[27]; Lakewood (type locality), 2; Rhinelander, 1.[28]

MICROSOREX HOYI ALNORUM (PREBLE)

ALDER PIGMY SHREW

(PL. 4, Q)

Sorex (Microsorex) alnorum Preble, North Amer. Fauna No. 22, p. 71, October 31, 1902.
Microsorex alnorum Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 457, 1905.
Microsorex hoyi alnorum Jackson, Proc. Biol. Soc. Washington 38: 126, November 13, 1925.

Type specimen.—No. 107014, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected June 27, 1900, by Edward A. Preble.

Type locality.—Robinson Portage, Manitoba, Canada.

Geographic range.—Known only from type locality. (Fig. 23.)

Diagnostic characters.—Size large for the species, about equal to *Microsorex h. eximius* or larger, somewhat darker and more grayish; skull deeper inferosuperiorly, both through cranium and rostrum, the molariform teeth a trifle heavier, the unicuspidate teeth more crowded. Larger than *M. h. intervectus*, with brain case more inflated, palate longer, and dentition heavier.

Color.—*Winter pelage:* Unknown. *Summer pelage:* General tone of upper parts mummy brown or slightly more grayish; underparts smoke gray tinged with light buff; tail mummy brown above, light buff below basally, gradually darkening to mummy brown apically.

Skull.—Large, with brain case inflated, rostrum relatively high, molariform dentition heavy, and unicuspidate teeth somewhat crowded. Larger than the skull of *M. h. intervectus*, with brain case more inflated, longer palate, and heavier molariform teeth. Higher than the skull of *M. h. eximius*, with heavier molariform teeth, and more crowded unicuspids.

Measurements.—Type specimen (adult female): Total length, 98; tail vertebrae, 35; hind foot, 12. *Skull:* Type specimen (adult female, teeth slightly worn): Condylobasal length, 15.8; palatal length, 5.9; cranial breadth, 7.3; interorbital breadth, 3.1; maxillary breadth, 4.4; maxillary tooth row, 5.0.

Remarks.—The type specimen of *M. h. alnorum* is unique, and until additional material is obtained it will be impossible to determine the exact status of the subspecies and its relationship to *M. h. intervectus*. It appears not improbable that *alnorum* may occupy an area bordering Hudson Bay and extending northeastwardly into Quebec. The Fort Chimo specimen, referred to *intervectus*, seems to indicate such a condition.

Specimen examined.—One, the type specimen.

MICROSOREX HOYI EXIMIUS (OSGOOD)

ALASKA PIGMY SHREW

(PLS. 4, R; 10, J)

Sorex (Microsorex) eximius Osgood, North Amer. Fauna No. 21, p. 71, September 26, 1901.

[22] Mus. Comp. Zool. [24] Nat. Mus. Canada. [25] Royal Ontario Mus. Zool. [26] Amer. Mus. Nat. Hist. [27] Field Mus. Nat. Hist. [28] Univ. Wis. Zool. Mus.

Microsorex eximius Elliot, Field Columb. Mus. Publ. 105 (zool. series 6): 457, 1905.

Microsorex hoyi eximius Jackson, Proc. Biol. Soc. Washington 38: 125, November 13, 1925.

Type specimen.—No. 107126. U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth slightly worn), skin and skull; collected September 14, 1900, by W. H. Osgood.

Type locality.—Tyonek, Cook Inlet, Alaska.

Geographic range.—Western Alaska from the Yukon River south to Kenai Peninsula and the base of the Alaska Peninsula. (Fig. 23.)

Diagnostic characters.—Size comparatively large, color in summer paler and more reddish than *Microsorex h. hoyi, M. h. intervectus,* or *M. h. alnorum.* Skull larger than that of *M. h. hoyi* or *intervectus,* with longer palate and heavier dentition. Skull somewhat more depressed both through brain case and rostrum, than that of *alnorum,* with the dentition a trifle weaker.

Color.—Winter pelage: Essentially like that of *M. h. hoyi* in corresponding pelage, less tinged with buff ventrally. *Summer pelage:* Upper parts sepia or slightly paler; underparts smoke gray tinged with avellaneous or vinaceous-buff; tail sepia to mummy brown above, pinkish buff to almost avellaneous below, nearly to tip.

Skull.—Large, with relatively long rostrum and heavy dentition. Larger than the skull of *M. h. intervectus,* with longer rostrum, and correspondingly longer tooth row, and heavier dentition. Brain case not so much inflated as in *M. h. alnorum,* and dentition somewhat weaker.

Measurements.—Type specimen (adult female): Total length, 98; tail vertebrae, 31; hind foot, 11. *Skull:* Type specimen (adult female, teeth slightly worn): Condylobasal length, 15.5; palatal length, 5.9; cranial breadth, 7.1; interorbital breadth, 3.2; maxillary breadth, 4.4; maxillary tooth row, 5.2.

Remarks.—Representatives of Microsorex referable to *M. h. eximius* have been examined from several localities in southwestern Alaska west of Kenai Peninsula and Tanana. The specimens from the more interior regions of Alaska—Tanana and Mount McKinley—show a slight approach cranially toward *M. h. intervectus.*

Specimens examined.—Total number, 11, as follows:

Alaska: Barabori, Kenai Peninsula, 1 [29]; Bear Creek, Mount McKinley, 1; Chalitna River (head), 1; Kakwok River (80 miles up), 1; Moose Camp, Kenai Peninsula, 1 [29]; Nulato, 2; Tanana, 3; Tyonek (type locality), 1.

MICROSOREX HOYI WASHINGTONI Jackson

Washington Pigmy Shrew

(Pl. 4, 8)

Microsorex hoyi washingtoni Jackson, Proc. Biol. Soc. Washington 38: 125, November 13, 1925.

Type specimen.—No. 91007, U. S. Nat. Mus., Biological Survey collection; ♀ adult (teeth moderately worn), skin and skull (posterior and basal portion of cranium broken); collected September 26, 1897, by Vernon Bailey. Original number 6293.

Type locality.—Loon Lake, Stevens County, Wash.

Geographic range.—Known only from type locality. (Fig. 23.)

Diagnostic characters.—Size small, about the size of *Microsorex h. thompsoni,* slightly larger than *M. h. winnemana;* color more reddish brown (less grayish) than in any other subspecies; skull about the size of that of *thompsoni* but with slightly broader and higher cranium.

[29] Amer. Mus. Nat. Hist.

Color.—Winter pelage: Unknown. *Summer pelage:* Upper parts between cinnamon-brown and Prout's brown, grading into snuff brown on the flanks; underparts smoke gray heavily tinged with avellaneous; tail sepia above, between drab and avellaneous below.

Skull.—Size rather small, moderately depressed, relatively broad, dentition weak. About the size of the skull of *M. h. thompsoni* with actually and relatively broader cranium.

Measurements.—Type specimen (adult female): Total length, 89; tail vertebrae, 27; hind foot, 9. *Skull:* Type specimen (adult female, teeth moderately worn): Condylobasal length, 13.9; palatal length, 5.2; cranial breadth, 6.6; interorbital breadth, 3.0: maxillary breadth, 4.1; maxillary tooth row, 4.6.

Remarks.—The reddish color and the small and flattened, but relatively broad, skull of *M. h. washingtoni* show the form to be well differentiated. Unfortunately but one specimen, the type, is available, but it seems highly probable that intergradation occurs between true *M. h. hoyi* and *washingtoni.*

Specimen examined.—One, the type specimen.

TABLE 15.—*Cranial measurements of adult specimens of* Microsorex hoyi

Species and locality	No.	Sex	Condylobasal length	Palatal length	Cranial breadth	Interorbital breadth	Maxillary breadth	Maxillary tooth row	Wear of teeth	Remarks
M. h. hoyi:										
Minnesota—Elk River.	186996	♀	15.0	5.3	6.4	3.1	4.3	4.8	Slight	
Do	187001	♀	14.3	5.2	6.4	3.1	4.3	4.9	do	
Do	187008	♀	14.7	5.3	6.6	3.0	4.2	4.9	Moderate	
M. h. thompsoni:										
Vermont—Burlington.	38838	♂						4.6	Slight	Type specimen.
Maine—Brunswick	[1] 456	♂	14.2	5.1	6.3	3.1	4.0	4.7	Moderate	
Do	[1] 730	♂	14.0	5.1	6.3	3.1	3.9	4.9	do	
Do	[1] 451	♀	14.2	5.0	6.4	3.0	4.1	4.6	Much	
Do	[1] 776	♀	13.6	5.0	6.3		4.0	4.8	Moderate	
M. h. winnemana:										
Virginia—4 miles below Great Falls.	126320	♀	13.0	4.8	6.1	2.7	3.8	4.1	Slight	Do.
M. h. intervectus:										
Wisconsin—Lakewood.	226978	♀	14.3	5.2	6.8	2.9	4.2	4.7	do	Type locality.
Do	226979	♀	14.8	5.3	7.1	3.1	4.4	4.9	do	Type specimen.
Quebec—Fort Chimo.	38848	♂	15.4	5.8	7.2	3.3	4.5	5.1	Very slight.	Approaching *alnorum*?
M. h. alnorum:										
Manitoba—Robinson Portage.	107014	♀	15.8	5.9	7.3	3.1	4.4	5.0	Slight	Type specimen.
M. h. eximius:										
Alaska—Tyonek	107126	♀	15.5	5.9	7.1	3.2	4.4	5.2	do	Do.
M. h. washingtoni:										
Washington—Loon Lake.	91007	♀	13.9	5.2	6.6	3.0	4.1	4.6	Moderate	Do.

[1] Manton Copeland coll., Brunswick, Me.

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PLATE 2

[Natural size]

A. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex cinereus miscix* Bangs; type specimen; ♂ adult; Black Bay, Labrador. (No 8651, Mus. Comp. Zool., Harvard College, Bangs collection.)

C. *Sorex cinereus haydeni* Baird; ♀ adult; Ekalaka, Mont. (No. 213832, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex cinereus streatori* Merriam; ♂ adult, Sitka, Alaska. (No. 73799, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex cinereus hollisteri* Jackson; type specimen; ♀ adult; St. Michael, Alaska. (No. 99305, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex fontinalis* Hollister; ♂ adult; Hyattsville, Md. (No. 76593, U. S. Nat. Mus.; Biological Survey collection.)

G. *Sorex lyelli* Merriam; type specimen; ♂ young adult; Mount Lyell, Calif. (No. 109530, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex preblei* Jackson; type specimen; ♂ adult; Jordan Valley, Malheur County, Oreg. (No. 208032, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111122, U. S. Nat. Mus.)

J. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex arcticus laricorum* Jackson; type specimen; ♂ adult; Elk River, Minn. (No. 186837, U. S. Nat. Mus., Merriam collection.)

L. *Sorex tundrensis* Merriam; type specimen; ♂ adult; St. Michael, Alaska. (No. 99,286, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex pribilofensis* Merriam; topotype; ♂ adult; St. Paul Island, Pribilof group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

O. *Sorex leucogenys* Osgood; type specimen; ♀ adult; 3 miles east of Beaver, Utah. (No. 157952, U. S. Nat. Mus., Biological Survey collection.)

P. *Sorex sclateri* Merriam; type specimen; ♀ adult; Tumbala, Chiapas, Mexico. (No. 75872, U. S. Nat. Mus., Biological Survey collection.)

Q. *Sorex longirostris longirostris* Bachman; adult, sex unknown; Butler, Ga. (No. 38425, U. S. Nat. Mus.)

R. *Sorex longirostris fisheri* Merriam; topotype; ♀ adult; Lake Drummond, Dismal Swamp, Va. (No. 75167, U. S. Nat. Mus., Biological Survey collection.)

S. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)

T. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

U. *Sorex trowbridgii montereyensis* Merriam; ♀ adult; Pacific Grove, Calif. (No. 107920, U. S. Nat. Mus., Biological Survey collection.)

V. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

W. *Sorex vagrans nevadensis* Merriam; type specimen; ♂ adult; Reese River, at line between Lander and Nye Counties, Nev. (No. 32302, U. S. Nat. Mus., Biological Survey collection.)

X. *Sorex vagrans halicoetes* Grinnell; topotype; ♀ adult; Palo Alto, Calif. (No. 3635, Mus. Vert. Zool., Univ. California.)

Y. *Sorex vagrans monticola* Merriam; ♂ young adult; Mount Thomas, White Mountains, Ariz. (No. 208664, U. S. Nat. Mus., Biological Survey collection.)

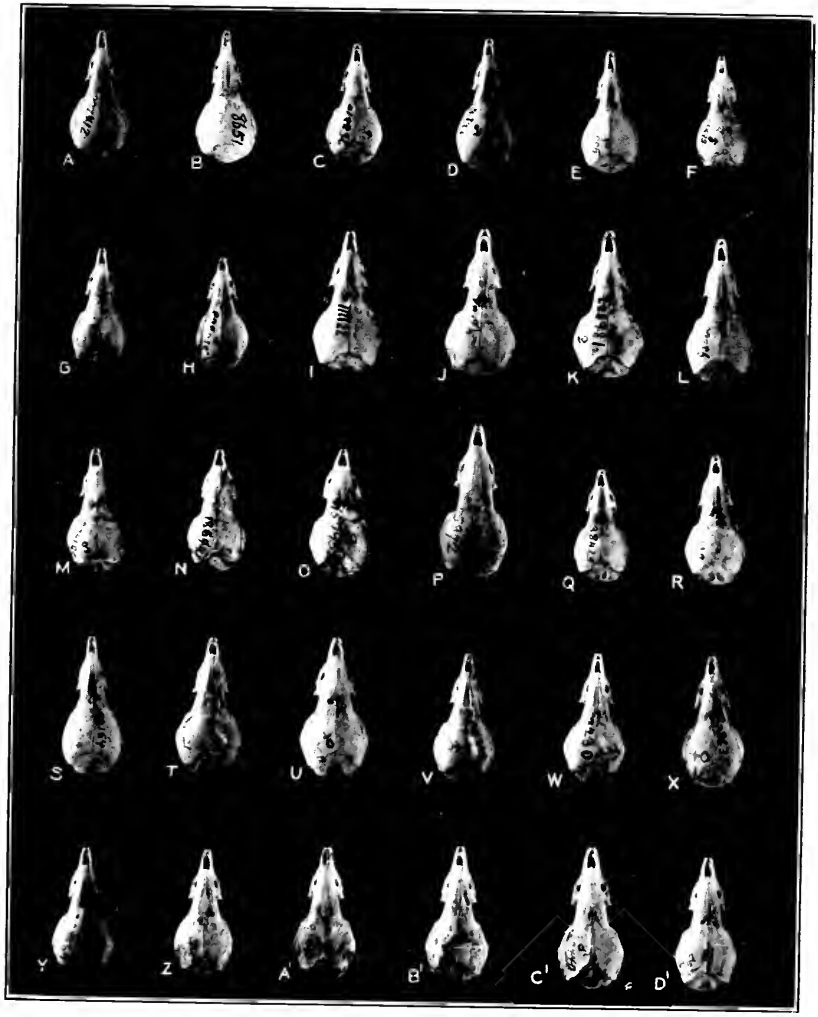
Z. *Sorex vagrans orizabae* Merriam; ♀ adult; Cofre de Perote, Vera Cruz, Mexico. (No. 54440, U. S. Nat. Mus., Biological Survey collection.)

A′. *Sorex durangae* Jackson; type specimen; ♂ adult; El Salto, Durango, Mexico. (No. 94540, U. S. Nat. Mus., Biological Survey collection.)

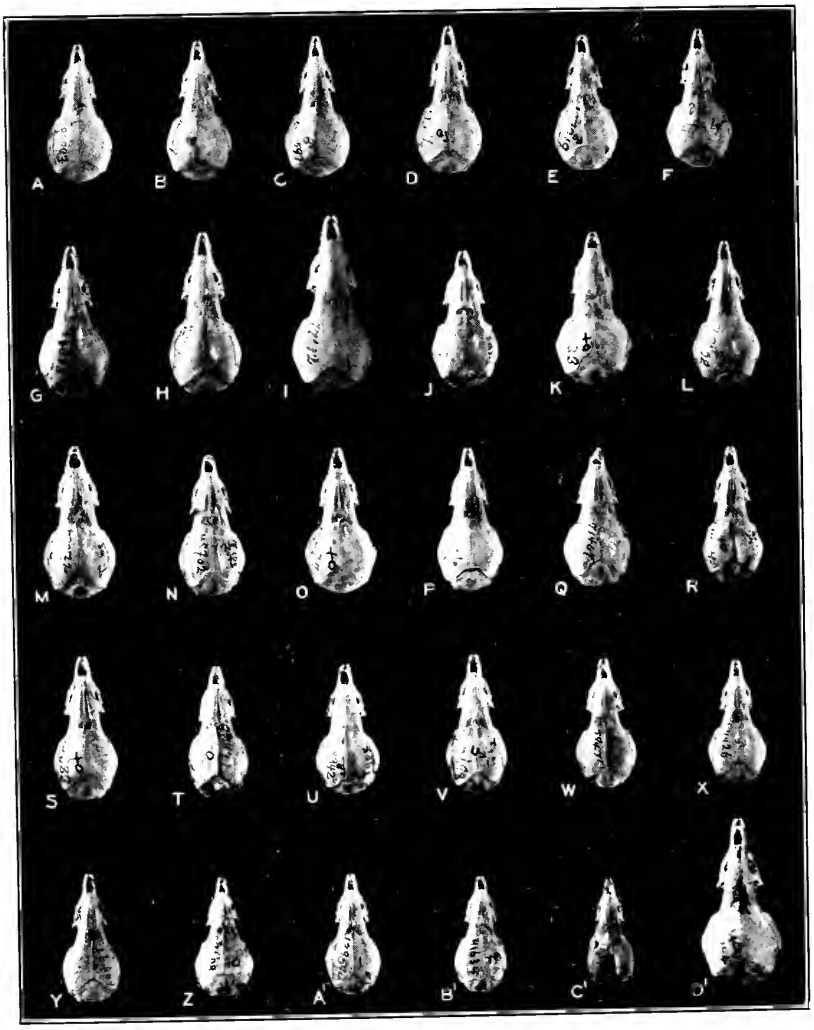
B′. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

C′. *Sorex obscurus neomexicanus* Bailey; type specimen ♂ adult; Cloudcroft, Sacramento Mountains, N. Mex. (No. 100440, U. S. Nat. Mus., Biological Survey collection.)

D′. *Sorex obscurus parvidens* Jackson; type specimen; ♂ adult; Bluff Lake, San Bernardino Mountains, Calif. (No. 56561, U. S. Nat. Mus., Biological Survey collection.)



SKULLS OF SOREX



SKULLS OF SOREX

PLATE 3

[Natural size]

A. *Sorex obscurus shumaginensis* Merriam; type specimen; ♀ adult; Popof Island, Shumagin Islands, Alaska. (No. 97993, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex obscurus alascensis* Merriam; type specimen; ♀ adult; Yakutat, Alaska. (No. 73539, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex obscurus classodon* Osgood; type specimen; ♂ adult; Cumshewa Inlet, Moresby Island, Queen Charlotte Islands, British Columbia. (No. 100597, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex obscurus longicauda* Merriam; type specimen; ♂ adult; Wrangell, Alaska. (No. 74711, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex obscurus isolatus* Jackson; type specimen; ♂ adult; mouth of Millstone Creek, Nanaimo, Vancouver Island, British Columbia. (No. 177719, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex obscurus setosus* Elliot; ♂ adult; Quinault Lake, Wash. (No. 89647, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex obscurus bairdi* Merriam; type specimen; ♀ adult; Astoria, Oreg. (No. 24318, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex pacificus pacificus* Coues; adult, sex unknown; Crescent City, Calif. (No. 97612, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex veraepacis veraepacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex veraepacis mutabilis* Merriam; topotype; ♀ adult; Reyes (near Cuicatlan), Oaxaca, Mexico. (No. 69602, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex macrodon* Merriam; type specimen; ♂ adult; Orizaba, Vera Cruz, Mexico. (No. 58272, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

O. *Sorex saussurei saussurei* Merriam; ♀ young adult; San Cristobal, Chiapas, Mexico. (No. 75877, U. S. Nat. Mus., Biological Survey collection.)

P. *Sorex saussurei veraecrucis* Jackson; type specimen; ♀ adult; Xico, Vera Cruz, Mexico. (No. 55106, U. S. Nat. Mus., Biological Survey collection.)

Q. *Sorex saussurei oaxacae* Jackson; type specimen; ♀ adult; mountains near Ozolotepec, Oaxaca, Mexico. (No. 71467, U. S. Nat. Mus., Biological Survey collection.)

R. *Sorex saussurei godmani* Merriam; type specimen; ♀ adult; Volcan Santa Maria, Quezaltenango, Guatemala. (No. 77044, U. S. Nat. Mus., Biological Survey collection.)

S. *Sorex saussurei cristobalensis* Jackson; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75883, U. S. Nat. Mus., Biological Survey collection.)

T. *Sorex emarginatus* Jackson; type specimen; ♀ young adult; Sierra Madre near Bolanos, Jalisco, Mexico. (No. 90847, U. S. Nat. Mus., Biological Survey collection.)

U. *Sorex ventralis* Merriam; type specimen; ♂ adult; Cerro San Felipe, Oaxaca, Mexico. (No. 68342, U. S. Nat. Mus., Biological Survey collection.)

V. *Sorex oreopolus* Merriam; type specimen; ♂ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45698, U. S. Nat. Mus., Biological Survey collection.)

W. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

X. *Sorex ornatus californicus* Merriam; type specimen; ♂ adult; Walnut Creek, Contra Costa County, Calif. (No. 44426, U. S. Nat. Mus., Biological Survey collection.)

Y. *Sorex sinuosus* Grinnell; topotype; ♂ adult; Grizzly Island, near Suisun, Solano County, Calif. (No. 16469, Mus. Vert. Zool., Univ. California.)

Z. *Sorex trigonirostris* Jackson; type specimen; ♀ adult; Ashland, Jackson County, Oreg. (No. 203608, U. S. Nat. Mus., Biological Survey collection.)

A′. *Sorex juncensis* Nelson and Goldman; type specimen; ♀ young adult; Socorro, 15 miles south of San Quintin, Lower California. (No. 139594, U. S. Nat. Mus., Biological Survey collection.)

B′. *Sorex myops* Merriam; type specimen; ♀ adult; Piper's Creek (Cottonwood Creek), White Mountains, Mono County, Calif. (No. 41634, U. S. Nat. Mus., Biological Survey collection.)

C′. *Sorex nanus* Merriam; type specimen; ♀ young adult; Estes Park, Larimer County, Colo. (No. 73733, U. S. Nat. Mus., Biological Survey collection.)

D′. *Sorex palustris palustris* Richardson; ♀ adult; Robinson Portage, Manitoba. (No. 107044, U. S. Nat. Mus., Biological Survey collection.)

PLATE 4

[Natural size]

A. *Sorex palustris hydrobadistes* Jackson; ♀ adult; Lac Vieux Desert, Wis. (No. 18348, Fleld Mus. Nat. Hist.)

B. *Sorex palustris albibarbis* (Cope); type specimen; ♀ adult; Profile Lake, Franconia Mountains, Grafton County, N. H. (No. 38743, U. S. Nat. Mus.)

C. *Sorex palustris gloveralleni* Jackson; type specimen; ♀ adult; Digby, Nova Scotia. (No. 2046, Mus. Comp. Zool., Harvard College, Bangs collection.)

D. *Sorex palustris navigator* (Baird); ♂ adult; Mount St. Helens, Wash. (No. 90751, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex palustris navigator* (Baird); ♀ adult; Pryor Mountains, Mont. (No. 66493, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex palustris navigator* (Baird); ♀ adult; Pryor Mountains, Mont. (No. 66495, U. S. Nat. Mus., Biological Survey collection.) Figs. E and F show individual variation.

G. *Sorex palustris navigator* (Baird); ♂ adult; Mount Whitney, Calif. (No. 42545, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex palustris navigator* (Baird); ♂ old adult; Mount Whitney, Calif. (No. 42547, U. S. Nat. Mus., Biological Survey collection.) (Figs. G and H show age variation.)

I. *Sorex alaskanus* Merriam; type specimen; ♂ adult; Point Gustavus, Glacier Bay, Alaska. (No. 97713, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex bendirii palmeri* Merriam; type specimen; ♀ adult; Astoria, Oreg. (No. 24263, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex bendirii albiventer* Merriam; type specimen; ♂ adult; Lake Cushman, Olympic Mountains, Wash. (No. 66198, U. S. Nat. Mus., Biological Survey collection.)

M, T. *Microsorex hoyi hoyi* (Baird); ♀ adult; Elk River, Minn. (No. 187008, U. S. Nat. Mus., Merriam collection.)

N. *Microsorex hoyi thompsoni* (Baird); adult, sex unknown; Brunswick, Me. (No. 284, Lee Mus. Biol. Bowdoin College, Brunswick, Me.)

O. *Microsorex hoyi winnemana* Preble; type specimen; ♀ adult; 4 miles below Great Falls of the Potomac, Fairfax County, Va. (No. 126320, U. S. Nat. Mus., Biological Survey collection.)

P. *Microsorex hoyi intervectus* Jackson; type specimen; ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)

Q. *Microsorex hoyi alnorum* (Preble); type specimen; ♀ adult; Robinson Portage, Manitoba. (No. 107014, U. S. Nat. Mus., Biological Survey collection.)

R. *Microsorex hoyi eximius* (Osgood); type specimen; ♀ adult; Tyonek, Cook Inlet, Alaska. (No. 107126, U. S. Nat. Mus., Biological Survey collection.)

S. *Microsorex hoyi washingtoni* Jackson; type specimen; ♀ adult; Loon Lake, Stevens County, Wash. (No. 91007, U. S. Nat. Mus., Biological Survey collection.)

U. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

V. *Sorex fontinalis* Hollister; ♂ adult; Hyattsville, Md. (No. 76593, U. S. Nat. Mus., Biological Survey collection.)

W. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111122, U. S. Nat. Mus.)

X. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

Y. *Sorex tundrensis* Merriam; topotype; ♀ adult; St. Michael, Alaska. (No. 99276, U. S. Nat. Mus., Biological Survey collection.)

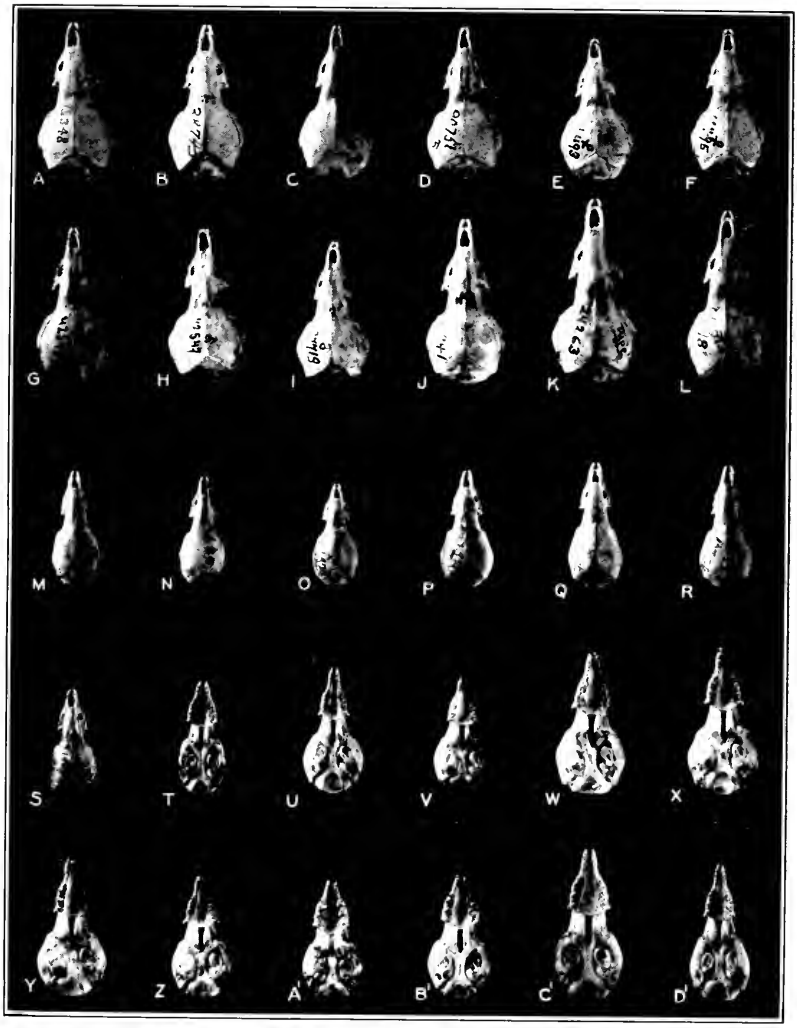
Z. *Sorex pribilofensis* Merriam; topotype; ♂ adult; Saint Paul Island, Pribilof Group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

A′. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

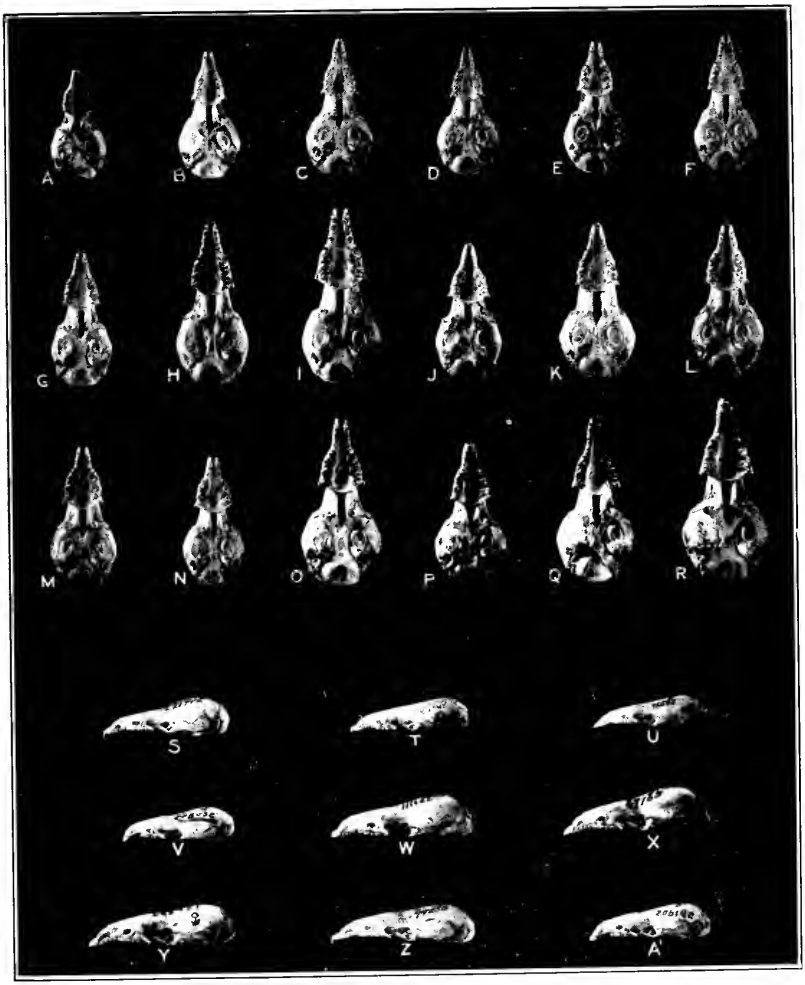
B′. *Sorex leucogenys* Osgood; type specimen; ♀ adult; 3 miles east of Beaver, Utah. (No. 157952, U. S. Nat. Mus., Biological Survey collection.)

C′. *Sorex sclateri* Merriam; type specimen; ♀ adult; Tumbala, Chiapas, Mexico. (No. 75872, U. S. Nat. Mus., Biological Survey collection.)

D′. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)



SKULLS OF SOREX AND MICROSOREX



SKULLS OF SOREX

PLATE 5

[Natural size]

A. *Sorex longirostris longirostris* Bachman; adult; sex unknown; Butler, Ga. (No. 38425, U. S. Nat. Mus.)

B. *Sorex longirostris fisheri* Merriam; topotype; ♀ adult; Lake Drummond, Dismal Swamp, Va. (No. 75167, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex durangae* Jackson; type specimen; ♂ adult; El Salto, Durango, Mexico. (No. 94540, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex obscurus parvidens* Jackson; type specimen; ♂ adult; Bluff Lake, San Bernardino Mountains, Calif. (No. 56561, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex pacificus pacificus* Coues; adult, sex unknown; Crescent City, Calif. (No. 97612, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex veraepacis veraepacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex macrodon* Merriam; type specimen; ♂ adult; Orizaba, Vera Cruz, Mexico. (No. 58272, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

O. *Sorex palustris palustris* Richardson; ♀ adult; Robinson Portage, Manitoba. (No. 107044, U. S. Nat. Mus., Biological Survey collection.)

P. *Sorex alaskanus* Merriam; type specimen; ♂ adult; Point Gustavus, Glacier Bay, Alaska. (No. 97713, U. S. Nat. Mus., Biological Survey collection.)

Q. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

R. *Sorex bendirii palmeri* Merriam; type specimen; ♀ adult; Astoria, Oreg. (No. 24,263, U. S. Nat. Mus., Biological Survey collection.)

S. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

T. *Sorex fontinalis* Hollister; ♂ adult; Hyattsville, Md. (No. 76593, U. S. Nat. Mus., Biological Survey collection.)

U. *Sorex lycili* Merriam; type specimen; ♂ young adult; Mount Lyell, Calif. (No. 109530, U. S. Nat. Mus., Biological Survey collection.)

V. *Sorex preblei* Jackson; type specimen; ♂ adult; Jordan Valley, Malheur County, Oreg. (No. 208032, U. S. Nat. Mus., Biological Survey collection.)

W. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111122, U. S. Nat. Mus.)

X. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

Y. *Sorex arcticus laricorum* Jackson; type specimen; ♂ adult; Elk River, Minn. (No. 186837, U. S. Nat. Mus., Merriam collection.)

Z. *Sorex tundrensis* Merriam; type specimen; ♂ adult; Saint Michael, Alaska. (No. 99286, U. S. Nat. Mus., Biological Survey collection.)

A'. *Sorex pribilofensis* Merriam; topotype; ♂adult; St. Paul Island, Pribilof Group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

PLATE 6

[Natural size]

A. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

B. *Sorex leucogenys* Osgood; type specimen; ♀ adult; 3 miles east of Beaver, Utah. (No. 157952, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex sclateri* Merriam; type specimen; ♀ adult; Tumbala, Chiapas, Mexico. (No. 75872, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex longirostris longirostris* Bachman; adult, sex unknown; Butler, Ga. (No. 38425, U. S. Nat. Mus.)

E. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)

F. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex durangae* Jackson; type specimen; ♂ adult; El Salto, Durango, Mexico. (No. 94540, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex obscurus shumaginensis* Merriam; type specimen; ♀ adult; Popof Island, Shumagin Islands, Alaska. (No. 97993, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex pacificus pacificus* Coues; adult, sex unknown; Crescent City, Calif. (No. 97612, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex veraepacis veraepacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

O. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

P. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

Q. *Sorex tenellus* Merriam; type specimen; adult, sex unknown; Lone Pine, Calif. (No. 32495, U. S. Nat. Mus., Biological Survey collection.)

R. *Sorex myops* Merriam; type specimen; ♀ adult; Pipers Creek (Cottonwood Creek), White Mountains, Mono County, Calif. (No. 41634, U. S. Nat. Mus., Biological Survey collection.)

S. *Sorex palustris palustris* Richardson; ♀ adult; Robinson Portage, Manitoba. (No. 107044, U. S. Nat. Mus., Biological Survey collection.)

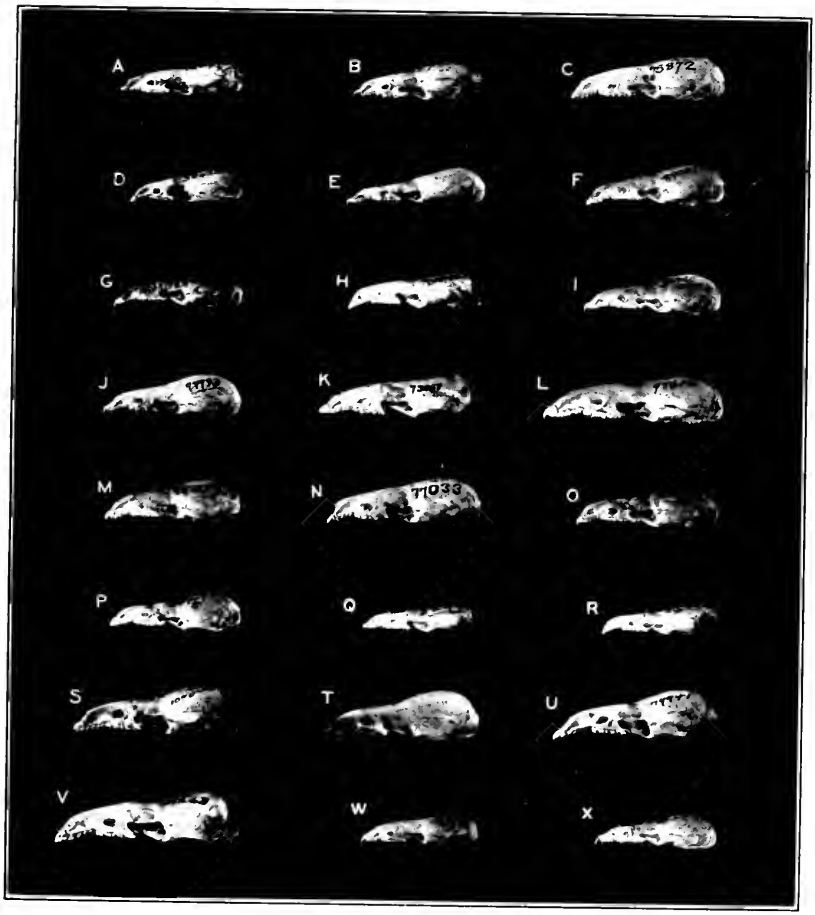
T. *Sorex palustris gloveralleni* Jackson; type specimen; ♀ adult; Digby, Nova Scotia. (No. 2046, Mus. Comp. Zool., Harvard College, Bangs collection.)

U. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

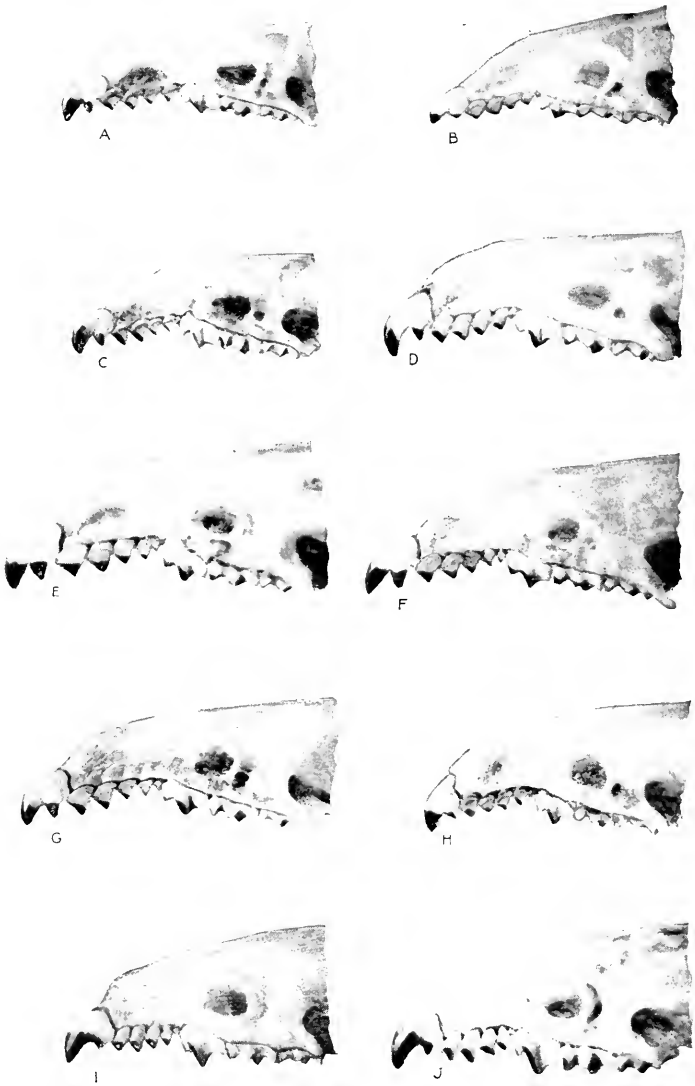
V. *Sorex bendirii palmeri* Merriam; type specimen; ♀ adult; Astoria, Oreg. (No. 24263, U. S. Nat. Mus., Biological Survey collection.)

W. *Microsorex hoyi hoyi* (Baird); ♀ adult; Elk River, Minn. (No. 187008, U. S. Nat. Mus., Merriam collection.)

X. *Microsorex hoyi intervectus* Jackson; type specimen; ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)



SKULLS OF SOREX AND MICROSOREX



ROSTRA AND UPPER TEETH OF SOREX

PLATE 7

[Enlarged five diameters]

A. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex fontinalis* Hollister; ♂ adult; Hyattsville, Md. (No. 76593, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex lyelli* Merriam; type specimen; ♂ young adult; Mount Lyell, Calif. (No. 109530, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111123, U. S. Nat. Mus.)

E. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex tundrensis* Merriam; topotype; ♀ adult; St. Michael, Alaska. (No. 99276, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex araneus araneus* Linnaeus; ♀ adult; Gudbrandsdalen, Norway. (No. 121343, U. S. Nat. Mus.)

H. *Sorex pribilofensis* Merriam; topotype; ♂ adult; St. Paul Island, Pribilof Group, Alaska. (No. 206182, U. S. Nat. Mus.; Biological Survey collection.)

I. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

J. *Sorex leucogenys* Osgood; type specimen; ♀ adult; 3 miles east of Beaver, Utah. (No. 157952, U. S. Nat. Mus., Biological Survey collection.)

PLATE 8

[Enlarged five diameters]

A. *Sorex sclateri* Merriam; type specimen; ♀ adult; Tumbala, Chiapas, Mexico. (No. 75872, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex longirostris longirostris* Bachman; adult, sex unknown; Young Harris, Ga. (No. 159415, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)

D. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex durangae* Jackson; type specimen; ♂ adult; El Salto, Durango, Mexico. (No. 94540, U. S. Nat. Mus., Biological Survey collection.)

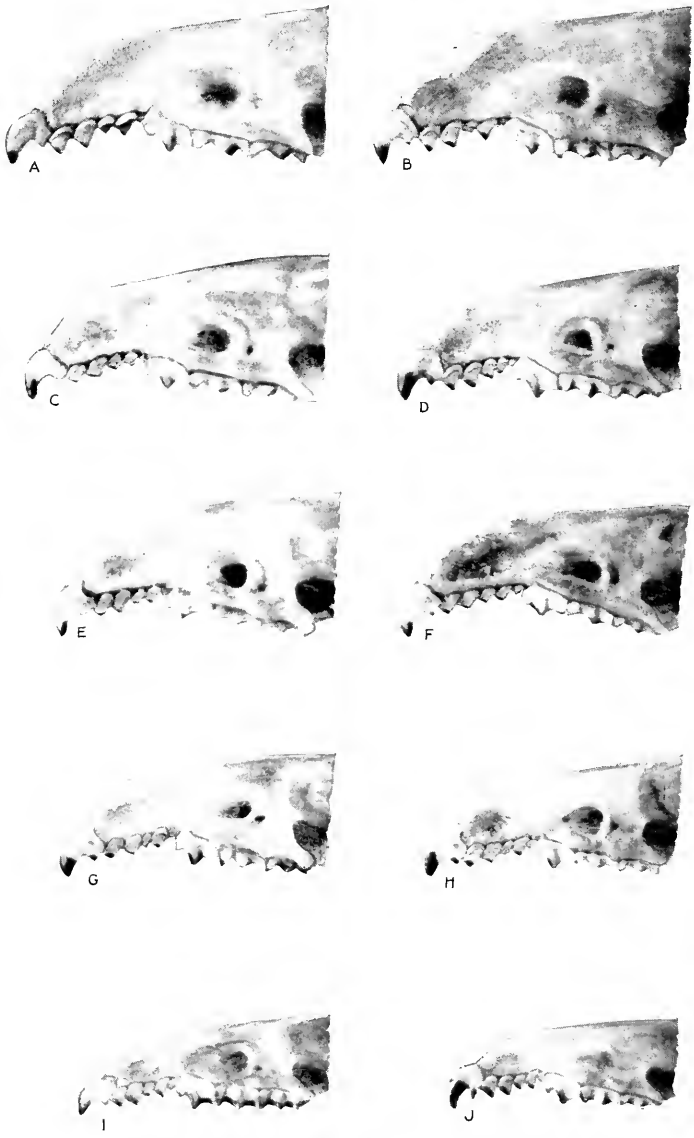
G. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex pacificus pacificus* Coues; adult, sex unknown; Crescent City, Calif. (No. 97612, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico. (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

ROSTRA AND UPPER TEETH OF SOREX



ROSTRA AND UPPER TEETH OF SOREX

PLATE 9

[Enlarged five diameters]

A. *Sorex veracpacis veraepacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex macrodon* Merriam; type specimen; ♂ adult; Orizaba, Vera Cruz, Mexico. (No. 58272, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex emarginatus* Jackson; type specimen; ♀ young adult; Sierra Madre near Bolanos, Jalisco, Mexico (No. 90847, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex ventralis* Merriam; type specimen; ♂ adult; Cerro San Felipe, Oaxaca, Mexico. (No. 68342, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex oreopolus* Merriam; type specimen; ♂ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico (No. 45698, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex ornatus californicus* Merriam; type specimen; ♂ adult; Walnut Creek, Contra Costa County, Calif. (No. 44426, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex tenellus* Merriam; type specimen; adult, sex unknown; Lone Pine, Calif. (No. 32495, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex nanus* Merriam; type specimen; ♀ young adult; Estes Park, Larimer County, Colo. (No. 73733, U. S. Nat. Mus., Biological Survey collection.)

PLATE 10

[Enlarged five diameters]

A. *Sorex palustris palustris* Richardson; ♀ adult; Robinson Portage, Manitoba. (No. 107044, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex palustris albibarbis* (Cope); type specimen; ♀ adult; Profile Lake, Franconia Mountains, Grafton County, N. H. (No. 38743, U. S. Nat. Mus.)

C. *Sorex palustris navigator* (Baird); ♂ adult; Mount Whitney, Calif. (No. 42545, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex palustris navigator* (Baird); ♂ old adult; Mount Whitney, Calif. (No. 42547, U. S. Nat. Mus., Biological Survey collection.) Figs. G and H show age variation.

E. *Sorex alaskanus* Merriam; type specimen; ♂ adult; Point Gustavus, Glacier Bay, Alaska. (No. 97713, U. S. Nat. Mus., Biological Survey collection.)

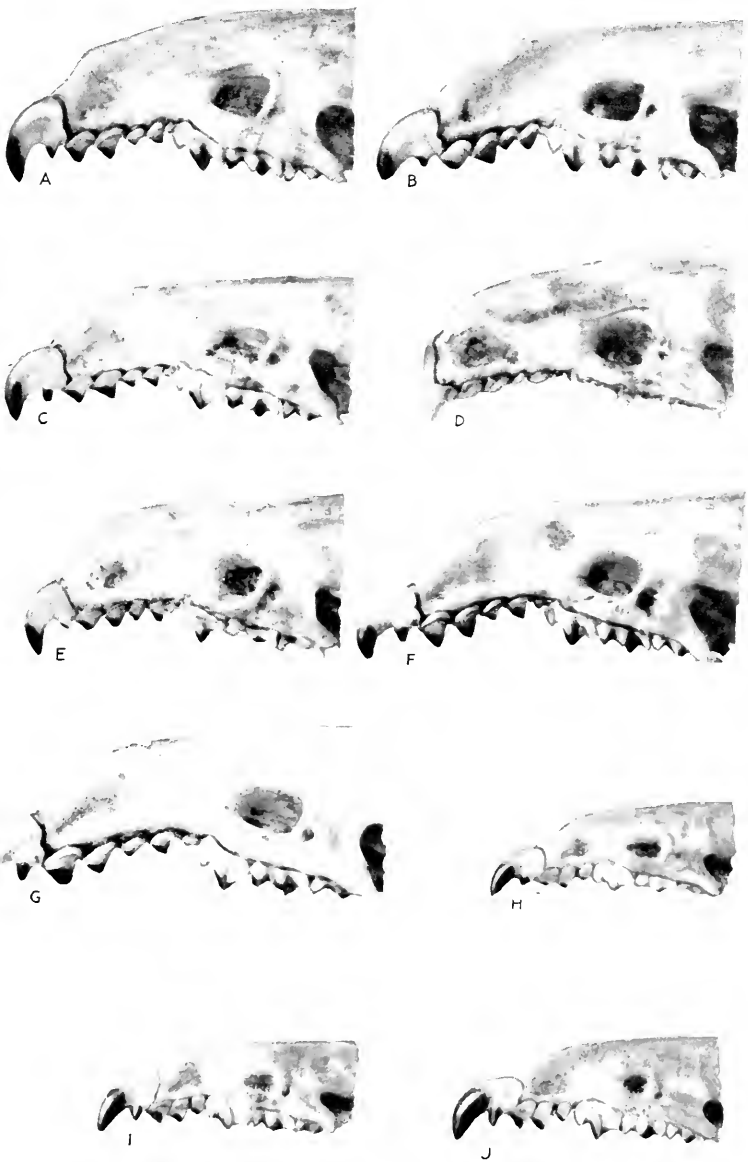
F. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex bendirii palmeri* Merriam; ♂ adult; Eugene, Oreg. (No. 204482, U. S. Nat. Mus., Biological Survey collection.)

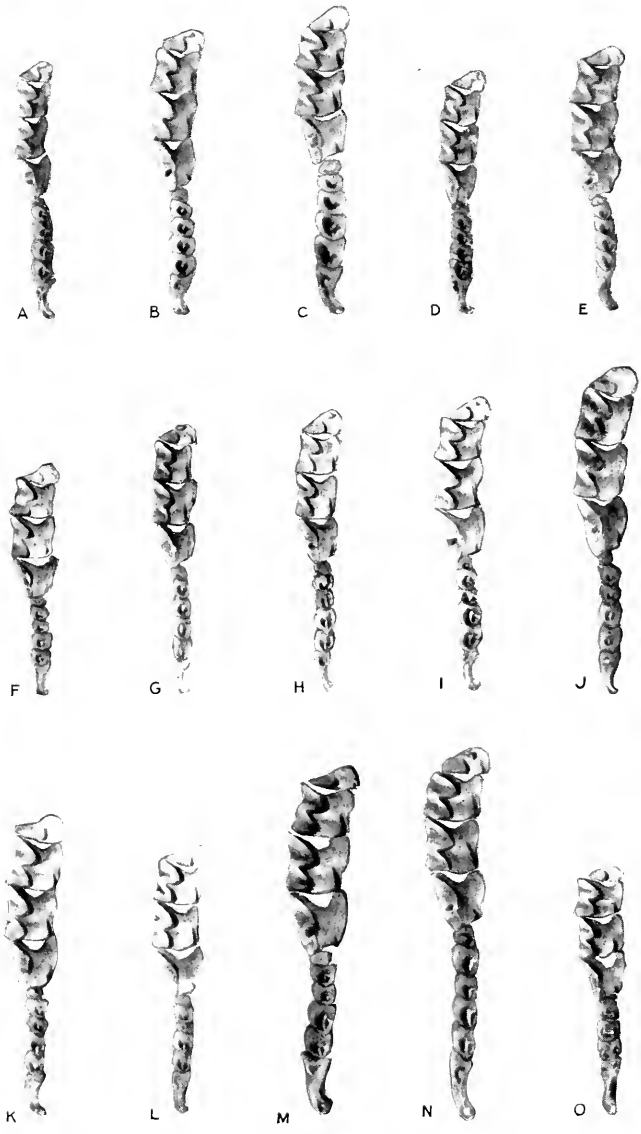
H. *Microsorex hoyi hoyi* (Baird); ♀ adult; Elk River, Minn. (No. 187008, U. S. Nat. Mus., Merriam collection.)

I. *Microsorex hoyi intervectus* Jackson; type specimen; ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)

J. *Microsorex hoyi eximius* (Osgood); type specimen; ♀ adult; Tyonek, Cook Inlet, Alaska. (No. 107126, U. S. Nat. Mus., Biological Survey collection.)



ROSTRA AND UPPER TEETH OF SOREX AND MICROSOREX



UPPER TEETH OF SOREX AND MICROSOREX

PLATE 11

[Enlarged five diameters]

A. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111123, U. S. Nat. Mus.)

C. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex pribilofensis* Merriam; topotype; ♂ adult; St. Paul Island, Pribilof Group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

F. *Sorex longirostris longirostris* Bachman; ♂ adult; Falls Church, Va. (No. 87190, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

I. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lembi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

J. *Sorex veraepacis veraepacis* Alston; ♀ adult; Reyes (near Cuicatlan), Oaxaca, Mexico. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

L. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex palustris hydrobadistes* Jackson; ♀ adult; Lac Vieux Desert, Wis. (No. 18348, Field Mus. Nat. Hist.)

N. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

O. *Microsorex hoyi intervectus* Jackson; type specimen: ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)

PLATE 12

[Enlarged five diameters]

A. *Sorex cinereus cinereus* Kerr; ♂ adult; Elkhart Lake, Wis. (No. 227412, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex fumeus fumeus* Miller; topotype; ♀ adult; Peterboro, N. Y. (No. 111123, U. S. Nat. Mus.)

C. *Sorex arcticus arcticus* Kerr; ♂ adult; South Edmonton, Alberta. (No. 69163, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex tundrensis* Merriam; type specimen; ♂ adult; St. Michael, Alaska. (No. 99286, U. S. Nat. Mus., Biological Survey collection.)

E. *Sorex pribilofensis* Merriam; topotype; ♂ adult; St. Paul Island, Pribilof Group, Alaska. (No. 206182, U. S. Nat. Mus., Biological Survey collection.)

F. *Sorex merriami* Dobson; type specimen; ♀ adult; Fort Custer, Bighorn County, Mont. (No. 186441, U. S. Nat. Mus., Merriam collection.)

G. *Sorex longirostris longirostris* Bachman; adult, sex unknown; Young Harris, Ga. (No. 159415, U. S. Nat. Mus., Biological Survey collection.)

H. *Sorex dispar* Batchelder; ♀ adult; Hunter Mountain, Catskill Mountains, N. Y. (No. 83159, U. S. Nat. Mus.)

I. *Sorex trowbridgii trowbridgii* Baird; topotype; ♀ adult; Astoria, Oreg. (No. 89021, U. S. Nat. Mus., Biological Survey collection.)

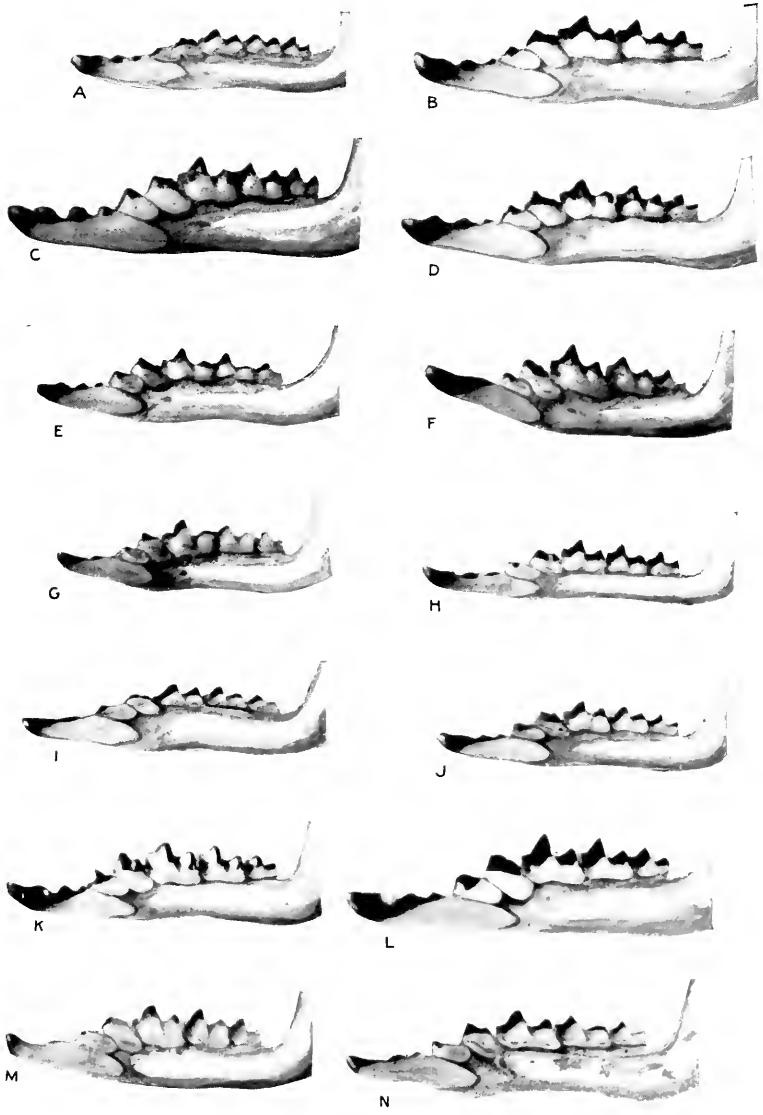
J. *Sorex vagrans vagrans* Baird; ♂ adult; Aberdeen, Wash. (No. 24339, U. S. Nat. Mus., Biological Survey collection.)

K. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

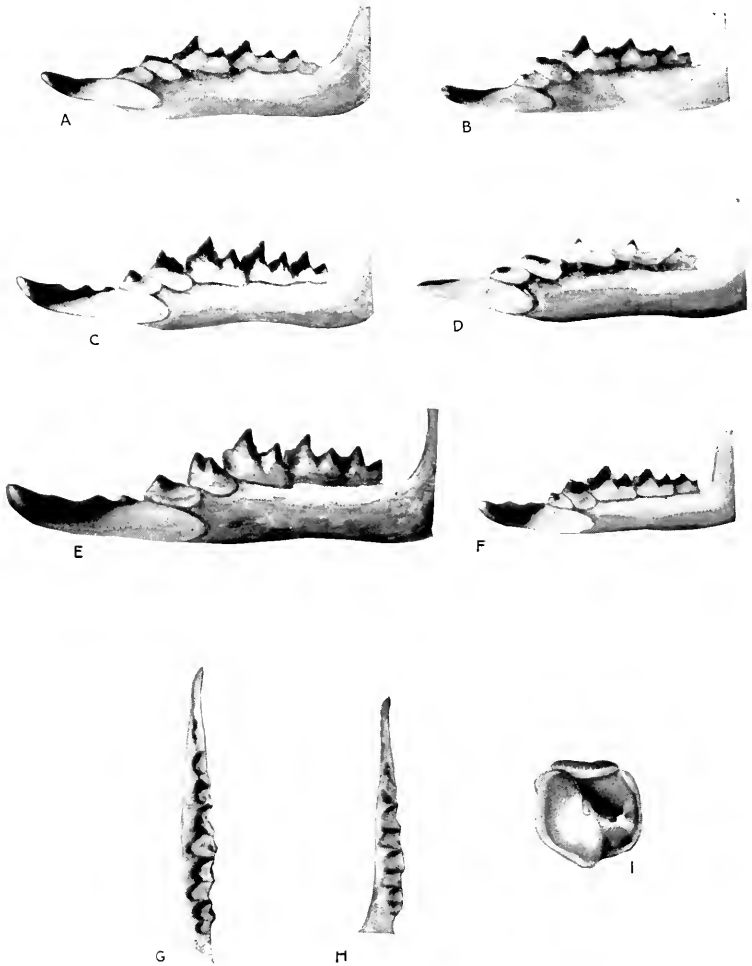
L. *Sorex yaquinae* Jackson; type specimen; ♀ adult; Yaquina Bay, Lincoln County, Oreg. (No. 73051, U. S. Nat. Mus., Biological Survey collection.)

M. *Sorex stizodon* Merriam; type specimen; ♀ adult; San Cristobal, Chiapas, Mexico (No. 75885, U. S. Nat. Mus., Biological Survey collection.)

N. *Sorex veraepacis veraepacis* Alston; ♀ adult; Todos Santos, Guatemala. (No. 77033, U. S. Nat. Mus., Biological Survey collection.)



LOWER TEETH OF SOREX



LOWER TEETH OF SOREX AND MICROSOREX AND UPPER TEETH OF MICROSOREX

PLATE 13

[A to H enlarged 5 diameters; I enlarged about 25 diameters]

A. *Sorex saussurei saussurei* Merriam; type specimen; ♀ adult; north slope Sierra Nevada de Colima, Jalisco, Mexico. (No. 45702, U. S. Nat. Mus., Biological Survey collection.)

B. *Sorex ornatus ornatus* Merriam; ♂ adult; Tehachapi, Calif. (No. 135947, U. S. Nat. Mus., Biological Survey collection.)

C. *Sorex palustris navigator* (Baird); ♂ adult; Mount Whitney, Calif. (No. 42545, U. S. Nat. Mus., Biological Survey collection.)

D. *Sorex palustris navigator* (Baird); ♂ old adult; Mount Whitney, Calif. (No. 42547, U. S. Nat. Mus., Biological Survey collection.) Figs. G and H show age variation.

E. *Sorex bendirii bendirii* (Merriam); ♂ adult; Fort Klamath, Oreg. (No. 79941, U. S. Nat. Mus., Biological Survey collection.)

F. H. *Microsorex hoyi intervectus* Jackson; type specimen; ♀ adult; Lakewood, Oconto County, Wis. (No. 226979, U. S. Nat. Mus., Biological Survey collection.)

G. *Sorex obscurus obscurus* Merriam; topotype; ♀ adult; Lemhi Mountains, 10 miles west of Junction, Idaho. (No. 30940, U. S. Nat. Mus., Biological Survey collection.)

I. *Microsorex hoyi hoyi* (Baird); ♀ adult; Elk River, Minn. (No. 187008, U. S. Nat. Mus., Merriam collection.)

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[Synonyms in *italics;* principal references in **boldface figures**]

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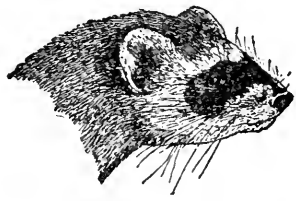

REVISION OF THE AMERICAN CHIPMUNKS

(Genera TAMIAS and EUTAMIAS)

BY

ARTHUR H. HOWELL

SENIOR BIOLOGIST, DIVISION OF BIOLOGICAL INVESTIGATIONS
BUREAU OF BIOLOGICAL SURVEY

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No. 50

[Actual date of publication, June 30, 1927]

REVISION OF THE AMERICAN LEMMING MICE

(Genus SYNAPTOMYS)

BY

A. BRAZIER HOWELL
SCIENTIFIC ASSISTANT, DIVISION OF BIOLOGICAL INVESTIGATIONS
BUREAU OF BIOLOGICAL SURVEY

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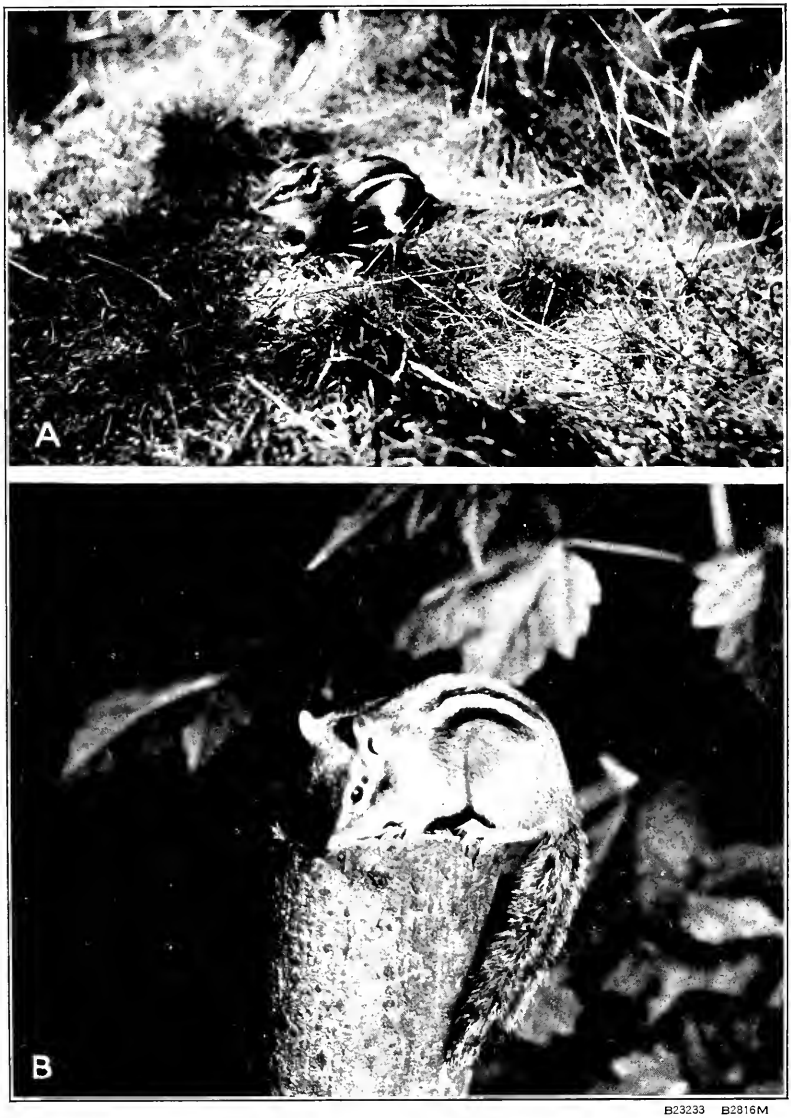

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EASTERN CHIPMUNKS

A, Gray chipmunk (*Tamias striatus griseus*), Basswood Lake, Wis. Photo by Vernon Bailey; B, Northeastern chipmunk (*T. s. lysteri*), Indian Lake, N. Y. Photo by Francis Harper

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REVISION OF THE AMERICAN CHIPMUNKS

(GENERA TAMIAS AND EUTAMIAS)

By ARTHUR H. HOWELL

CONTENTS

INTRODUCTION

The American chipmunks comprise two distinct groups—the eastern chipmunks of the genus Tamias and the western chipmunks of the genus Eutamias.[1] Tamias is a compact group comprising but one species with five geographic races; Eutamias is represented in North America by five distinct groups comprising 16 species and a total of 60 valid forms. (Howell, 1922, p. 183–185.) [2]

The eastern chipmunks have not been revised since 1886, when Merriam (1886b) divided the species into two races, nor the western chipmunks since 1890, when only 23 forms were recognized by Allen. In the western chipmunks (Eutamias) many of the forms bear close external resemblance to other forms belonging to quite distinct groups, and in the absence of a critical revision of the entire genus, based on adequate material, it was inevitable that much confusion should arise as to the proper identification and allocation of certain forms.

In the present revision the author has had at his disposal practically all the material in the principal museums and private collections in North America, numbering 1,349 specimens of Tamias

[1] The ground squirrels of the genus Callospermophilus are sometimes locally known as chipmunks, but these are not treated in this revision.

[2] Literature citations in parentheses refer to the bibliography, p. 138.

and 13,205 of Eutamias.[3] All measurements given are in millimeters. The names of colors used in descriptions are mainly those of Ridgway.[4] Specimens listed, unless otherwise indicated, are in the United States National Museum collection.

GEOGRAPHIC DISTRIBUTION

The eastern chipmunks (Tamias) occupy the greater part of eastern United States and southern Canada east of the Great Plains, from James Bay, Ontario, and Shoal Lake, Manitoba, south to Louisiana, southern Mississippi, Alabama, and Georgia; east to southern Quebec (Matamek River), and the Atlantic seaboard from Gaspé Peninsula and Nova Scotia south to Virginia and the highlands of North Carolina, South Carolina, and Georgia; west to Turtle Mountains, N. Dak., and eastern parts of South Dakota, Nebraska, Kansas, and Oklahoma. (Fig. 1.)

The western chipmunks (Eutamias) occupy practically all of western North America west of the Plains, from central Yukon and southern Mackenzie south to south-central Lower California (lat. 25° 30′) and northwestern Durango; west to the Pacific coast of United States; east to eastern Ontario, Wisconsin, North Dakota, South Dakota, eastern Colorado, New Mexico, extreme western Texas, and the northwestern corner of Oklahoma. (Fig. 1.)

The ranges of the two groups overlap in southern Ontario and northern North Dakota, Minnesota, Wisconsin, and Michigan.[5]

LIFE HISTORY

HABITAT

The eastern chipmunks (Tamias) are largely ground dwellers, and although they can climb trees they rarely do so. Indeed, in many localities, they are commonly called "ground squirrels." Their favorite habitats are wooded hillsides or mountain slopes, especially about bluffs or ravines where rocks abound; they are partial also to stone walls and rail fences but rarely leave their protecting shelter for any distance to enter adjacent fields. Though usually preferring dry upland timber, they are occasionally found in moist bottom-land woods. Probably food and shelter are the most important factors in their choice of a habitat. Community life is not strongly developed in the chipmunks as it is in the prairie dogs or the true ground squirrels, but the animals often associate in family groups, and in winter

[3] For the loan of material used in this study the author desires to extend thanks to the owners and custodians, as follows: H. E. Anthony, of the American Museum of Natural History; Witmer Stone, of the Academy of Natural Sciences of Philadelphia; Samuel Henshaw, formerly of the Museum of Comparative Zoology, Harvard University; Joseph Grinnell, of the Museum of Vertebrate Zoology, University of California; W. H. Osgood, of the Field Museum of Natural History; W. E. Clyde Todd, of the Carnegie Museum; J. D. Figgins, of the Colorado Museum of Natural History; W. L. Burnett, of the Colorado Agricultural College; C. D. Bunker, of the Kansas University Museum; Dayton Stoner, formerly of the University of Iowa; Myron H. Swenk, of the University of Nebraska; Lee R. Dice, of the University of Michigan; George Wagner, of the University of Wisconsin; M. H. Spaulding, of the Montana State College; Albert H. Wright, of Cornell University; R. M. Anderson, of the National Museum of Canada; F. Kermode, of the Provincial Museum of British Columbia; Elon H. Eaton, of Geneva, N. Y.; Morris M. Green, of Ardmore, Pa.; Miss Edith Hardin, of Pullman, Wash.; Arthur H. Helme, of Miller Place, N. Y.; A. Brazier Howell, of Baltimore, Md. (whose collection has now become the property of Donald R. Dickey, of Pasadena, Calif.); John C. Phillips, of Wenham, Mass.; Kenneth Racey, of Vancouver, British Columbia; W. E. Saunders, of London, Ontario; E. T. Seton, of Greenwich, Conn.; J. Dewey Soper, of Edmonton, Alberta; R. C. Tate, of Kenton, Okla.; and Edward R. Warren, of Colorado Springs, Colo.

[4] RIDGWAY, R. COLOR STANDARDS AND COLOR NOMENCLATURE, 1912.

[5] The genus Eutamias occurs also in Asia, but by reason of the lack of adequate material available for study, the Old-World species are not considered in this report; none of them bears close resemblance to any American species.

several individuals may be found occupying the same den and subsisting on a common store of provisions.

Although less sprightly and agile than many of the western chipmunks (Eutamias), the eastern chipmunks at times display marked vivacity and when frightened can cover the ground at a lively pace. As a rule they are rather shy and secretive in their habits, and when frightened are apt to seek shelter in a burrow or the crevices of a stone wall.

The western chipmunks (Eutamias) vary considerably in habits and habitat, but in general they are more agile and sprightly than

FIGURE 1.—Distribution of the genera Tamias and Eutamias in North America

the eastern chipmunks (Tamias) and most species are decidedly more arboreal. They are also less shy and more often seen abroad.

No chipmunks are found in the more arid deserts of the Southwest, with the exception of *Eutamias merriami meridionalis*, found in the deserts of Lower California, but practically every "niche" in the vast area from the Rocky Mountains and the plains of western North Dakota to the Pacific coast is filled by one or more species. Some occupy the sage-covered plains; others live in the chaparral or brush-covered slopes of mountains and foothills; some prefer the open yellow-pine forests, others the heavy, dark, moist timber of the Pacific coast belt; rocky hillsides or canyons overgrown with berry-

bearing bushes are favorite resorts for many species; while a few species live at timberline and above, apparently with as much success as those that occupy more salubrious regions.

Although never so completely arboreal as the tree squirrels (Sciurus), many species of Eutamias climb trees easily and frequently. The members of the *quadrivittatus* group are perhaps the best climbers, and individuals of this group often ascend large trees to a height of 40 or 50 feet and gather cones or fruits from the branches.

The members of the *townsendii* group are also semi-arboreal, climbing with great facility through underbrush and often ascending trees to a considerable height. Members of the other groups (*minimus*, *amœnus*, and *alpinus*) are in general more strictly terrestrial, but all on occasion may be seen in trees.

BURROWS AND NESTS

The eastern chipmunks spend a large part of their lives in burrows, which they dig for themselves, often beneath a rock, a stone wall, the roots of a tree, or a building. The entrance holes are small and inconspicuous, and there is rarely any earth thrown out about the used doorways. This is accomplished, apparently, by digging the burrow in some thicket or sheltered place and, after it is completed, closing up the original opening and making another entrance at the other end where it reaches the surface. Vernon Bailey excavated a chipmunk burrow at Elk River, Minn., July 4, 1920, which he found to be about 20 feet in length and from 1 to 3 feet below the surface. It had several branches and openings and four or five storage and nest cavities. A large old nest about 18 feet from the entrance, composed mainly of oak leaves, rested on a foundation of stored food supplies, consisting of about 8 quarts of the previous year's acorns, a pint of old moldy corn, and a handful of the previous year's hazelnuts. This cavity would have held about a bushel. A smaller storage chamber at one side of the burrow contained a handful of freshly stored corn and about a pint of the previous year's acorns. At one side and about a foot below the nest cavity was a much-used toilet; the nest and storage chambers were clean and sweet.

All species of Eutamias, so far as known, dig burrows either in the ground or in old logs, but little is known of the details of their construction. Mearns states (1907, p. 286) that the young [of *cinereicollis*] are brought forth in nests of dry grass and similar material placed at the end of their burrows and mentions seeing the chipmunks early in June carrying immense loads of dry grass into the burrows.

Miller (1897, p. 31) describes a burrow of *E. minimus borealis* that he examined at Peninsula Harbor, Ontario, as follows:

> On October 23, I found an adult female in a nest built of feathers and soft vegetable fibers at the end of a tunnel under a clump of bearberry. The tunnel was about 2 feet long and terminated a foot or more beneath the surface in a chamber about the size of a cocoanut. This chamber was completely filled by the nest, which contained, in addition to its occupant, a small store of seeds of various weeds and wild fruits.

STORAGE OF FOOD

All through the summer and especially early in the fall the eastern chipmunks are busy gathering food materials, which they carry to their dens in their capacious cheek pouches.

Audubon and Bachman (1846, vol. 1, p. 69) record a specimen taken in Louisiana that had 16 chinquapins in its pouches and another that held about 1½ tablespoonfuls of bush-trefoil seeds.

Vernon Bailey has found 25 kernels of corn in the pouches of one individual and also reports instances of finding 17 hazelnuts in the pouches of one and 7 large jack-oak acorns in another. Hahn (1909, p. 473) records finding 145 grains of wheat in the pouches of a chipmunk of this genus (Tamias).

A specimen taken in North Dakota and examined in the Bureau of Biological Survey contained 96 fruits of the basswood (*Tilia americana*) besides a quantity of seeds of wheatgrass (Triticum) and wild oats (Avena). Two specimens taken in Fairfax County, Va., contained, respectively, 47 and 48 snails (*Pomatiopsis lapidara*).

Kennicott (1857, p. 72) found over half a bushel of hickory nuts and acorns in a burrow that he opened in November; Bachman opened one in January and found "about a gill of wheat and buckwheat in the nest; but in the galleries we afterward dug out, we obtained about a quart of the beaked hazelnuts (*Corylus rostrata*), nearly a peck of acorns, some grains of Indian corn, about 2 quarts of buckwheat, and a very small quantity of grass seeds" (Audubon and Bachman, 1846, vol. 1, p. 70). Rowley (1902, p. 39) records a burrow examined in May that contained about a peck of chestnuts, cherry pits, and dogwood berries. Vernon Bailey dug out a burrow in Herkimer County, N. Y., September 23, 1921, in which he found about a peck of stored food, chiefly ripe berries and seeds of arrow-wood (*Viburnum dentatum*) with smaller quantities of cherry pits, bunchberries (*Cornus canadensis*), and bellwort (Uvularia) seeds. The nest cavity, which was about 3 feet below the surface and 7 feet from the entrance, was about the size of a half-bushel measure. The nest was a large ball of soft, dry leaves in the center of the cavity, and around and under the nest was packed the store of berries and seeds.

The western chipmunks (Eutamias) apparently store food for winter in much the same manner as the eastern chipmunks (Tamias), but very little is known about the construction of their storage chambers or the quantity of food stored. Some species—perhaps all—store food in small caches beneath old logs, in rock piles or crevices of cliffs, or in sand at the base of a shrub. Swarth states (1919, p. 408) that *Eutamias alpinus* in making these caches digs a hole and after putting in the food replaces the dirt dug out. The capacity of these chipmunks for transporting food is indicated by many records of the contents of their cheek pouches, some of which are as follows: 264 seeds of buckbrush (Ceanothus); 112 cherry pits (*Prunus emarginatus*); 92 seeds of buffalo berry (*Lepargyrea canadensis*); 162 cactus seeds; 290 currant seeds; 710 seeds of a sedge (Carex); 1,150 of a grass (Stipa); 1,440 of cinquefoil (Potentilla); 1,650 of cranberry (Oxycoccus); and 2,100 of speedwell (Veronica).

HIBERNATION

The extensive storing of food by the eastern chipmunks in their dens and the fact that they do not become noticeably fat in autumn point to the conclusion that they remain more or less active during the winter, and the rather scanty recorded observations mainly bear

out this conclusion. Bachman, describing chipmunks taken from a den that he opened in January under 5 inches of snow, says:

> They were not dormant, and seemed ready to bite when taken in the hand; but they were not very active, and appeared somewhat sluggish and benumbed, which we conjectured was owing to their being exposed to sudden cold from our having opened their burrow. (Audubon and Bachman, 1846, vol. 1, p. 70.)

Kennicott (1857, p. 72) also opened a chipmunk's burrow in Illinois in November and found the single occupant active. C. C. Abbott dug out a nest of this species in New Jersey on November 3 and

> found four chipmunks very cozily fixed for winter, in a roomy compartment, and all of them thoroughly wide awake. Their store of provisions was in a smaller room or storehouse immediately adjoining, and consisted wholly of chestnuts and acorns; and the shells of such of these nuts as had been eaten were all pushed into one of the passages, so that there might be no litter mingled with the soft materials that lined the nest. (Abbott, 1884, p. 62.)

On another occasion, however, Doctor Abbott found two chipmunks actually dormant. Of these, he says (1884, p. 59):

> A pair that I dug out in March, having two days before reentered their winter quarters and become quite torpid, were apparently lifeless when first taken up in the hands, and it was not until after several hours' warming that they became lively and altogether like themselves.

A note by Wirt Robinson confirms this observation of Doctor Abbott and proves conclusively that the eastern chipmunk sometimes becomes wholly dormant in winter. Doctor Robinson says (1923, p. 257):

> At this place, West Point, N. Y., on March 15, 1907, the weather very cold and the Hudson River still frozen over, on my way to my office, I passed some workmen who were moving a large bowlder which was threatening to slide down into the roadway. As they rolled it over, I saw underneath it the galleries of some small animal and, in one corner, a ball of dried leaves. On opening this, I found inside a chipmunk, tightly coiled up, eyes closed, cold to the touch and stiff and rigid. I moved it to another spot, placed it where the sun would strike it, and covered it with some dry leaves. Two hours later I returned and found it with its eyes open, but still stiff and unable to move. I put it in my overcoat pocket which I hung up in the warm building for an hour or so and forgot about the chipmunk. In putting on the coat later, I slipped my hand into my pocket and the chipmunk promptly bit me severely, its incisors passing through my finger nail. When I reached a suitable spot, I released it and it scampered off, now perfectly alert.

Seton states (1909, p. 363) that a specimen kept in captivity at Toronto was active all winter while in a warm room, "but as soon as exposed to a temperature near freezing point, he curled up in his sleeping place and took no further interest in the affairs of life."

The date in fall when the chipmunks retire permanently into their burrows varies with the latitude and with the weather. At Cayuga Lake, N. Y., the last one seen in fall was on November 26 (1906) and the first in spring on February 26 (1905) (Reed and Wright, 1909, p. 454). At Lake Maxinkuckee, Ind., Evermann and Clark (1911, p. 8) observed a chipmunk that had its burrow beneath their cottage, and noted its disappearance on November 27, 1900, and its reappearance (the same individual) on March 20, 1901.

In the Southern States, the chipmunks apparently are more or less active above ground all winter. Specimens have been taken in Pike County, Ark., December 17 and 23 and January 28 and 31, and at Washington, D. C., individuals are occasionally seen abroad during warm spells throughout the winter. They sometimes emerge from

their burrows in winter, even in the North, but these appearances are rare, and the animals soon retire again to await the coming of spring. Mearns states that he shot a chipmunk on the snow in Lewis County, N. Y., in January, 1878, and another at Circleville, Ohio, December 4, 1880, during very cold weather, with snow on the ground. (Mearns, 1898, p. 339.) Vernon Bailey saw one out on the snow at White Sulphur Springs, W. Va., on January 24, 1897.

As with the eastern chipmunk, very little is on record concerning the hibernating habits of the various species of Eutamias. In the North, the chipmunks disappear during the colder months and hibernation is probably complete in regions where snow lies all winter. In the South, however, and in some places on the Pacific coast, they are active all winter. All the species are hardy and do not retire to their winter quarters until late in fall, after snow and freezing weather have set in.

In the Bitterroot Valley, Mont., Bernard Bailey reports the chipmunks as disappearing about the last week in November and coming out in spring between the 10th and 20th of March. In the Yellowstone Park, M. P. Skinner saw the first (*luteiventris*) in spring on March 22 and the last in fall on November 3. E. A. Preble reports a chipmunk seen on the snow near the mouth of Liard River, Mackenzie, October 25, 1903, and G. G. Cantwell reports *Eutamias affinis* active on November 9 at Republic, Wash., after the ground was well frozen. J. B. Flett reports seeing a chipmunk (*caurinus*) at Longmire, Mount Rainier, Wash., on February 14, 1920, and another (*cooperi*) two days later.

With the return of cold weather, about a week later, both disappeared and neither was seen until March 31, when the little *caurinus* appeared in the worst storm of the season. This individual ate until his cheeks were puffed out, then went back to sleep, and came out the third time on April 13.

Nelson and Palmer found *E. palmeri* active the middle of February at an altitude of 8,000 feet on Charleston Peak, Nev., while snow lay a foot deep in the canyons. At Twining, N. Mex., *E. quadrivittatus* disappeared early in December, but at Cienequilla, N. Mex., the species was seen throughout the winter. At Kenton, Okla., according to R. C. Tate, chipmunks usually disappear between October 15 and November 1.

Records of finding these chipmunks in a dormant condition are very few. C. P. Streator, while at Agassiz, British Columbia, was informed by a man employed on the Dominion Experimental Farm that about November 20, 1895, while leveling some knolls with a scraper, a chipmunk (probably *Eutamias felix*) was unearthed with its nest and winter store, consisting of about a pint of hazelnuts. The animal would move about a little when teased, but when let alone would lie down and curl up.

Alexander Walker (1923, p. 257) gives an account of finding one of the western chipmunks in a torpid condition in its nest. Mr. Walker says:

On January 2, 1920, while removing a very large decayed spruce stump from a beach lot at Netarts, Tillamook County, Oreg., I examined the winter quarters of an Oregon chipmunk (*Eutamias townsendii*). The nest chamber, situated about 5 feet above the ground and 1 foot from the outside of the stump, was well filled with dry grasses and moss. No supply of food was found in the vicinity of this nest. The occupant of the nest was dormant and lay curled up so cold and stiff that it could hardly be straightened. It was carried several miles in a box, but did not become active until, some hours after being removed from the nest, it was placed in a warm room. Later in the day it escaped.

A ranchman living near Sundance, Wyo., reported to Vernon Bailey that he had several times found chipmunks in haystacks in winter, curled up and apparently dead; and loggers at Shelton, Oreg., report finding them in winter asleep in logs and dead trees.

A. W. Anthony (1924, p. 76) describes his discovery of several dormant Townsend's chipmunks late in winter near Portland, Oreg., as follows:

> The animals had selected a sloping hillside and were deep under large fir stumps. Each nest was a small bunch of shredded vegetable fiber, in the center of which the chipmunk was curled, the tail covering the head and as far along the spine as it might reach. Hibernation was complete, the animal being stiff and cold, the flesh almost as if it might be frozen. There was no food either in the nest or in the earth under the stump, so far as could be discovered by human hands. The entire stump was uprooted before we finished the job. No two chipmunks were found under the same stump, nor, as I recall, near enough to be considered "neighborly," though all were on the same hillside and under similar conditions.

W. P. Taylor reports an instance of the effect of cold on a chipmunk that was captured alive at Owyhigh Lakes, Mount Rainier National Park, Wash., on August 9, 1919. When brought into camp the chipmunk was placed in a box for safe-keeping. The next morning it was curled up in the form of a sphere, its respiration was very slow, and its body was stiff and cold. On being placed where it could warm up slowly, it partially came out of its torpor, its respiration increasing in speed and its circulation being somewhat restored. During the awakening process its whiskers vibrated and it trembled all over.

BREEDING

The mating period of the eastern chipmunk is not definitely known but doubtless extends over a considerable period, beginning early in spring. A female specimen taken by Vernon Bailey in Marquette County, Mich., on March 30, 1907 (the first individual seen that season), contained small embryos; in Westchester County, N. Y., Rowley opened a burrow on May 10 and found five young chipmunks more than half grown. (Rowley, 1902, p. 39.) Half-grown young, accompanying their parents, may also be seen throughout the summer and until the middle of October.

In the Bitterroot Valley, Mont., females (of Eutamias) carrying large embryos were taken on April 12 and young were seen abroad on April 17. In the Panamint Mountains, Calif., pregnant specimens were obtained on April 3, 18, and 19; at Shelton, Wash., females containing embryos were collected on April 15 and 18. At Canyon City, Colo., a specimen containing six embryos was taken on June 14, 1893.

The young in both genera vary from four to six in number and the females have four pairs of mammæ, arranged as follows: Pectoral, $\frac{1}{1}$; abdominal, $\frac{2}{2}$; inguinal, $\frac{1}{1}$.

VOICE

The common note of the eastern chipmunk is a rather low-pitched *cluck* or *chuck*, which at times is repeated rapidly and gives the suggestion of a song. Seton (1909, p. 46) describes an instance of a chipmunk repeating these notes without ceasing for a period of 11 minutes at the rate of 130 chirps to the minute. Another note is a higher-pitched *chip*, which much resembles the alarm note of the hooded warbler (*Wilsonia citrina*). When frightened and about to

dive into its burrow the chipmunk utters a rapidly trilled whistle accompanied by a nervous twitching of the tail.

The notes of the western chipmunks are similar in general to those of the eastern chipmunk but vary considerably among themselves. The common alarm note is a sharp chipper varying in pitch and intensity in different species; the other common note is a low clucking, which in some species is described as a "hollow barking note" (Swarth). Hollister compared the notes of *Eutamias sonomæ* with those of the brown towhee (*Pipilo fuscus*), and Townsend, the discoverer of the species bearing his name, says the clucking note of that species resembles a note of the dusky grouse *(Dendragapus obscurus)* so closely that he had more than once been deceived by it.

FOOD

The food of the eastern chipmunk comprises a considerable variety of nuts, fruits, grains, and other vegetable matter, with a small percentage of animal matter. The various nuts are probably most frequently eaten, these including acorns, hazelnuts, beechnuts, hickory nuts, chestnuts, and chinquapins. Corn is consumed in some quantities and wheat and oats less frequently. Wild fruits and berries furnish a considerable part of the chipmunk's diet; those commonly eaten include strawberries, raspberries, blueberries, gooseberries, wild cherries, and the fruit of the Virginia creeper (Parthenocissus), arrowwood (Viburnum), dogwood (Cornus), basswood (Tilia), sweet gum (Liquidambar), prickly-ash (Xanthoxylum), and red maple (*Acer rubrum*). Seeds of various weeds and grasses are frequently eaten, and wintergreen berries, according to C. E. Brown (1913, p. 18), furnish a favorite food early in spring in Massachusetts. Mushrooms are mentioned by Mearns as one of the chipmunk's food items.

Animal matter apparently forms a very small percentage of the total food. Land snails and insect larvæ and pupæ are eaten not infrequently, and solitary instances are reported of a chipmunk eating a salamander, a frog, and a snake. Attacks upon birds or their eggs apparently are rare, but a few cases are recorded of this objectionable habit. Bachman narrates an instance of a chipmunk devouring young robins in the nest (Audubon and Bachman, 1846, vol. 1, p. 69), and Forbush (1904, p. 505) reports another instance of a chipmunk observed in the act of destroying young birds in the nest. William Brewster once saw a chipmunk pursue and kill a wounded wood thrush *(Hylocichla mustelina)* and greedily eat its brains. (Seton, 1909, vol. 1, p. 355.)

The food habits of Eutamias are similar to those of the eastern chipmunks (Tamias), but since many of the species live in more or less open country where nuts are not obtainable, they take a larger percentage of wild berries and seeds. Wherever nuts are available, however, they form an acceptable food supply. Acorns, hazelnuts, chinquapins, and walnuts are frequently found in the pouches of specimens collected; pinyon nuts are a favorite food, as are the seeds of most of the conifers—pines, spruces, firs, tamarack, and hemlock. Merriam (1891, p. 44) mentions finding 332 seeds of the lodgepole pine (*Pinus murrayana*) in the pouches of a specimen of *Eutamias amœnus* taken in Idaho.

Wild fruits of many kinds are eaten by these chipmunks and form one of the most important items in their food supply. The kinds most frequently taken are currants, gooseberries, raspberries, blackberries, huckleberries, buffalo berries (Lepargyrea), wild cherries, manzanita berries (Arctostaphylos), service berries (Amelanchier), elderberries, dogwood berries (Cornus), hackberries (Celtis), and juniper berries. Cactus fruit is eaten when available, and E. A. Goldman records a specimen taken at Redrock, N. Mex., the stomach of which was filled with the soft red pulp of this fruit. Whenever fleshy fruits are eaten, the seeds are apparently removed and carried in the pouches to the storage chamber.

The foliage and flowers of certain plants are sometimes eaten, such as dandelion blossoms, willow buds, and the flowers and tender tips of sagebrush and rabbit brush (Chrysothamnus). Mushrooms, camas bulbs, and bulbs of Epilobium and Polygonum are occasionally consumed.

Following is a partial list of the varieties of seeds stored and eaten by chipmunks, identified by members of the Bureau of Biological Survey staff from cheek pouches examined either in the field or laboratory: Blueberry (Vaccinium), western cranberry (Oxycoccus), raspberry, manzanita (Arctostaphylos), currant (Ribes), chinaberry (Melia), sumac (Rhus), honeysuckle (Lonicera), maple (Acer), rose, wild crab apple, chokecherry, wild red cherry (*Prunus pennsylvanica*), buck brush (Ceanothus), mountain mahogany (Cercocarpus), Purshia, mesquite (Prosopis), cactus, sagebrush (Artemisia), lupine, violet, thistle, aster, sunflower, plantain, ragweed (Ambrosia), bindweed (Polygonum), dock (Rumex), beardtongue (Pentstemon), geranium, dayflower (Commelina), speedwell (Veronica), Potentilla, greasewood (Sarcobatus), and a number of species of wild grasses.

Insects are frequently eaten by these chipmunks, but apparently they are never placed in the cheek pouches; the few stomachs examined showed a considerable percentage of insect remains, some containing no vegetable food at all. The insects identified were beetles, grasshoppers, and caterpillars.

At Halleck, Nev., in June, 1893, Vernon Bailey found the sage chipmunk (*Eutamias m. pictus*) feeding extensively on the larvæ and pupæ of a webworm that was stripping the sagebushes. Several stomachs examined contained little else but these insects, and Mr. Bailey estimated that the caterpillars formed about 60 per cent of the chipmunk food at that time.

Attacks by these chipmunks on birds or their nests have rarely been recorded. Grinnell (1908, p. 139) mentions an instance of *E. speciosus* seen destroying the eggs in the nest of a wood pewee (*Myiochanes richardsoni*) placed 10 feet up in a pine tree and 6 feet out from the trunk on a limb. A few other similar instances are on record.

ECONOMIC STATUS

The eastern chipmunks occasionally damage grain in the fields and dig up and eat corn and other planted seeds, but in the main their habits in relation to agriculture are neutral. The western chipmunks, living as they do largely in mountains and the wilderness, remote from agricultural sections, also are mainly neutral in their relation to man's interests. Occasionally, however, where their habitat borders on cultivated fields, they do some damage locally to crops. In some

localities they are reported to be destructive to grain, especially oats, in the shock. Standing wheat is sometimes injured, the stems being bent down and the heads cut to be eaten or carried by the chipmunks to their storehouses. They sometimes prove troublesome on areas that have been planted for reforestation by eating the tree seeds. If chipmunks are abundant in regions where forest planting is being carried on they frequently eat or carry off a good share of the planted seeds and it has been found necessary, in order to insure a successful stand, first to reduce the numbers of chipmunks by trapping or poisoning. Under natural conditions they apparently have no harmful effect on forest growth.

In the coast region of Oregon, the fondness of the large chipmunks (*E. townsendii*) for plums and prunes has compelled the ranchers to adopt measures to keep the animals from climbing the trees.

KEY TO GENERA AND SUBGENERA

a.[1] Upper premolars 2; dorsal stripes unequally spaced (median stripe bordered on either side with a much broader band) ---------- Genus Tamias (p. 11).

a.[2] Upper premolars 4; dorsal stripes equally spaced (all of approximately equal width) ---------- Genus Eutamias (p. 23).

b.[1] Antorbital foramen suborbicular; postorbital processes broad at base ---------- Subgenus Eutamias (p. 26).

b.[2] Antorbital foramen narrowly oval; postorbital processes narrow at base ---------- Subgenus Neotamias (p. 26).

Genus TAMIAS Illiger

Sciurus Linnæus, Syst. Nat. 1: 63–64, ed. 10, 1758 (part).
Tamias Illiger, Prod. Syst. Mamm. et Avium, p. 83, 1811.

HISTORY AND NOMENCLATURE

The eastern chipmunk was mentioned by several of the early writers, even in the seventeenth century, but was first accurately described and figured by Catesby, in his History of Carolina (1743, p. 75) under the name *Sciurus striatus*. Linnæus, in 1754 (p. 8), and again in 1758 (p. 64) adopted this name, basing his description on a specimen in the collection of King Frederic Adolphus of Sweden and on the accounts of Catesby, Edwards, and Kalm, all of which refer exclusively to the American chipmunk. In his twelfth edition (1766) he included Siberia in its range, confusing (as did several later writers) the very distinct Siberian chipmunk, which belongs to the genus Eutamias, with the North American Tamias.

Schreber (1785, vol. 4, p. 791) divided the species (as then understood) into two varieties, "*Das asiatische*" and "*Das americanische*," citing the Old World references under the former and the New World references under the latter.

Gmelin (1788, vol. 1, p. 150) adopted Schreber's classification, and bestowed the name *americanus* on the American form. This name was used by numerous writers during the first half of the nineteenth century, while others continued to use *striatus*. It is, of course, a pure synonym of *striatus*, having exactly the same basis.

Illiger (1811, p. 83) first proposed the generic name Tamias for the American chipmunk, thus definitely separating it from the arboreal squirrels.

Richardson (1829, vol. 1, p. 181) proposed a new name, *Sciurus (Tamias) lysteri*, for the northern form of the animal, and this name was used by numerous later authors for the species as a whole until Baird (1857b, p. 295) pointed out that *striatus* of Linnæus, having been based wholly on a specimen of the eastern chipmunk, was the proper name of the species.

The species was undivided until 1886, when Merriam (1886b, p. 242) pointed out the characters distinguishing the northern race, and revived Richardson's name *lysteri* for it. The northwestern race (*griseus*) was described by Mearns (1891, p. 231) and the southwestern race by Bangs (1896, p. 137). Another eastern race (*fisheri*) has recently been described (Howell, 1925, p. 51).

GENERIC CHARACTERS

Skull relatively long and narrow; brain case slightly flattened (less inflated than in most American species of Eutamias and much shallower than in Ammospermophilus); lambdoidal crest well developed; frontoparietal region relatively broad; interorbital constriction narrow; postorbital processes broad at base and rather short; temporal region slightly convex (not flattened); rostrum broad at base and narrowing evenly from base to tip, its dorsal surface evenly convex (not flattened), zygomata rather weak, evenly curved and not widely expanded; notch in posterior edge of zygomatic plate of maxillary opposite pm^4 or anterior edge of m^1; palate relatively long, ending considerably behind plane of last molars; incisive foramina small and narrow; antorbital foramen large, suborbicular, piercing the zygomatic plate of the maxillary; audital bullæ relatively small; upper incisors with shallow and indistinct striations or with none; upper tooth rows slightly convergent posteriorly; molars rather weak, with very low crowns, the cusps on outer border widely spaced; metaconules usually undeveloped or very small, on both upper and lower molars; last lower molar about same size as m_2; transverse enamel folds on m^1 and m^2 usually continuous (without sulcus); dentition: $i, \frac{2}{2}$; $pm, \frac{2}{2}$; $m, \frac{6}{6} = 20$.

The skull of Tamias shows resemblances to both the Asiatic and American members of Eutamias. It has heavier postorbital processes than Neotamias—more nearly like those of typical *Eutamias asiaticus* but longer; it agrees also with the latter in having large suborbicular antorbital foramina and a well-developed lambdoidal crest, but differs from it in having a much longer palate—longer than in Neotamias.

EXTERNAL CHARACTERS

Form sciurine, the body rather stout; ears prominent, rounded at the summit; tail slightly more than one-third the total length, somewhat flattened, well haired but not bushy; front feet with five toes, the first rudimentary, covered with a broad, flattened nail, the others furnished with sharp recurved claws; third and fourth toes longest, nearly equal, the second and fifth shorter; palms naked, with five tubercles—three at the bases of the toes and two larger ones on the posterior palm; hind feet with five toes, the three middle ones longest and nearly equal, the fifth considerably shorter and the first still shorter, but fully developed and functional; soles hairy

nearly to the bases of the toes; with four tubercles on the end of the metatarsus, between the bases of the toes; cheek pouches large, opening inside the mouth anterior to the molars and extending back to the posterior base of the ears. Weight varying from 65 to 107 grams.

The baculum of *Tamias striatus* is a slender bone 4.5–5 millimeters in length, nearly straight, but upturned at the tip and slightly expanded into the shape of a narrow spoon or scoop, with a slight median ridge on the under surface.

COLOR PATTERN

The dorsal surface in Tamias is marked by five blackish and two whitish longitudinal stripes; a median blackish stripe extends from the occiput to the posterior back or to the rump, this bordered on either side with a band of gray or tawny about twice the width of the median stripe; on either side of these dorsal bands are a pair of shorter blackish stripes with a whitish stripe between them.

PELAGE AND MOLT

The pelage in the eastern chipmunks is of moderate length, and of a soft texture; the bases of the hairs are plumbeous (this color wholly concealed by the tips unless in much worn pelage) except on the ventral surface, where the hairs are unicolor to the base—white or buffy white. One complete albino has been examined from Saylorsburg, Pa.

Apparently there is but one annual molt, which occurs usually in June or July. Very few molting specimens have been found in the material examined, but these indicate that the new hair appears in irregular patches over the whole dorsal surface. A specimen from Lake George, N. Y., June 28, 1894, shows patches of the new pelage on the crown, sides of face and neck, and sides of body in front of the hips. Another from the same locality, July 2, 1892, shows a similar condition, except that the new pelage is coming in irregularly along the entire sides.

A specimen from Milton, Wis., July 26, 1907, is in fresh summer pelage; another, same date, is still in worn winter pelage, new hair coming in on the anterior part of belly and throat and on the cheeks and forehead. The winter pelage apparently is the same pelage worn in summer, but somewhat paler as a result of fading and wear. This effect is usually rather pronounced by March or April and often excessive by June. Occasional specimens taken in April, however, show little wear and are only slightly paler on the sides than specimens of the same race in full summer pelage.

LIST OF SPECIES AND SUBSPECIES OF TAMIAS WITH TYPE LOCALITIES

Tamias striatus striatus (Linnæus)	Upper Savannah River, S. C. (p. 14).
striatus fisheri Howell	Merritts Corners, near Ossining, N. Y. (p. 16).
striatus lysteri (Richardson)	Penetanguishene, Ontario (p. 18).
striatus griseus Mearns	Fort Snelling, Minn. (p. 20).
striatus venustus Bangs	Stilwell, Adair County, Okla. (p. 21).

KEY TO SUBSPECIES OF TAMIAS STRIATUS

a.[1] Cheeks very dark (ochraceous tawny); light dorsal stripes strongly tinged with buff ---------- *striatus* (p. 14).
a.[2] Cheeks paler (cinnamon buff); light dorsal stripes not strongly tinged with buff (usually whitish).
b.[1] Size larger (greatest length of skull, 40 to 44 mm.).
c.[1] Tawny color of rump deeper, extending to hinder back ---------- *venustus* (p. 21).
c.[2] Tawny color of rump paler, not extending to hinder back ---------- *griseus* (p. 20).
b.[2] Size smaller (greatest length of skull 38 to 41 mm.).
c.[1] Colors paler (especially the rump and grayish dorsal bands) ---------- *lysteri* (p. 18).
c.[2] Colors darker ---------- *fisheri* (p. 16).

TAMIAS STRIATUS STRIATUS (LINNÆUS) [6]

SOUTHEASTERN CHIPMUNK

(PLS. 3, A; 7, A)

[*Sciurus*] *striatus* Linnæus, Syst. Nat. 1: 64, ed. 10, 1758.
Myoxus striatus Boddært, Elenchus Animal. 1: 122, 1784.
[*Sciurus striatus*] *americanus* Gmelin, Syst. Nat. 1: 150, 1788.
Tamias americana Kuhl, Beitrage zur Zoologie, p. 69, 1820.
Sciurus americanus Fischer, Synopsis, p. 349, 1829.
Tamias striatus Baird, 11th Ann. Rept. Smithsonian Inst., 1856 [1857], p. 55; Mamm. North Amer. (Pacific R. R. Reports, vol. 8), p. 292, 1857.

Type.—None designated; type locality, upper Savannah River, S. C.[7]

Geographic distribution.—Southeastern United States, from highlands of North Carolina, South Carolina, Georgia, and central Alabama west to the Mississippi River in Kentucky and Tennessee; north to the Ohio Valley in Kentucky. (Fig. 2.)

Characters.—Size medium (for the species); colors dark, the head and rump very dark (auburn or bay); sides of body and face deep cinnamon-buff, and white dorsal stripes usually washed with buff.

Color.—*Winter pelage* (western North Carolina, February to May): Top of head russet or bay; a narrow stripe from nose, above the eye, nearly to the ear, and a somewhat wider stripe from beneath the eye to the ear, cinnamon buff or pinkish buff; broad stripe from eye to ear russet or mars brown often becoming blackish just behind the eye; another broader band of russet extends on the lower face from the nose to base of ear or slightly beyond; borders of lips, lower cheeks, and sides of neck to shoulders, deep cinnamon buff to ochraceous tawny; ears russet or tawny anteriorly, shaded posteriorly with hair brown or drab and edged with dull buffy white; median dorsal bands mixed grayish white and ochraceous buff narrowly bordered on each side with auburn and more or less sprinkled with the same, shading posteriorly into the color of the rump, which is solid auburn or bay; dark dorsal stripes black, the median one becoming auburn anteriorly; light dorsal stripes (one pair) buffy white to cinnamon buff; sides of body light clay color; front feet cinnamon; hind feet tawny or ochraceous tawny, shading on thighs to russet; tail above, fuscous black, sprinkled with pale smoke gray; tail beneath, hazel or tawny, bordered with fuscous black and tipped with pale smoke gray or pale buff; underparts creamy white, more or less washed with pale naples yellow. *Summer pelage* (northern Georgia, September 21): Similar to the winter pelage but averaging slightly darker on dorsal region.

Skull.—Size medium (larger than *lysteri*, smaller than *venustus*).

Measurements.—Average of eight adults from western North Carolina:[8] Total length, 225 (215–230); tail vertebræ, 86.4 (78–96); hind foot, 34.2 (32–36.5);

[6] The characters of the single species in the genus are given under the diagnosis of the genus (p. 12).
[7] Here restricted, as based primarily on Catesby's account. Merriam (Amer. Nat. 20: 238, 1886) states that a specimen in his collection from Sylva, N. C., "may be regarded as the type of *striatus*," but it is obviously impossible to fix the type locality at a point outside the region where Catesby is known to have traveled.
[8] External measurements taken in part from dry skins.

ear from notch, 14.8 (14–16). *Skull:* Average of 11 adults from western North Carolina: Greatest length, 41.1 (39.8–42.6); zygomatic breadth 22.9 (22.1–23.5); breadth of cranium, 17 (16.5–17.6); interorbital breadth, 11 (9.8–12.6); postorbital breadth, 11.4 (10.5–12.4); length of nasals, 14.4 (13.7–16.2).

Remarks.—The southeastern chipmunk is the darkest of all the races. It reaches its strongest development in the Carolina mountains but ranges in nearly typical form over most of the lowlands of the

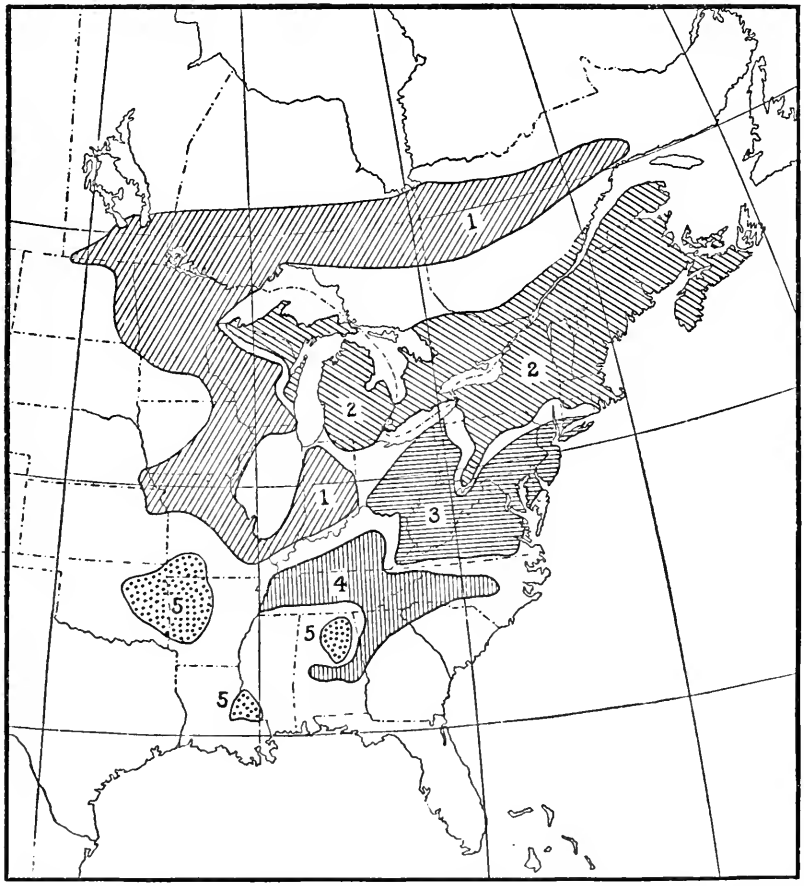

FIGURE 2.—Distribution of the subspecies of *Tamias striatus:* 1, *T. striatus griseus;* 2, *T. striatus lysteri;* 3, *T. striatus fisheri;* 4, *T. striatus striatus;* 5, *T. striatus venustus*

southern States east of the Mississippi River. Its absence from the lowlands of the Carolinas and Georgia is difficult to explain.[9]

In the writer's report on the mammals of Alabama (Howell, 1921, p. 63), the chipmunks of that State were referred to *venustus*, with the statement that they are intermediate between that race and *striatus*. More critical study of the whole group shows the necessity of referring the series from Greensboro, Ala., to *striatus*, since they agree closely in color with typical specimens of that form, the skulls, however, being larger. The chipmunks from the highlands of

[9] Merriam has recorded a specimen from Charleston, S. C. (Amer. Nat. 20: 238, 1886), but this specimen has not been seen by the writer, and some doubt attaches to the correctness of the assigned locality.

Alabama are referred to *venustus*, but additional material is needed from southern Alabama and Mississippi before the relationships of the forms can be satisfactorily determined.

The occurrence of nearly typical *striatus* in northwestern Indiana (Hebron and Mount Ayr) is rather surprising, since *lysteri* is found in southern Michigan and northwestern Ohio.

Two immature individuals from southern Illinois (Olney and Wolf Lake) are provisionally referred to this race. Chipmunks are scarce in that region and are probably absent from most of the prairie sections of the State.

Specimens examined.—Total number, 103, as follows:

Alabama: Greensboro, 6.
Georgia: Young Harris, 3.
Illinois: Olney, 1; Wolf Lake, 1.
Indiana: Bascom, 1; Hebron, 1; Lake Maxinkuckee, 1; La Porte, 1 [10]; Miami County, 2 [11]; Mount Ayr, 1; Wayne County, 1.
Kentucky: Eubanks, 16; Hickman, 6; Lexington, 5; Mammoth Cave, 1.
North Carolina: Buncombe County, 3 [11]; Chapel Hill, 5; Craggy Mountain, 3 [11]; Cranberry, 2 [12]; Highlands, 5; Mount Mitchell Road (5,000 feet alt.), 1; Roan Mountain, 12; Sylva, 1; Weaverville, 14.
South Carolina: Cæsars Head, Greenville County, 1 [12]; Greenville, 1.
Tennessee: Clarksville, 6; Hickman County, 2.

TAMIAS STRIATUS FISHERI Howell

Fisher's Chipmunk

(Pls. 3, E; 7, E)

Tamias striatus fisheri Howell, Journ. Mamm. 6: 51, February 15, 1925.

Type.—Collected at Merritts Corners, 4 miles east of Ossining (Sing Sing), N. Y., August 23, 1884, by A. K. Fisher; ♀ subadult, skin and skull; No. 193370, U. S. Nat. Mus. (No. $\frac{8\,0\,1}{1\,3\,3\,8}$ Merriam collection).

Geographic distribution.—Middle Atlantic States, from the lower Hudson River Valley, N. Y., south to Virginia, West Virginia, and extreme eastern Kentucky; west to Ohio. (Fig. 2.)

Characters.—Similar to *Tamias s. striatus* but coloration paler, especially the rump, feet, and sides of head and body; dorsal area much more grayish (less ochraceous or tawny); light dorsal stripes clearer white (less shaded with ochraceous); head and underside of tail averaging paler. Compared with *T. striatus griseus:* Size smaller; sides of head and body averaging darker; gray of upper parts less extensive and slightly darker (especially in winter pelage); underside of tail slightly darker.

Color.—*Summer pelage* (type, August 23): Top of head russet, shaded with cinnamon; facial stripes cartridge buff; a blackish patch behind the eye; sides of face and neck with a broad, irregular stripe of russet, bordered beneath with cinnamon buff; ears hair brown, shaded on anterior margin with mikado brown and on posterior margin with dull buffy white; median dorsal bands smoke gray, narrowly margined on each side with hazel; median dorsal stripe, extending from a point between the ears nearly to the rump, black; two outer pairs of dark stripes of same color but much shorter; light dorsal stripes creamy white; rump and hinder back hazel; thighs ochraceous tawny; hind feet sayal brown; front feet pinkish cinnamon; sides of head and body cinnamon buff; tail above fuscous black, overlaid with smoke gray; tail beneath, between tawny and russet, bordered with fuscous black and edged with smoke gray; underparts creamy white, washed with pale pinkish buff. *Winter pelage* (March): Very similar to the summer pelage, but rump slightly paler; gray of back more prominent and under side of tail slightly paler.

Skull.—Very similar to that of *Tamias s. striatus* but averaging smaller.

Measurements.—Type (♀ adult): Total length, 257; tail vertebræ, 88 (measured dry); hind foot, 35 (relaxed); ear from notch, 14; average of 10 adults from

[10] Field Mus. Nat. Hist. [11] Mus. Comp. Zool. [12] Amer. Mus. Nat. Hist.

Highland Falls, N. Y.: Total length, 245 (230–283); tail vertebræ, 91.6 (83–97); hind foot, 34.2 (33–35); ear from notch, 15.2 (14–16.5). *Skull:* Average of 10 adults from type locality: Greatest length, 40.1 (38.8–41); zygomatic breadth, 22 (21.4–22.8); cranial breadth, 16.5 (16–17.3); interorbital breadth, 9.9 (9.4–10.4); postorbital breadth, 11.1 (10.2–11.7); length of nasals, 13.5 (12.6–14.3). *Weight:* Average of 16 specimens from Ossining, N. Y., 90.3 grams (65–107).

Remarks.—This race is, of course, intermediate in characters between *striatus* and *lysteri*, but since the characters are well marked and the form has a considerable range, it seems best to separate it as a subspecies. Specimens from as far south as Washington, D. C., and Franklin, W. Va., are practically typical *fisheri*, while those from Redbird, W. Va., show approach to *striatus*.

Specimens from extreme southern New England (Providence, R. I., and Guilford and Plainfield, Conn.), intermediate between *fisheri* and *lysteri*, are referred to the present form. In Pennsylvania and western New York, *fisheri* and *lysteri* both occur, the former in the lowlands, the latter on the mountains, and, of course, many specimens are intermediate in characters.

A series from Garrettsville and Ravenna, Ohio, are typical *fisheri*, as is also a single specimen from Avondale, near Cincinnati, but additional material from western Ohio may throw new light on the distribution of the species in that region.

Specimens examined.—Total number, 322, as follows:

Connecticut: Guilford, 1;[13] Plainfield, 3; Stonington, 4.
District of Columbia: Washington, 28.
Kentucky: Clover Fork, Harlan County, 1.
Maryland: Chevy Chase, 2; Fallston, 3; Laurel, 5; Linden, 1; Long Corner, Howard County, 2; Rockville, 3; Washington Grove, 2.
New Jersey: Newton, Sussex County, 5;[14] Pleasant Valley, 1;[13] Tuckerton, 2; West Orange, 1.[13]
New York: Cornwall, 2;[13] Cold Spring, Dutchess County, 1;[13] Dobbs Ferry, 1; Eastport, 1;[13] Hastings, 6;[13] Hertsdale, 1; Highland Falls, 22; Kiskatom, Greene County, 2;[15] Lake Grove, 1; Lanesville, Greene County, 2; Miller Place, 1;[13] J. P. Morgan's Pond, Orange County, 1; Mount Kisco, 1;[13] Mount Sinai, 1;[13] Nyack, 1;[13] Oyster Bay, 1; Rockaway, 1; Ossining (Sing Sing), 35; South Yonkers, 1;[13] Suffolk County, 1;[13] West Point, 11; White Plains, 1;[16] Yonkers, 1.[13]
Ohio: Avondale, 1;[13] Garrettsville, 3; Ravenna, 6.[13]
Pennsylvania: Allegheny County, 1; Blairsville Intersection, Westmoreland County, 1;[17] Bushkill Creek, 7 miles east of Cresco, 1;[18] Carlisle, 2; Carnot, 1;[17] Chester County, 2; Cresson, 1;[17] Erie, 4;[13] Flowing Spring, Blair County, 1;[17] Greensburg, 4; Harveys Lake, Luzerne County, 3;[18] Holmesburg, 5;[18] Hustontown, 1;[17] Kennett Square, 1;[18] Krings Station, Cambria County, 4;[18] Laughlintown, 7;[17] Leasuresville, 9;[17] Lehigh Gap, Lehigh County, 7;[18] Nazareth, 1; New Paris, 2; Paradise, Lancaster County, 1;[18] Pittsburgh, 1;[18] Riddlesburg, 1;[17] Saylorsburg, Monroe County, 1; Spruce Creek, 1;[17] Summit Mills, 4;[18] Swarthmore, 2;[18] Tyrone, 3;[18] Tuscarora, 9;[18] Waynesburg, 4.[18]
Rhode Island: Providence, 2;[13] Providence County, 2.
Virginia: Bluemont, 1; Falls Church, 5; Fauquier County, 1; Gainesville, 1; Great Falls, 2; Hampstead, 1; Hanover County, 1; Henrico County, 1; Hot Springs, 3; McLean, 1; Mountain Lake, Giles County, 5; Peaks of Otter, 4; Potomac River (opposite Cabin John, Md.), 1; Stony Man Mountain, 1; Suffolk, 1;[13] Washington, 4.
West Virginia: Berkeley Springs, 2; Cold Knob Mountain, 1;[19] Elkins, 1; Franklin, 9; Jobs Knob, 2;[19] Redbird, 2; Travellers Repose, 2; White Sulphur Springs, 11.[20]

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[13] Amer. Mus. Nat. Hist.
[14] Amer. Mus. Nat. Hist., 3; Field Mus. Nat. Hist., 2.
[15] Amer. Mus. Nat. Hist., 1; Field Mus. Nat. Hist., 1.
[16] Nat. Mus. Canada.
[17] Carnegie Mus.
[18] Acad. Nat. Sci. Philadelphia.
[19] Mus. Comp. Zool.
[20] Mus. Comp. Zool., 8.

TAMIAS STRIATUS LYSTERI (Richardson)

Northeastern Chipmunk

(Pls. 1, b; 3, b; 7, b)

Sciurus (*Tamias*) *lysteri* Richardson, Fauna Boreali-Americana 1: 181, pl. 15, 1829.

T. [*amias*] *lysteri* Wagner, Suppl. Schreber's Saugeth. 3: 232, 1843; Audubon and Bachman, Quad. North Amer. 1: 65, pl. 8, 1846.

Tamias striatus lysteri Merriam, Amer. Nat. 20: 242, March, 1886.

Type.—Not designated by number; specimen collected at Penetanguishene, Ontario, in April, 1825.

Geographic distribution.—Southern Ontario, southern Quebec, the Maritime Provinces, New England, New York (except southeastern part), and most of Michigan; south to Ann Arbor, Mich., and in the higher Alleghenies to western Maryland; west to extreme northern Wisconsin (Bayfield County); north to the Ottawa Valley and the Gaspé Peninsula, Quebec. (Fig. 2.)

Characters.—Similar to *Tamias striatus fisheri* but upper parts paler, especially the rump and the median grayish bands.

Color.—*Summer pelage* (Mount Forest, Ontario, July): Top of head between sayal brown and cinnamon; facial stripes rather indistinct, dull whitish, washed with light ochraceous buff; dark facial stripes mikado brown; a blackish patch behind the eye; lower cheeks and sides of neck cinnamon buff; median dorsal bands pale smoke gray, narrowly margined with mikado brown; dark dorsal stripes black; light dorsal stripes creamy white, faintly tinged with buff; sides pinkish buff; rump and thighs light ochraceous tawny, shaded in center with mikado brown; hind feet cinnamon or cinnamon buff; front feet pinkish buff; tail above, fuscous black overlaid with pale smoke gray; tail beneath, mikado brown or pale ochraceous tawny, bordered with fuscous black and edged with pale smoke gray; underparts creamy white. *Winter pelage* (April): Not appreciably different from the summer pelage.

Skull.—Similar to that of *T. striatus fisheri* but averaging smaller, with relatively longer nasals.

Measurements.—Average of 5 adults from Mount Forest, Ontario: Total length, 245.3 (228.6–257); tail vertebræ, 93.8 (84–103); hind foot, 35 (34–36); ear from notch, 15.1 (14–16.5). Average of 10 adults from Mount Mansfield, Vermont: 246.4; 95.6; 35; 14.2. *Skull:* Average of 7 adults from Mount Forest and Emsdale, Ontario: Greatest length, 39.4 (38–40.7); zygomatic breadth, 21.7 (21–22); cranial breadth, 16.7 (16.2–17); interorbital breadth, 10.5 (9.9–11.1); postorbital breadth, 11.4 (10.6–12.2); length of nasals, 14 (13.2–14.4). *Weight:* Average of 10 specimens from Ticonderoga, N. Y., 78.2 grams (65–100).

Remarks.—The northeastern chipmunk is the smallest and palest member of the group. It has an extensive range but shows little variation throughout. Intergradation with *fisheri* takes place in extreme southern New England and at many places in New York and Pennsylvania, where the ranges of the two forms inosculate, *lysteri* occupying the more elevated regions and *fisheri* the lowlands. Specimens from Round Island, Clinton County, Eaglesmere, Sullivan County, and from Mount Pocono are referred to *lysteri*, though not typical; some individuals in the series might as well be called *fisheri*. The present form doubtless intergrades also with *griseus* wherever their ranges meet; intermediate examples have been examined from Burbridge, Quebec,[21] and from near Ishpeming, Mich. In southern Michigan and northwestern Ohio the range of *lysteri* nearly meets the

[21] One example from there is typical *lysteri*, but another closely resembles *griseus*.

range of *striatus*, which occupies northern Indiana, but no evidence of intergradation between these forms has been discovered.

Specimens examined.—Total number, 568, as follows:

Connecticut: Liberty Hill, 1;[22] Portland, 2.

Maine: Dickey, 2; Eliot, 1; Greenville, 2;[22] Kennebago Lake, 2; Penobscot River (east branch), 1; Sebec Lake, 1; South Twin Lake, Penobscot County, 6;[23] Umbagog Lake, 2.

Maryland: Accident, 1;[24] Bittinger, 1; Dans Mountain (4 miles northwest of Rawlings), 1; Finzel, 4; Grantsville, 1.

Massachusetts: Burlington, 3; Easthampton, 2; Essex County, 2; Harvard, 2; Lunenburg, 6; Mount Wachusett, 2; Newton, 2;[23] Rehoboth, 1;[23] Sheffield, 2;[23] Southville, 1; Wareham, 7;[22] Wellesley, 1; Wilmington, 10; Woods Hole, 1.

Michigan: Alger County, 2;[25] Ann Arbor, 18;[26] Brown Lake, 5;[25] Chippewa County, 4;[25] Douglas Lake, Cheboygan County, 6;[27] Escanaba, 1; Fishhawk Lake, Gogebic County, 2;[25] Floodwood, Schoolcraft County, 2;[25] Gogebic Lake, Ontonagon County, 4;[25] Groveland Township, Oakland County, 1;[25] Huron Mountains, 1;[25] Iosco, Livingstone County, 2;[25] Ironwood, Gogebic County (12 miles north), 1;[25] Le Roy, Osceola County, 2;[25] Little Girls Point, Gogebic County, 3;[25] Luzerne, 1;[25] Michigamme, 1; Murphy Lake, 1;[28] Parks Siding, Iron County, 2;[28] Porcupine Mountains, Ontonagon County, 7;[25] Rush Lake, Huron County, 3;[25] Sand Point, Huron County, 3;[25] Seney, 1;[22] Silver Lake (18 miles north of Ishpeming), 1; Warren Woods, Berrien County, 1;[25] Whitefish Point, Chippewa County, 1;[25] Ypsilanti, 1.[25]

New Brunswick: Bathurst, 6;[24] Scotch Lake, York County, 1;[29] Tobique Point, Victoria County, 1;[23] Trousers Lake, 2;[23] Youghall, 9.[24]

New Hampshire: Antrim, 1; Charlestown, 9; Dublin, 1;[22] Ossipee, 12; Webster, 3.[22]

New York: Alder Creek, 3; Ausable Lake, Essex County, 1;[30] Catskill Mountains, 38; Chittinango Falls, 1;[22] Elizabethtown, 7; Essex County, 1; Kaaterskill Junction, 2; Lake George, 16; Lawyersville, 3;[23] Locust Grove, 37; Lyons Falls, 2; Owego, 3; Palensville, 1;[23] Plattsburg, 1; Peterboro, 3; Piseco, 1; Rochester, 1;[30] Stamford, 8;[31] Syracuse, 8; Ticonderoga, 50; Troy, 4; Whitehall, 8.

Nova Scotia: Digby, 15;[22] Halifax, 2;[22] James River, 8; Kedgemakooge, 1; Kings County, 1;[24] Newport, 1.[23]

Ohio: Hicksville, 1.[23]

Ontario: Algonquin Park, 4;[24] Branchton, 3;[23] Cobourg, 2; Constant Bay, 1;[24] Emsdale, 5; Go Home Bay, Georgian Bay, 2;[24] Gravenhurst, 12;[23] Guelph, 1;[24] Kilmarnook Lock, Rideau River, 1;[24] Linwood, 6;[32] London, 3;[29] Lorne Park, 5;[33] Mount Forest, 5;[22] Ottawa, 2;[24] Point Pelee, 3;[24] Richmond, 1;[24] Toronto, 1;[23] Trout Creek, 4;[28] Waterloo County, 1;[28] Long Point, Norfolk County, 2.[34]

Pennsylvania: Clinton County, 1; Eaglesmere, 4;[35] Kane, McKean County, 1;[35] McKean County, 1; Mount Pocono, Monroe County, 4;[35] Round Island, 19;[35] Sayre, 1; Summit, Cambria County, 2;[36] Tamarack Swamp [head of Drury Run, Clinton County], 1;[28] Tyrone, 1.[35]

Quebec: Aylmer, 2;[24] Burbridge, 2;[24] Murray Bay, 13;[28] Percé, Gaspé County, 2;[24] Riviére du Loup, 1;[28] St. Rose, 1; St. Thomas, 1.[24]

Vermont: Brandon, 2; Castleton, 1;[23] Clarendon, 1;[23] Mount Mansfield, 10; North Clarendon, 1;[23] Pico [Peak], 1;[23] Rutland, 2.[23]

Wisconsin: Ellison Bay, 1; Fish Creek, Door County, 2; Herbster, 5; Lake St. Germain, Vilas County, 5.

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[22] Mus. Comp. Zool.
[23] Amer. Mus. Nat. Hist.
[24] Nat. Mus. Canada.
[25] Univ. Mich.
[26] Univ. Mich., 12.
[27] Univ. Mich., 4; Cornell Univ., 2.
[28] Field Mus. Nat. Hist.
[29] Univ. Wis.
[30] E. H. Eaton coll.
[31] Amer. Mus. Nat. Hist., 6; Field Mus. Nat. Hist., 2.
[32] Field Mus. Nat. Hist., 4; Amer. Mus. Nat. Hist., 2.
[33] Amer. Mus. Nat. Hist., 2; Nat. Mus. Canada, 3.
[34] Royal Ontario Mus.
[35] Acad. Nat. Sci. Philadelphia.
[36] Carnegie Mus.

TAMIAS STRIATUS GRISEUS Mearns

Gray Chipmunk

(Pls. 1, a; 3, c; 7, c)

Tamias striatus griseus Mearns, Bul. Amer. Mus. Nat. Hist. 3:231, June 5, 1891.

Type.—Collected at Fort Snelling, Minn., April 2, 1889, by E. A. Mearns; ♀ adult, skin and skull; No. $\frac{21262}{2862}$, Amer. Mus. Nat. Hist.; original number, 791.

Geographic distribution.—Upper Mississippi Valley region, from southeastern Missouri and southern Illinois north to southern Manitoba (Shoal Lake); east to Lake Michigan and eastern Indiana and in Canada through central Ontario and Quebec to Matamek River and the Gaspé Peninsula, Gulf of St. Lawrence; west to Turtle Mountains, N. Dak., and Onaga, Kans.; north in Canada to James Bay, Ontario, and Mattagami Lake, Quebec. (Fig. 2.)

Characters.—Similar to *Tamias striatus lysteri* but larger; ears shorter; gray of dorsal region darker and less mixed with buff; head and rump averaging darker. Compared with *fisheri:* Size larger; sides of head and body paler; gray of upper parts more extensive and slightly paler; underside of tail paler.

Color.—*Summer pelage* (topotype, September 22): Top of head russet, more or less shaded with cinnamon; dark facial stripes russet; light facial stripes pinkish buff; outer surface of ears hair brown, edged anteriorly with russet; inner surface mikado brown posteriorly, pinkish buff anteriorly; median dorsal bands smoke gray, more or less shaded on posterior back by tawny; rump hazel, shading on thighs to ochraceous tawny; dark dorsal stripes black, narrowly edged with hazel; light dorsal stripes creamy white; hind feet cinnamon; front feet and sides of head and body pinkish buff; tail above, fuscous black overlaid with pale smoke gray; tail beneath, cinnamon or ochraceous tawny, bordered with fuscous black and edged with pale smoke gray; underparts creamy white. *Winter pelage* (April and May): Similar to the summer pelage but gray of back more extensive and rump paler (less brownish); sides of body paler buff (near cartridge buff); tail averaging paler beneath.

Skull.—Similar to that of *T. striatus fisheri* but averaging larger.

Measurements.—Average of 11 adults from type locality: Total length, 268.4 (253–299); tail vertebræ, 101.3 (93–110); hind foot, 36.6 (35–38); ear from notch, 13.7 (12–16.5). *Skull:* Average of 10 adults from type locality: Greatest length, 41.4 (40–42.3); zygomatic breadth, 22.9 (22.2–24); cranial breadth, 17 (15.7–18); interorbital breadth, 10.9 (10.2–11.9); postorbital breadth, 11.3 (10.7–12); length of nasals, 14.5 (14–15).

Remarks.—The gray chipmunk is one of the largest forms in the genus; it is closely related to both *lysteri* and *venustus* and occupies an extensive area in Canada, and middle-western United States. Specimens collected by W. E. Clyde Todd at Cochrane and Dane, Ontario, and Mattagami Lake and St. Margaret River, Quebec, materially extend the known range of this race to the eastward. These specimens agree closely in coloration with typical *griseus*, but have smaller skulls—in this respect approaching *lysteri*. A series from the Gaspé Peninsula, collected by Childs Frick and G. G. Goodwin, are also referable to *griseus*, though showing approach to *lysteri* in smaller size of the skull.

Intergradation with *lysteri* is shown also by specimens from Ishpeming, Mich., and from Burbridge, Quebec.[37]

A large series from Burlington, Iowa, in full summer pelage, average a little deeper ochraceous on the sides of the head and neck, perhaps approaching *T. s. striatus*. Specimens in spring pelage from Boone County, Ind., are nearly typical *griseus*.

[37] See remarks under *Tamias striatus lysteri*.

A small series from eastern Kansas (Douglas and Leavenworth Counties) does not differ appreciably in color from typical *griseus*, but shows approach to *venustus* in the larger size of the skulls. A specimen from Williamsville, Mo., shows approach to *venustus* in having the gray dorsal bands more broadly margined with hazel.

Specimens examined.—Total number, 315, as follows:

Illinois: Fox Lake, 13;[38] Mount Carroll, 1; Warsaw, 8.
Indiana: Boone County, 2;[39] Denver, 2;[40] Noblesville, 1; Wheatland, 1.
Iowa: Ames, 1; Burlington, 29; Cedar Rapids, 1;[38] Charles City, 1;[41] Hillsboro, 2; Wayland, 1.[41]
Kansas: Douglas County, 2;[42] Lawrence, 3;[43] Leavenworth County, 1;[42] Onaga, 1.
Manitoba: Portage la Prairie, 3;[40] Riding Mountain, 1;[44] Shoal Lake (west of Erinview), 1;[45] Winnipeg, 1.[46]
Minnesota: Breckenridge, 1; Brown Valley, 3; Cass Lake, 1;[40] Clear Lake Portage, Lake County, 1;[47] Elk River, 30; Ely, 1; Fort Snelling, 59;[48] Grant County, 1;[39] Houston County, 2;[40] Isabelle River, Lake County, 4;[49] Ortonville, 1; Pine Creek, Fillmore County, 1; Princeton, 1; Root River, near Houston, 1; Tower, 4.
Missouri: Independence, 1; St. Louis, 1; Williamsville, 1.
North Dakota: Fish Lake, Birchwood post office, 5; Grafton, 7; Grand Forks, 1; Harwood, 1; Kathryn, 2; Larimore, 6; Lisbon, 1; Manvel, 2; Pembina, 3; Portland, 1; Turtle Mountains, 2;[50] Walhalla, 2.
Ontario: Cochrane, 2;[51] Dane, 1;[51] Ingolf, 1;[46] James Bay, 1; Kapuskasing, 5.[45]
Quebec: Godbout, 1; Cascapedia River, 7;[39] Grand Portage, St. Margaret River, 1;[51] Matamek River (head), 10 miles east of Moise River, 1; Mattagami Lake (head), 1;[51] St. Anne des Monts, 8;[39] St. Margaret River, 4 miles above Clark City, 1.[51]
South Dakota: Fort Sisseton, 4; Lake Traverse, 6.
Wisconsin: Beaver Dam, 1;[52] Camp Douglas, Juneau County, 3; Crescent Lake, Oneida County, 1; Danbury, 2; Delavan, 1; Devils Lake, 1; Echo, 1;[53] Fountain City, 1; Friendship, 2; Holcombe, 2; Kelley Lake, Oconto County, 2; Long Lake, Washburn County, 6; Mamie Lake, Vilas County, 1; Mellen (8 miles southwest), 1; Milton, 2;[53] Namekagon Lake, Bayfield County, 1; Nashotah, 6; Ogema, 1; Racine, 1; Rhinelander, 2; Rib Hill, Marathon County, 3; Solon Springs, 2; St. Croix Falls, 2; Trempealeau, 1; Wauzeka, 2; Wild Rose, 2; Withee, 1; Worden Township, Clark County, 1.[54]

TAMIAS STRIATUS VENUSTUS Bangs

Southwestern Chipmunk

(Pls. 3, d; 7, d)

Tamias striatus venustus Bangs, Proc. Biol. Soc. Washington 10:137, December 28, 1896.

Type.—Collected at Stilwell, Adair County, Okla., August 13, 1896, by Thaddeus Surber; ♂ adult, skin and skull; No. 5478, Mus. Comp. Zool.; original number, 63.

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[38] Field Mus. Nat. Hist.
[39] Amer. Mus. Nat. Hist.
[40] Mus. Comp. Zool.
[41] Univ. Iowa.
[42] Kans. Univ. Mus.
[43] Amer. Mus. Nat. Hist., 1; Kans. Univ. Mus., 2.
[44] J. H. Fleming coll.
[45] Nat. Mus. Canada.
[46] E. T. Seton coll.
[47] Univ. Minn.
[48] Amer. Mus. Nat. Hist., 23.
[49] Mus. Comp. Zool., 2; Univ. Minn., 1; Kans. Univ. Mus., 1.
[50] Amer. Mus. Nat. Hist., 1; Univ. Mich., 1.
[51] Carnegie Mus.
[52] Colo. Agr. Coll.
[53] Univ. Wis.
[54] Univ. Mich

Geographic distribution.—Eastern Oklahoma, southwestern Missouri (Ozark Plateau), Arkansas,[55] eastward to mountains of northern Alabama and southward to southwestern Mississippi and southeastern Louisiana. (Fig. 2.)

Characters.—Similar to *T. striatus griseus;* tail and hind feet slightly shorter; coloration richer, especially in winter pelage, the tawny color of rump deeper and extending farther forward on the back; dorsal stripes shorter; gray dorsal bands more broadly margined with hazel; sides darker in winter pelage; hind feet darker; tail slightly darker beneath. Compared with *T. s. striatus:* Size larger (especially the skull); upper parts paler and more grayish; head paler; dorsal stripes shorter; the outer pair of light stripes clearer white (less buffy). Compared with *fisheri:* Size larger; head slightly more vinaceous (less tawny); sides of head and body paler; rump and hinder back more extensively reddish.

Color.—Summer pelage (type, August 13): Top of head russet; ocular and submalar stripes pale russet; ears fuscous, margined anteriorly with dark tawny, the posterior third tilleul buff; hind neck, shoulders, and median dorsal bands pale smoke gray, sprinkled with russet; the dorsal bands broadly margined on each side with hazel; dark dorsal stripes black; light dorsal stripes creamy white; rump kaiser brown; thighs and hind feet tawny; sides of head and body pinkish buff; tail above fuscous black, overlaid with pale smoke gray; tail beneath, tawny, bordered with fuscous black and tipped with pale smoke gray; underparts creamy white. *Winter pelage*: Closely similar to the summer pelage.

Skull.—Similar to that of *T. striatus griseus* but averaging larger.

Measurements.—Average of 11 adults from Oklahoma, Arkansas, and southwestern Missouri: Total length, 258.3 (239–286); tail vertebræ, 96.5 (83–113); hind foot, 35.7 (34.3–37); ear from notch, 14.6 (14–16). *Skull*: Average of 17 adults from same region: Greatest length, 42.2 (40.5–44.3); zygomatic breadth, 23.1 (21.9–24.4); cranial breadth, 17.1 (16.4–18.3); interorbital breadth, 11.7 (10.2–12.3); postorbital breadth, 11.9 (11.3–12.5); length of nasals, 15.1 (14.2–16.2).

Remarks.—The southwestern chipmunk is the largest and most brightly colored of all the races of *striatus*. It intergrades with *griseus* in southern Missouri and eastern Kansas, and with *striatus* in northern Alabama. It resembles *fisheri* rather closely in general appearance but is larger and more extensively reddish, and their ranges apparently do not meet.

Three specimens from Adams County, southwestern Mississippi, and a considerable series from the mountains of Alabama are clearly intermediate between *venustus* and *striatus* and seem best referred to the former; they resemble *venustus* in the color of the head and approach it in having the sides of the body paler buff than in *striatus;* the rump, however, is less extensively reddish and the dorsal stripes more buffy than in typical *venustus;* the skulls average large, in this respect agreeing with *venustus*. There is at present a wide gap between the known ranges of these two races (see map, fig. 2) and considerable collecting must be done in eastern Arkansas, northern Louisiana, and northern Mississippi before their ranges and relationships can be thoroughly understood.[55a] No specimens are available from Louisiana, although Audubon, more than 80 years ago (1846, vol. 1, p. 69), recorded the species as occurring in that State. The writer has been informed by H. H. Kopman that chipmunks are known to occur at Wakefield, West Feliciana Parish. Allison (1907, p. 13) reports them common in the Tennessee Valley in Tishomingo County, Miss.

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[55] None recorded from eastern Arkansas.

[55a] Stanley C. Arthur has recently made special efforts to find evidence of the presence of chipmunks in Bienville Parish, La., but without avail.

Specimens examined.—Total number, 41, as follows:

Alabama: Ardell, 1; Bucks Pocket, De Kalb County (2 miles north of Grove Oak), 6; Guntersville, 1; Talladega Mountains (east of Rendalia), 1; Woodville, 3.
Arkansas: Delight, 12; Pettigrew, 1; Rich Mountain, 1; Van Buren, 2.
Mississippi: Foster, Adams County, 1; Washington, 2.
Missouri: Carthage (8 miles south), 1;[56] Marble Cave, Stone County, 1; Noel, 1;[57] Pineville, McDonald County, 1.[58]
Oklahoma: Red Fork, 2; Stilwell, 4.[59]

TABLE 1.—*Cranial measurements, in millimeters, of typical adults of* Tamias striatus

Species and locality	No.	Sex	Greatest length	Zygomatic breadth	Cranial breadth [1]	Interorbital breadth	Postorbital breadth	Length of nasals	Remarks
Tamias striatus striatus:									
Highlands, N. C.	193388	♀	42.6	23	17.4	11.5	12.4	15.9	
Craggy Mountain, N. C.	[2] 780	♂	39.8	22.9	16.5	11.2	11.7	13.7	
Roan Mountain, N. C.	50852	♂	41.8	23.3	17.3	11.2	10.5	14	
Tamias striatus fisheri:									
Ossining, N. Y.	135551	♂	41	22.8	16.8	10.4	11	14	
Do	193377	♀	39.4	21.9	16	10	11.2	13.4	
Tamias striatus lysteri:									
Emsdale, Ontario	75856	♀	40.7	-------	16.9	10.4	10.9	14.6	
Do	75859	♀	38.9	21.6	16.5	10.2	11.8	14.4	
Mount Forest, Ontario	[2] 1778	♂	39.1	22.3	17	10.7	11.6	14.4	
Tamias striatus griseus:									
Fort Snelling, Minn.	122227	♂	42.3	24	17.1	11.9	11.5	14.3	
Do	122194	♀	40.6	22.6	16.5	11.5	10.9	14.5	Old adult.
Do	125395	♂	41.1	22.6	16.9	11	11.3	14.3	
Tamias striatus venustus:									
Stilwell, Okla.	[2] 5478	♂	43.2	23.9	17.4	12.7	11.9	16.2	Type.
Do	87264	♀	42	23.5	17.3	11.8	12	15.4	
Pettigrew, Ark.	169014	♀	44.3	24.4	18.3	12.3	11.3	15.4	

[1] Measured directly behind zygomata. [2] Mus. Comp. Zool.

Genus EUTAMIAS Trouessart

Sciurus Pallas, Nov. Spec. Quad., p. 378, 1778 (not *Sciurus* Linnæus).
Tamias Bachman, Journ. Acad. Nat. Sci. Philadelphia 8: pt. 1, p. 68, 1839 (not *Tamias* Illiger, 1811).
Eutamias Trouessart, Catal. Mamm. Viv. et Foss., Rodentia, in Bul. Soc. d' Etudes Sci. d' Angers 10: 86–87, 1880 (type, *Tamias striatus asiaticus* Gmelin).
Neotamias Howell, postea, p. 26 (type, *Eutamias merriami* Allen).

HISTORY AND NOMENCLATURE

Apparently the first account of any member of this genus is that of Pallas (1778, p. 378), wherein, under the name *Sciurus striatus*, he described the Siberian species, erroneously believing it to be the same as the American animal previously described under that name by Linnæus.[60] Schreber (1785, vol. 4, p. 790) divided the "species" into two varieties, *Das asiatische* and *Das americanische*, and gave a detailed description of each form. Three years later, in 1788, Gmelin gave technical names to these two "varieties," and his *Sciurus striatus asiaticus* thus became the first name to be strictly applied to the Siberian chipmunk (now known as *Eutamias asiaticus*).

[56] Univ. Wis.
[57] Mus. Comp. Zool.
[58] Kans. Univ. Mus.
[59] Mus. Comp. Zool., 2.
[60] Linnæus's species was based solely on Catesby's ground squirrel, now known as *Tamias striatus*.

The American members of this genus, confined as they are to the portions of the continent more remote from the early settlements, naturally remained unknown to science for a much longer period than did the eastern chipmunk (Tamias). The first species to be discovered was *quadrivittatus*, named by Say (1823, vol. 2, p. 45) from specimens collected by Major Long's expedition in eastern Colorado.

The large Pacific coast species was the next to become known; it was first collected by John K. Townsend, probably in 1834 or 1835 near the mouth of the Columbia River, and named in his honor by Bachman (1839, p. 68). In the same paper Bachman named *minimus* from western Wyoming—also collected by Townsend on his historic journey across the continent—the earliest recognized member of a large group since found to range from northern Canada to southern New Mexico and Arizona.

J. E. Gray (1842, p. 264) described a species from the Pacific coast as *Tamias hindsii*, collected by Surgeon Hinds on the voyage of the *Sulphur* and sent to the British Museum. This specimen was supposed to have come from California, and the name *hindsii* has passed current for many years for a species inhabiting the region just north of San Francisco Bay. Quite recently, however, careful comparison of the type with related forms has shown it to be referable to *townsendii*.[61]

In 1855, Baird described two new forms, *dorsalis* from the copper mines of New Mexico and *cooperi* from the Cascades of Washington, the latter named in honor of its collector, J. G. Cooper.

In Baird's epochal treatise on North American mammals, published in 1857, only three species in this genus were recognized, *quadrivittatus*, *dorsalis*, and *townsendii—minimus* having been placed in synonymy under *quadrivittatus* and *cooperi* under *townsendii*. During the next 20 years, there was little activity in the study of this group and only two new forms were proposed, the very distinct *quadrimaculatus* of California by Gray, in 1867, and *pallidus*, a pale form of the *minimus* group from the plains of the upper Missouri and Yellowstone Rivers, by Allen in 1874.

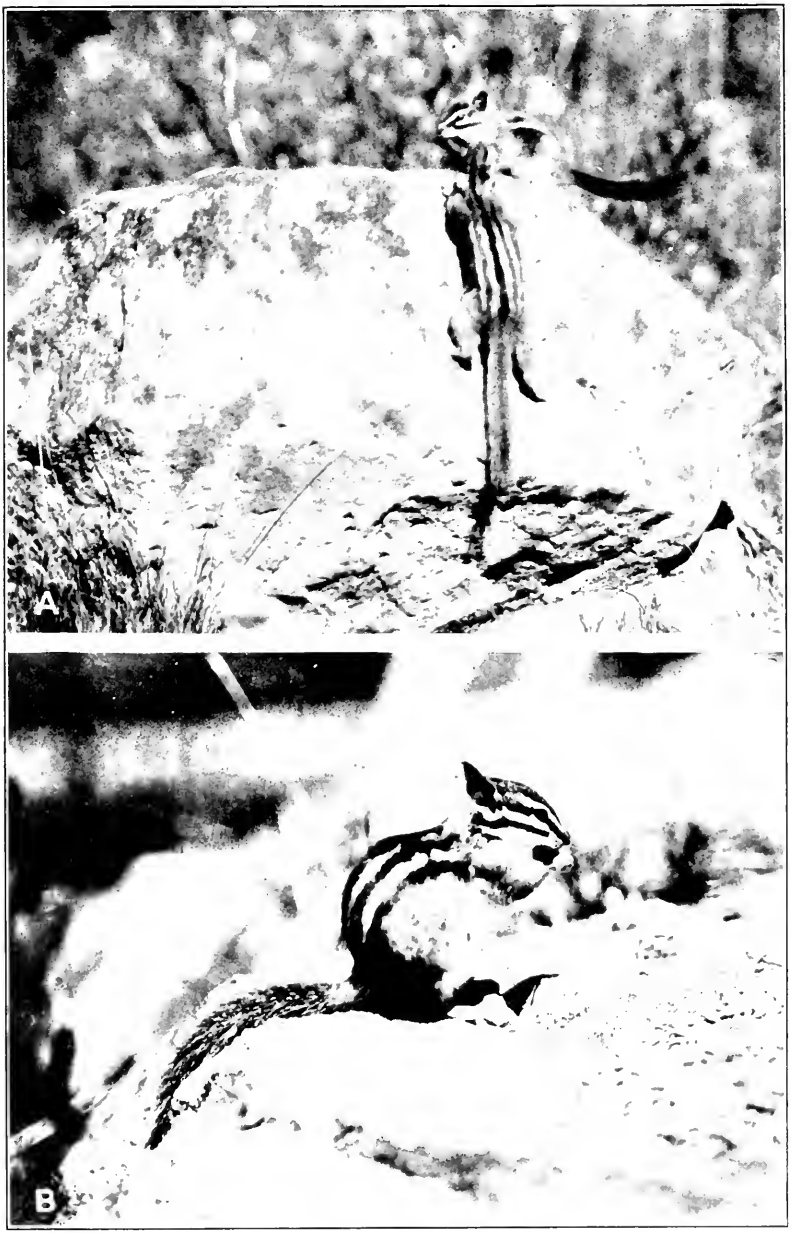
In 1877 appeared the first revision of the group, by J. A. Allen, in his Monographs of the Rodentia, but by reason of the paucity and poor quality of the material then existing and the extreme conservatism of the reviser in the matter of speciation, this monograph, although replete in details of nomenclature and geographical distribution, really represented a backward step in the understanding of the relationships of the species within the group. Thus in place of the three species recognized by Baird in 1857, Allen in 1877 reduced the group to a single species, *asiaticus*, with five varieties.

But one new form, *borealis*, was proposed and this, very strangely, was made to include both the small chipmunk inhabiting the interior of Canada and the much larger species of Siberia, the true *asiaticus*.[62]

In 1886 Merriam described *macrorhabdotes* from California, which later proved to be the same as *quadrimaculatus* of Gray (Merriam, 1897, p. 203.) In 1889, Allen described two well-marked new species, *bulleri* from central Mexico and *merriami* from southern California,

[61] See Howell (1922, p. 181).

[62] Some years later, Doctor Allen, in fixing the type of *borealis*, remarked: "In the first use of the name *borealis* it was improperly and somewhat inadvertently allowed to cover the Old World *T. asiaticus*, as well as the form of the American Fur countries." (Allen, 1890, p. 109.)



B1887M B2348M

WESTERN CHIPMUNKS

A, Larger Colorado chipmunk (*Eutamias quadrivittatus quadrivittatus*), Trappers Lake, Colo.; B, Wasatch chipmunk (*E. minimus consobrinus*), Buffalo Pass, Colo. Photos by E. R. Warren

and in 1890 the same author presented his second revision of the group in a paper that marked a notable advance in the conception of the relationships of the species and furnished a sound basis for the work of later investigators.

As pointed out by Doctor Allen in the introductory paragraphs of this paper, the greatly increased knowledge of the group was due mainly to the recent acquisition of more abundant and more carefully prepared material, and much of the credit for this improved status is due to C. Hart Merriam, who, about 1885, began to acquire for his private collection (and a little later for the Bureau of Biological Survey collection) large series of specimens prepared in accordance with the greatly improved methods developed by him and by his collectors.[63]

Of the 23 American forms recognized by Allen in his 1890 revision, 13 were described as new, and of these all but two are to-day considered valid.[64] Increased activity in mammal collecting after 1890 resulted in rapid multiplication of new species, so that in the period of about 40 years between that date and the present the number of described forms has increased from 23 to 69.[65] Of this number, 12 are at present placed in synonymy.[66] Although Allen's second revision was satisfactory as regards the forms admitted and the careful and detailed diagnoses, the relationships of the species were not always clearly indicated, and in some cases the forms were wrongly associated. This is particularly true of the species *quadrivittatus*, under which name three distinct species were confused. His typical *quadrivittatus* is in the main the equivalent of *operarius*, a member of the *minimus* group, to which group, also, his subspecies *neglectus* and *borealis* belong; his subspecies *gracilis* is really a synonym of the original *quadrivittatus* of Say, while his subspecies *luteiventris* and *affinis* are actually subspecies of *amœnus*, described in the same paper.

This confusion, however, is not greatly to be wondered at, considering the relatively small amount of material then available and the fact that Doctor Allen found it "impracticable to make much use of cranial characters as a basis for specific distinctions." Had he made the same detailed study of the skulls that was his custom in later years, some of the confusing problems in this difficult group might have been cleared up.

Shortly after the appearance of this monograph, Doctor Merriam, having discovered that there were two species of chipmunks living together in the mountains of Colorado, undertook to determine to which one the name *quadrivittatus* applied. Accordingly, between 1890 and 1903 he sent a number of his collectors at different times to the type locality, near Canyon City, with the result that 70 specimens were secured, all proving to belong to the larger of the two forms, the ranges of which overlap in the mountains of the State. These results were published in 1905 in connection with a description of the small Colorado form under the name of *Eutamias amœnus operarius*.

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[63] It might be added, also, that a large share of this credit is due to the energy and skill of Vernon Bailey, who, even before he began active collecting for Doctor Merriam in 1887, had developed on his own initiative improved methods of trapping and preparing mammal specimens.

[64] *Tamias gracilis* proves to be a synonym of *quadrivittatus* and *T. macrorhabdotes* a synonym of *quadrimaculatus; hindsii* and *neglectus* represented valid forms, which are now recognized under other names.

[65] Including two old names, *cooperi* and *pallidus*, not recognized by Allen but since revived.

[66] See list of recognized forms by the present writer (Howell, 1922, p. 183–185).

Meanwhile Doctor Merriam had been making detailed studies of certain of the Pacific coast forms and in 1897 published a synopsis of these, with a revision of the *townsendii* and *speciosus* groups. (Merriam, 1897, pp. 189–212.)

No revision of the Rocky Mountain forms was undertaken until the present writer began a study of the group in 1920, so that while the correct application of the old name *quadrivittatus* was known, the relationships of most of the forms associated with it were not clearly appreciated and in the literature many names were wrongly assigned.[67]

The first results of the revision undertaken by the writer appeared in 1922, when seven new forms were named and a list presented of the described forms arranged in five groups. (Howell, 1922, pp. 178–185.)

GENERIC CHARACTERS

Skull similar in general to that of Tamias, but rostrum shorter and more abruptly constricted near base; brain case smoothly rounded, slightly flattened or moderately inflated; palate relatively short, terminating on the plane of last molars or but little posterior to it; notch in posterior edge of zygomatic plate of maxillary opposite middle or hinder part of pm^4; audital bullæ relatively large; upper incisors with numerous longitudinal striations, often well defined; molariform teeth much as in Tamias but with an additional (minute) premolar in the upper tooth row; lower molars with a small cusp between the protoconid and hypoconid, not reaching the outer border of the tooth row; last lower molar relatively long, often slightly longer than m_2; dentition: i, $\frac{2}{2}$; pm, $\frac{4}{2}$; m, $\frac{6}{6}$; equals 22.

SUBGENUS EUTAMIAS

Type.—*Sciurus striatus asiaticus* Gmelin.

Subgeneric characters.—As given above for the genus; also, in comparison with Neotamias: Ears broad, rounded, and of medium height (much as in Tamias); interorbital constriction slight (as in Tamias); postorbital processes broad at base, tapering to a point (much as in Tamias); antorbital foramen large, suborbicular (as in Tamias); lambdoidal crest moderately developed; upper molariform tooth rows slightly convergent posteriorly (as in Tamias); palate short, ending about on plane of last molars.

The baculum of *Eutamias asiaticus* (subsp.) from Japan is quite different from that of the American species, being much slenderer and more simple. It is 5 millimeters in length and tapers gradually from base to tip, the distal portion upturned in an even curve and slightly flattened, but without ridges.

Geographic distribution.—Northern and eastern Asia (species not treated).

SUBGENUS NEOTAMIAS nobis

Type.—*Eutamias merriami* Allen.

Subgeneric characters.—Similar to typical Eutamias (of Asia), but antorbital foramen narrowly oval; postorbital processes narrower at base and much slenderer throughout; interorbital constriction more pronounced; lambdoidal crest less strongly developed; ears relatively

[67] For example, *affinis*, *felix*, *luteiventris*, *borealis*, and *neglectus* continued to appear in the check lists and elsewhere as subspecies of *quadrivittatus*, the first three really being subspecies of *amoenus* and the last two being subspecies of *minimus*.

longer and more pointed; upper molariform tooth rows approximately parallel; palate ending slightly posterior to plane of last molars.

Remarks.—Comparison of the characters of the west American chipmunks of the genus Eutamias with those of the Asiatic chipmunks and with those of the eastern chipmunks (genus Tamias) discloses a number of remarkable relationships among these three rather distinct groups. Typical Eutamias of Asia resembles Tamias of eastern North America and differs from the American Eutamias in a number of characters, notably the shape of the antorbital foramen and of the postorbital processes, the breadth of the interorbital region, the development of the lambdoidal crest, and the shape of the external ears. On the other hand, the American Eutamias agrees with the Asiatic members of the genus in the shape of the rostrum, the flattening of the temporal region, the well-defined striations on the upper incisors,[68] the presence of the extra peglike premolar and in the pattern of the dorsal stripes.

The baculum in the subgenus Neotamias differs from that of both Tamias and typical Eutamias; specimens examined of six species show essential similarity in the shape of the bone but considerable variation in size.

In *Eutamias cinereicollis*, the baculum is a slender bone about 4.5 millimeters in length, thickest at the proximal end, with a bend in the middle, the distal portion laterally compressed, and the tip abruptly bent upward and flattened into a shape much resembling a human foot, with a prominent narrow ridge in the center of the "instep."

In two specimens of *E. townsendii*, the bacula are of similar shape, but much slenderer, being only 3.5 and 4 millimeters in length, while in two specimens of *E. amœnus* these bones measured but 3 millimeters. In a specimen of *E. dorsalis* the baculum resembles that of *E. cinereicollis*, but is much slenderer, straighter, and has the terminal portion less abruptly bent. In a specimen of *E. quadrivittatus frater* the resemblance to a human leg is maintained, but the baculum is shorter (4 millimeters) and stouter than in *cinereicollis*, and flattened out on the distal portion just above the bend, where the ankle would be on a human foot.

EXTERNAL CHARACTERS

Form more slender than in Tamias; tail relatively longer (about 42 to 48 per cent of total length); ears longer and somewhat more pointed at tip; feet and cheek pouches as in Tamias (see p. 12); weight varying from 27.5 grams (in *alpinus*) to 123 grams (in *senex*).

COLOR PATTERN

The normal pattern on the upper parts consists of five blackish and four whitish stripes, all of approximately equal width; all but the outer pair extend from the shoulders to the rump and the median stripe reaches to the occiput; the outer (lateral) pair is shorter and often obsolete, and in some species (e. g., *obscurus* and *dorsalis*) all the stripes except the median one are frequently much reduced or nearly obsolete; in certain members of the *townsendii* group the

[68] The lower incisors in all three groups are about alike in the striations.

median pair of light stripes are tawny or olivaceous—practically the same color as the sides; the bases of the hairs over the entire body are plumbeous.

PELAGE AND MOLT

The pelage of the chipmunks of this genus is soft, dense, rather short and appressed in summer and longer and more woolly in winter. The bases of the hairs are plumbeous, but this color is ordinarily concealed by the terminal portions of the hairs, except on the belly, where the hair is much thinner.

Four melanistic specimens have been examined—three *Eutamias minimus borealis* from Tatletuey Lake, British Columbia, and one *E. m. caniceps* from Lake Bennett, British Columbia. Two of these are coal black all over, including the bases of the hairs, with a slight sprinkling of grayish and cinnamon hairs on the back, giving a suggestion of the usual striped effect. The other two are solid black with a slight brownish tinge.

All members of this genus molt twice a year, in spring or summer, and again in early fall. The spring or summer molt, involving a change from the worn and faded winter pelage, which has been carried from 8 to 10 months, is usually clearly marked by a molting line or by patches of new hair. This molt may begin as early as the first half of May (in Arizona) but usually occurs in July, and in breeding females, may be delayed until August or in exceptional cases even later.

The spring molt begins usually on the head and progresses backward, often quite uniformly, or it may begin in scattered patches on the foreback or shoulders, but in any case the rump is the last part of the body to be renewed.

The resulting summer pelage [69] is usually decidedly brighter and more tawny than the winter pelage, which is characterized by softer and more grayish tones. This pelage is worn for a much shorter period than the winter pelage and consequently, as a rule, shows less wear and fading.[70]

The fall molt takes place usually late in September or early in October, but instead of being clearly marked, as is the spring molt, the new pelage at this time appears insidiously and in only a small percentage of individuals is it possible to discover a "molting line" or even a clear indication of the area involved in the molt. There are, however, a sufficient number of specimens showing the progress of the fall molt to establish with reasonable certainty the fact that this molt proceeds in the reverse direction from the spring molt, that is, beginning on the rump and advancing forward to the head.

This pelage, as already stated, is carried throughout the winter and through the breeding season, which in the case of nursing females may extend almost through the following summer.[71] With such extensive wear, it is not surprising to find that the pelage of late spring and early summer often appears decidedly unlike the same pelage when it was acquired in the fall. The amount of wear and

[69] This pelage is called the "post-breeding pelage" by Doctor Merriam, but it seems more logical to designate it as the summer pelage, in contradistinction to the winter pelage, remembering that it may be acquired at any time between May and August.

[70] In some cases it is probably carried not more than six or eight weeks, that is, from late in August to early in October.

[71] A female specimen taken August 26 in the Beaver Mountains, Utah, shows this molt completed over most of the body, the rump alone retaining faded winter pelage.

fading varies with different species and different individuals, some specimens late in summer being exceedingly ragged or almost naked.

The most remarkable instance of delayed molt that has come to the writer's attention is that shown by a breeding female specimen of *ochrogenys* taken at Mendocino City, Calif., November 7, 1897, in which the old, worn, faded winter pelage persists on the posterior half of the body, while a fresh "summer" pelage is coming in the usual manner on the head, shoulders, and foreback. Another female taken the same day at the same place is acquiring winter pelage in the usual way, beginning on the rump and proceeding forward.

LIST OF SPECIES AND SUBSPECIES OF EUTAMIAS WITH TYPE LOCALITIES

EUTAMIAS ALPINUS GROUP

Eutamias alpinus (Merriam)	Mount Whitney, Calif. (p. 34).

EUTAMIAS MINIMUS GROUP

Eutamias minimus minimus (Bachman)	Green River, Wyo. (p. 36).
minimus pictus (Allen)	Kelton, Utah (p. 39).
minimus grisescens Howell	Farmer, Wash. (p. 41).
minimus caryi Merriam	San Luis Valley, Colo. (p. 42).
minimus pallidus (Allen)	Camp Thorne, Mont. (p. 42).
minimus cacodemus Cary	Sheep Mountain, S. Dak. (p. 44).
minimus confinis Howell	Bighorn Mountains, Wyo. (p. 45).
minimus consobrinus (Allen)	Wasatch foothills, east of Salt Lake City, Utah (p. 46).
minimus operarius Merriam	Gold Hill, Colo. (p. 48).
minimus atristriatus Bailey	Sacramento Mountains, N. Mex. (p. 51).
minimus arizonensis Howell	Prieto Plateau, Ariz. (p. 52).
minimus oreocetes Merriam	Summit Mountain, Mont. (p. 53).
minimus borealis (Allen)	Fort Liard, Mackenzie (p. 54).
minimus caniceps Osgood	Lake Lebarge, Yukon (p. 58).
minimus jacksoni Howell	Crescent Lake, Wis. (p. 59).

EUTAMIAS AMŒNUS GROUP

Eutamias amœnus amœnus (Allen)	Fort Klamath, Oreg. (p. 61).
amœnus ochraceus Howell	Siskiyou Mountains, Calif. (p. 64).
amœnus monoensis Grinnell and Storer.	Warren Fork of Leevining Creek, Mono County, Calif. (p. 65).
amœnus luteiventris (Allen)	Waterton Lake, Alberta (p. 66).
amœnus vallicola Howell	Bass Creek, near Stevensville, Mont. (p. 69).
amœnus canicaudus Merriam	Spokane, Wash. (p. 70).
amœnus affinis (Allen)	Ashcroft, British Columbia (p. 71).
amœnus ludibundus Hollister	Yellowhead Lake, British Columbia (p. 73).
amœnus felix (Rhoads)	Church Mountain, British Columbia (p. 75).
amœnus caurinus Merriam	Olympic Mountains, Wash. (p. 76).
panamintinus (Merriam)	Panamint Mountains, Calif. (p. 78).

EUTAMIAS QUADRIVITTATUS GROUP

Eutamias quadrivittatus quadrivittatus (Say)	Arkansas River, about 26 miles below Canyon City, Colo. (p. 79).
quadrivittatus hopiensis Merriam	Keam Canyon, Ariz. (p. 83).
quadrivittatus inyoensis Merriam	White Mountains, Calif. (p. 84).
quadrivittatus frater (Allen)	Donner, Calif. (p. 86).
quadrivittatus sequoiensis Howell	Mineral King, Calif. (p. 88).
quadrivittatus speciosus (Merriam)	San Bernardino Mountains, Calif. (p. 89).

Eutamias callipeplus (Merriam)	Mount Piños, Calif. (p. 91).
palmeri Merriam	Charleston Peak, Nev. (p. 92).
adsitus Allen	Beaver Mountains, Utah (p. 93).
umbrinus (Allen)	Blacks Fork, Uinta Mountains, Utah (p. 94).
ruficaudus ruficaudus Howell	Upper St. Marys Lake, Mont. (p. 96).
ruficaudus simulans Howell	Coeur d' Alene, Idaho (p. 97).
cinereicollis cinereicollis (Allen)	San Francisco Mountain, Ariz. (p. 99).
cinereicollis cinereus Bailey	Magdalena Mountains, N. Mex. (p. 100).
cinereicollis canipes Bailey	Gaudalupe Mountains, Tex. (p. 101).
bulleri bulleri (Allen)	Sierra de Valparaiso, Zacatecas, Mexico (p. 102).
bulleri durangæ Allen	Sierra Candella, Durango, Mexico (p. 104).
bulleri solivagus Howell	Sierra Guadalupe, Coahuila, Mexico (p. 105).

EUTAMIAS TOWNSENDII GROUP

Eutamias townsendii townsendii (Bachman)	Lower Columbia River, Oreg. (p. 106).
townsendii cooperi (Baird)	Klickitat Pass, Wash. (p. 110).
townsendii ochrogenys Merriam	Mendocino, Calif. (p. 112).
townsendii siskiyou Howell	Siskiyou Mountains, Calif. (p. 113).
townsendii senex (Allen)	Donner Pass, Calif. (p. 114).
townsendii sonomæ Grinnell	Guerneville, Calif. (p. 117).
alleni Howell	Inverness, Calif. (p. 119).
quadrimaculatus (Gray)	Michigan Bluff, Calif. (p. 121).
merriami merriami (Allen)	San Bernardino Mountains, Calif. (p. 123).
merriami pricei (Allen)	Portola, Calif. (p. 127).
merriami kernensis Grinnell and Storer	Fay Creek, 6 miles north of Weldon, Calif. (p. 128).
merriami obscurus (Allen)	San Pedro Martir Mountains, Lower California (p. 129).
merriami meridionalis Nelson and Goldman.	Aguaje de San Esteban, Lower California (p. 130).
dorsalis dorsalis (Baird)	Fort Webster, N. Mex. (p. 131).
dorsalis utahensis Merriam	Ogden, Utah (p. 133).

KEY TO SPECIES AND SUBSPECIES OF EUTAMIAS

a^1. Dorsal stripes (except the median one) more or less indistinct.
  b^1. Postauricular patches large and clearly defined ..... *dorsalis* (p. 131).
  b^2. Postauricular patches smaller and less clearly defined.
    c^1. Size larger (greatest length of skull usually more than 36.5 mm.).
      d^1. Under surface of tail dark tawny; range in Lower California ..... *obscurus* (p. 129).
      d^2. Under surface of tail pale tawny; range in California ..... *kernensis* (p. 128).
    c^2. Size smaller (length of skull usually less than 36.5 mm.).
      d^1. Tail darker (under surface tawny).
        e^1. Tail longer (more than 105 mm.) ..... *meridionalis* (p. 130).
        e^2. Tail shorter (less than 105 mm.) ..... *palmeri* (p. 92).
      d^2. Tail paler (under surface cinnamon) ..... *utahensis* (p. 133).
a^2. Dorsal stripes all distinctly marked.
  b^1. Size larger (length of skull 37 mm. or over [72]).
    c^1. Interior forms (New Mexico, Arizona, and Mexico).
      d^1. Larger (hind foot 36–38 mm.); range in Sierra Madre, Mexico.
        e^1. Submedian pair of dorsal stripes blackish; tail paler beneath ..... *bulleri* (p. 102).
        e^2. Submedian pair of dorsal stripes brownish, tail darker beneath ..... *durangæ* (p. 104).
      d^2. Smaller (hind foot 32–35 mm.); range in United States ..... *canipes* (p. 101).

[72] Sometimes less in *canipes* and *kernensis*.

c^2. Pacific coast forms (British Columbia to Lower California).
d^1. Postauricular patches large and conspicuous; ears long and narrow ---------- *quadrimaculatus* (p. 121).
d^2. Postauricular patches smaller and less conspicuous; ears averaging shorter and broader.
e^1. Median pair of light dorsal stripes mainly tawny or olivaceous (never clear white or gray).
f^1. Underparts whitish.
g^1. Light dorsal stripes tawny or olivaceous --- *townsendii* (p. 106).
g^2. Light dorsal stripes more or less whitish ----- *sonomæ* (p. 117).
f^2. Underparts buffy.
g^1. Size larger (hind foot 37–39 mm.); cheeks more ochraceous ---------- *ochrogenys* (p. 112).
g^2. Size smaller (hind foot 34–37 mm.); cheeks less ochraceous ---------- *alleni* (p. 119).
e^2. Median pair of light dorsal stripes mainly gray or white.
f^1. Upper parts cinnamon buff in general tone ----- *cooperi* (p. 110).
f^2. Upper parts tawny or grayish in general tone.
g^1. Sides of face buffy.
h^1. Rump and thighs grayish in tone ---------- *senex* (p. 114).
h^2. Rump and thighs brownish in tone ------- *siskiyou* (p. 113).
g^2. Sides of face grayish.
h^1. Tail pale tawny beneath ---------- *kernensis* (p. 128).
h^2. Tail dark tawny beneath.
i^1. Colors darker; tail longer ---------- *pricei* (p. 127).
i^2. Colors paler; tail shorter ---------- *merriami* (p. 123).
b^2. Size smaller (length of skull less than 37 mm.).
c^1. Size larger (length of skull between 34.5 and 37 mm.[73]).
d^1. Range, Rocky Mountain region (British Columbia to Mexico; also Utah and Arizona).
e^1. Dorsal stripes (except median one) tawny ------- *hopiensis* (p. 83).
e^2. Dorsal stripes not tawny (blackish or fuscous).
f^1. Shoulders washed with grayish.
g^1. Submedian pair of dorsal stripes brownish; hind feet grayish ---------- *canipes* (p. 101).
g^2. Submedian pair of dorsal stripes blackish; hind feet buffy.
h^1. Head and rump darker; range in Mexico - *solivagus* (p. 105).
h^2. Head and rump paler; range in United States.
i^1. Shoulders and rump more grayish ------ *cinereus* (p. 100).
i^2. Shoulders and rump less grayish ------ *cinereicollis* (p. 99).
f^2. Shoulders not washed with grayish.
g^1. Under side of tail tawny.
h^1. Colors darker; under side of tail amber brown ---------- *ruficaudus* (p. 96).
h^2. Colors paler; under side of tail ochraceous tawny.
i^1. Head darker (ochraceous tawny or cinnamon) ---------- *simulans* (p. 97).
i^2. Head paler (drab or grayish).
j^1. Colors brighter; dorsal stripes blackish ---------- *quadrivittatus* (p. 79).
j^2. Colors duller; dorsal stripes brownish - *umbrinus* (p. 94).
g^2. Underside of tail not tawny (sayal brown to pinkish cinnamon).
h^1. Sides darker (mikado brown) ---------- *adsitus* (p. 93).
h^2. Sides paler (sayal brown to pinkish buff).
i^1. Tail darker beneath (sayal brown) --------- *affinis* (p. 71).
i^2. Tail paler beneath (pinkish buff) ------ *canicaudus* (p. 70).
d^2. Range, Pacific coast and Great Basin regions.[74]
e^1. Dorsal area more grayish; stripes less distinct.
f^1. Size larger; colors darker ---------- *obscurus* (p. 129).
f^2. Size smaller; colors paler ---------- *meridionalis* (p. 130).

[73] Rarely exceeding 37 mm. in *obscurus*.
[74] One form reaching western and central Utah.

e^2. Dorsal area more tawny; stripes more distinct.
f^1. Black tip of tail longer (usually more than 20 mm.).
g^1. Upper parts more tawny; tail longer (92–114 mm.) ---------- *sequoiensis* (p. 88).
g^2. Upper parts more grayish; tail shorter (80–95 mm.) ---------- *speciosus* (p. 89).
f^2. Black tip of tail shorter (usually less than 20 mm.).
g^1. Underside of tail paler (sayal brown or cinnamon) *frater* (p. 86).
g^2. Underside of tail darker (tawny or ochraceous tawny).
h^1. Submalar stripe blackish; outer pair of dorsal stripes buffy white ---------- *callipeplus* (p. 91).
h^2. Submalar stripe brownish; outer pair of dorsal stripes clear white.
i^1. Dark dorsal stripes brownish (much reduced in winter pelage) ---------- *palmeri* (p. 92).
i^2. Dark dorsal stripes blackish ---------- *inyoensis* (p. 84).
c^2. Size smaller (length of skull less than 35.6 mm.).
d^1. Size medium (length of skull usually more than 31 mm.).
e^1. Dorsal stripes blackish or fuscous black.
f^1. Underparts washed with buff.
g^1. Underside of tail paler (pinkish buff or cinnamon buff).
h^1. Median pair of light dorsal stripes clear white ---------- *vallicola* (p. 69).
h^2. Median pair of light dorsal stripes not clear white ---------- *canicaudus* (p. 70).
g^2. Under side of tail darker (tawny or ochraceous tawny).
h^1. Sides of face washed with ochraceous tawny --- *felix* (p. 75).
h^2. Sides of face not washed with ochraceous tawny.
i^1. Dorsal stripes blackish; underparts heavily washed with buff ---------- *luteiventris* (p. 66).
i^2. Dorsal stripes brownish; underparts faintly washed with buff ---------- *ochraceus* (p. 64).
f^2. Underparts not washed with buff.
g^1. Larger (length of skull between 33 and 35.6 mm.).
h^1. Underside of tail paler (sayal brown or clay color) ---------- *affinis* (p. 71).
h^2. Underside of tail darker (tawny or ochraceous tawny).
i^1. Dorsal stripes black.
j^1. Head tawny; tail longer (103–121 mm.) ---------- *simulans* (p. 97).
j^2. Head drab or cinnamon drab; tail shorter (85–110 mm.).
k^1. Sides and tail darker tawny ------ *ludibundus* (p. 73).
k^2. Sides and tail paler tawny ---------- *caurinus* (p. 76).
i^2. Dorsal stripes fuscous black ---------- *umbrinus* (p. 94).
g^2. Smaller (length of skull between 31 and 34 mm.).
h^1. Range in Sierra-Cascade region and the Great Basin.
i^1. Tail darker beneath ---------- *amœnus* (p. 61).
i^2. Tail paler beneath ---------- *monoensis* (p. 65).
h^2. Range in Rocky Mountain region and Great Plains (Yukon to New Mexico and Arizona).
i^1. Tail darker beneath (tawny or ochraceous tawny).
j^1. Dorsal stripes intensely black; rump and thighs ochraceous.
k^1. Dark dorsal stripes very broad; range New Mexico ---------- *atristriatus* (p. 51).
k^2. Dark dorsal stripes narrower; range Canada and northern United States.

l^1. Sides and tail darker tawny------- *jacksoni* (p. 59).
l^2. Sides and tail paler tawny-------- *borealis* (p. 54).
j^2. Dorsal stripes not intensely black (fuscous black or brownish); rump and thighs grayish.
k^1. Colors on upper parts brighter and more contrasted.
l^1. Sides paler; shoulders washed with gray---------- *arizonensis* (p. 52).
l^2. Sides darker; shoulders not washed with gray---------- *operarius* (p. 48).
k^2. Colors on upper parts duller and less contrasted.
l^1. Ears with conspicuous black patches ---------- *confinis* (p. 45).
l^2. Ears without conspicuous black patches---------- *oreocetes* (p. 53).
i^2. Tail paler beneath (clay color or pinkish buff).
j^1. Dorsal stripes darker; tail paler------- *caniceps* (p. 58).
j^2. Dorsal stripes paler; tail darker------- *pallidus* (p. 42).
e^2. Dorsal stripes (except median one) brownish or cinnamon.
f^1. Sides tawny; dorsal stripes darker-------- *panamintinus* (p. 78).
f^2. Sides not tawny; dorsal stripes paler.
g^1. Darker; dorsal stripes sayal brown---------- *pallidus* (p. 42).
g^2. Paler; dorsal stripes pinkish cinnamon----- *cacodemus* (p. 44).
d^2. Size small (length of skull usually less than 31 mm.).
e^1. Interorbital region broader (6.7–10.1 mm.); tail more bushy---------- *alpinus* (p. 34).
e^2. Interorbital region narrower (6–7 mm.); tail less bushy.
f^1. Median pair of light dorsal stripes broader than dark stripes---------- *grisescens* (p. 41).
f^2. Median pair of light dorsal stripes not broader than dark stripes.
g^1. Tail more blackish (less tawny) above, with paler edgings---------- *pictus* (p. 39).
g^2. Tail less blackish (more tawny) above, with darker edgings.
h^1. Dorsal stripes darker (blackish or bister)- *consobrinus* (p. 46).
h^2. Dorsal stripes paler (sayal brown of fuscous).
i^1. Shoulders and rump more grayish---------- *caryi* (p. 42).
i^2. Shoulders and rump less grayish-------- *minimus* (p. 36).

EUTAMIAS ALPINUS GROUP

EUTAMIAS ALPINUS (MERRIAM)

ALPINE CHIPMUNK

(PLS. 6, o; 10, o)

Tamias alpinus Merriam, Proc. Biol. Soc. Washington 8:137, December 28, 1893.

Eutamias alpinus Merriam, Proc. Biol. Soc. Washington 11:191, July 1, 1897.

Type.—Collected at Big Cottonwood Meadows, just south of Mount Whitney, Calif. (altitude, 10,000 feet), August 12, 1891, by Basil Hicks Dutcher; ♀ adult, skin and skull; No. $\frac{30507}{42491}$, United States National Museum (Biological Survey collection); original number, 191.

Geographic distribution.—Upper slopes of the southern Sierra Nevada, Calif., from Olancha Peak northward to southern Tuolumne County (Mount Conness). *Zonal range:* Hudsonian (about 8,000 to 12,500 feet altitude). (Fig. 3.)

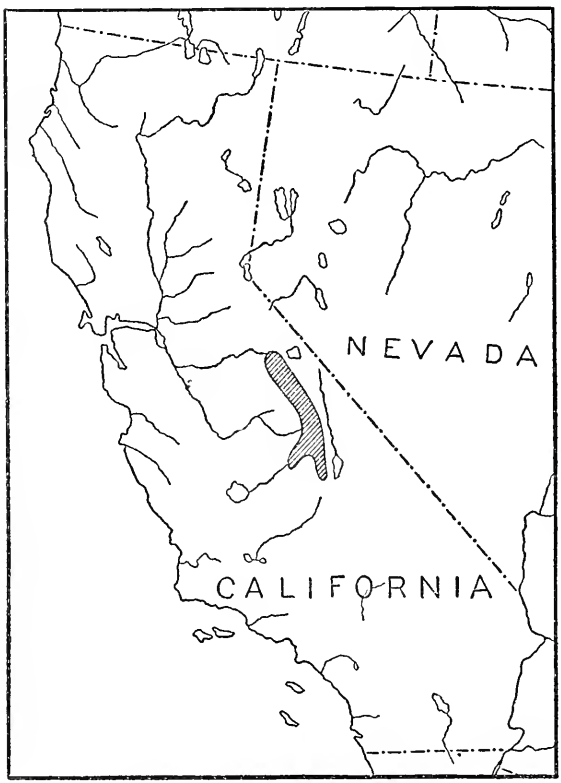

FIGURE 3.—Distribution of *Eutamias alpinus*

Characters.—About the size of *Eutamias minimus pictus* but ears larger; skull slightly larger and relatively broader interorbitally; tail broader and more bushy, with more black at the tip; coloration in summer pelage much brighter and more tawny than in *pictus* (similar to *panamintinus* but paler); in winter pelage coloration more buffy (less grayish), the sides slightly darker. Compared with *E. amœnus monoensis:* Upper parts in summer pelage similar, but paler, the dark stripes less blackish, the outer pair of light stripes broader and more prominent; head, rump, sides of body, hind feet, and underside of tail paler, the latter with more black at the tip.

Color.—*Summer pelage* (August): Head smoke gray, faintly washed with light pinkish cinnamon; stripe on each side of head pale fuscous mixed with sayal brown; ocular stripe fuscous; submalar stripe snuff brown; light facial stripes grayish white; ears chætura drab or dark hair brown anteriorly, buffy white posteriorly; postauricular patches rather large, creamy white; dark dorsal stripes tawny, more or less mixed with fuscous black, the median one darkest and usually mainly blackish; median pair of light dorsal stripes smoke gray, sometimes sprinkled with tawny; outer pair broader, creamy white; sides clay color, with an indistinct patch of smoke gray on the shoulders; rump and thighs smoke gray, sprinkled with clay color; tail above fuscous black, overlaid with clay

color; tail beneath, between clay color and pinkish cinnamon, bordered with fuscous black and edged with clay color, the tip fuscous black for about 20 mm.; fore and hind feet pale smoke gray, faintly washed with light pinkish buff; underparts creamy white. *Winter pelage* (October 11): Similar to the summer pelage but upper parts more grayish and less tawny; sides pinkish buff.

Molt.—The beginning of the summer molt is shown by a specimen (♂) from Mount Whitney, Calif., June 19, in which the new summer pelage is coming in irregularly on the fore back; another male from east fork of Kaweah River, August 4, has nearly completed this molt, only the rump retaining the worn winter pelage. A breeding female from Alta Peak, August 10, is still in worn winter pelage, with no signs of molting; a male from the same place on the same day is in greatly worn winter pelage, with the new summer pelage just beginning to appear on the head and the middle of the back.

Skull.—Similar to that of *E. minimus pictus* but averaging larger in all dimensions and relatively much broader interorbitally.

Measurements.—Average of 12 adults from vicinity of Mount Whitney, Calif.: Total length, 184.9 (176–195); tail vertebræ, 79.5 (70–85); hind foot, 29.6 (28–31); ear from notch, 12.9 (12–14). *Skull:* Greatest length, 30.9 (30.3–31.7); zygomatic breadth, 17.3 (16.6–17.8); cranial breadth, 13.8 (13.4–14.4); interorbital breadth, 7.6 (6.7–8.1); length of nasals, 9.7 (8.7–10.1). *Weight:* Average of 90 ndividuals, 35.3 (27.5–45.5) grams.

Remarks.—This species is remarkable in that it is not closely irelated to any living species and can not satisfactorily be placed in any of the groups. Externally it resembles *E. minimus caryi* rather closely in winter pelage and *E. panamintinus* in summer pelage, but in the skull characters the relatively great breadth of the interorbital region is not found in any other species.

It is one of the highest ranging of any of the chipmunks, occurring at timber line on the High Sierra at 11,000 to 12,000 feet altitude, but ranges down also to about 8,000 feet, thus overlapping the ranges of *E. amœnus monoensis*, *E. quadrivittatus frater*, *E. q. sequoiensis*, and *E. q. inyoensis*. Its range is separated from that of *E. minimus pictus* (which occurs in Mono Valley) by a considerable gap comprising the greater part of two life-zone belts—the Transition and the Canadian.

This species is most likely to be confused with *E. amœnus monoensis* but may be distinguished by somewhat smaller size, generally paler colors, decidedly paler (more grayish) hind feet, and more black on the end of the tail.

Specimens examined.—Total number, 374, as follows:

California: Alta Peak, Kaweah River (11,500 feet altitude), 15; Bullfrog Lake, Fresno County (10,600 feet altitude), 24;[75] Cirque Peak, Tulare County, 6;[75] Colby Mountain, Yosemite National Park, 1;[75] Cold Canyon, Yosemite National Park (8,00ᴗ feet altitude), 1;[75] Cottonwood Canyon, Inyo County (8,500 feet altitude), 1; Cottonwood Lakes, Inyo County (11,000 feet altitude), 35;[75] Dana Fork, Yosemite National Park, 2;[75] Glen Aulin, Yosemite National Park, 1;[75] Horse Corral Meadows, Fresno County (7,600 feet altitude), 1;[75] Independence Creek, Inyo County (10,000 feet altitude), 3; east fork Kaweah River (9,000 to 10,000 feet altitude), 13; Kearsarge Pass, 33;[75] Kings River (9,800 feet altitude), 2; Lake Tenaya, 2; Leevining Creek, Warren Fork, Mono County, 3; Little Cottonwood Creek, Inyo County, 1;[75] Lyell Canyon, Yosemite National Park, 16;[75] McClure Fork, Merced River (9,200 feet altitude), 1;[75] Merced River (near head), 1; Mineral King, 2; Mitchell Peak, Tulare County, 2;[75] Mono Pass, 6; Mount Clark, Yosemite National Park, 6;[75] Mount Conness, 1; Mount Dana, 4; Mount Florence Ridge, Yosemite National Park, 3;[75] Mount Gould, Fresno County (12,600 feet altitude), 1;[75] Mount Hoffman, Yosemite National Park, 10;[75] Mount Kearsarge, 1;[75] Mount Lyell, 22; Mount Unicorn, 12; Mount Whitney, 34;[76] Olaucha Peak (9,750 to 12,000 feet altitude), 13;[77] Onion Valley, Inyo County 13;[75] Ten Lakes, Yosemite National Park,

[75] Mus. Vert. Zool. [76] Mus. Vert. Zool., 5. [77] Mus. Vert. Zool., 8.

7;[75] Tioga Peak, Mono County (9,700 feet altitude), 1;[75] Tioga Road, near Ellery Lake, Mono County, 2;[75] Tuolumne Meadows, Yosemite National Park, 35;[78] Twin Lakes, Tulare County 3;[75] Twin Peaks, Tulare County, 1;[75] Vogelsang Lake, Yosemite National Park, 4;[75] Vogelsang Peak (9,800 feet altitude), 1;[75] Whitney Creek, Tulare County (10,650 feet altitude), 4;[75] Whitney Meadows, Tulare County, 23;[75] Young Lake, Yosemite National Park, 1.[75]

EUTAMIAS MINIMUS GROUP

EUTAMIAS MINIMUS (BACHMAN)

[Synonymy under subspecies]

Diagnosis.—Size small to medium; hind foot, 26 (*pictus*) to 35 (*cacodemus*); skull length, 28.7 (*minimus*) to 34.2 (*pallidus*); brain case suborbicular, not conspicuously flattened; rostrum relatively short and stout; interorbital constriction pronounced; coloration extremely variable; color of sides ranging from pinkish buff or light pinkish cinnamon in the paler forms (*minimus, cacodemus, caryi, pictus,* and *pallidus*) through clay color and sayal brown to ochraceous tawny in the darkest forms (*operarius, consobrinus,* and *jacksoni*); dark dorsal stripes ranging from cinnamon or pinkish cinnamon (in *cacodemus*) through sayal brown, snuff brown, and chætura black to black (in *borealis, caniceps, jacksoni,* and *atristriatus*); median pair of light dorsal stripes grayish white or smoke gray, unmixed in some forms (*caryi, pictus,* etc.) but usually more or less mixed with cinnamon or sayal brown; outer pair of light stripes white or creamy white, usually clear, rarely mixed with cinnamon; top of head ranging in general tone from pale smoke gray through mouse gray, light drab, and cinnamon to brownish drab, the colors always intimately mixed and hard to define; under surface of tail ranging from pinkish buff or light pinkish cinnamon through clay color, avellaneous, cinnamon, sayal brown, snuff brown, and mikado brown to ochraceous tawny; rump and thighs varying from pinkish buff or smoke gray to sayal brown and ochraceous tawny; hind feet grayish white, pinkish buff, pinkish cinnamon, or cinnamon buff.

EUTAMIAS MINIMUS MINIMUS (BACHMAN)

LEAST CHIPMUNK

(PLS. 6, A; 10, A)

Tamias minimus Bachman, Journ. Acad. Nat. Sci. Philadelphia 8: 71, 1839; Allen, Bul. Amer. Mus. Nat. Hist. 3: 110, June, 1890.
Eutamias minimus Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30 (no. 1): 42, December 27, 1901.

Type.—Collected on Green River, near mouth of Big Sandy Creek, Wyo. (Townsend, 1839, p. 72).

Geographic distribution.—Central and southwestern Wyoming and extreme northwestern Colorado. *Zonal range:* Upper Sonoran; 5,800 to 8,500 feet altitude. (Fig. 4.)

Characters.—Size small (hind foot, 28–30 mm.); colors pale; dark dorsal stripes (except median one) mainly brownish; sides pinkish buff; under surface of tail light brown.

Color.—Summer pelage: Head pinkish buff mixed with grayish white, the general tone near avellaneous; dark facial stripes snuff brown (sometimes fuscous) mixed with cinnamon; light facial stripes grayish white; ears drab, washed with cinnamon, the outer posterior portion grayish white; postauricular patches grayish white; median dorsal stripe narrow, black, margined on each side with sayal brown; outer dark dorsal stripes (two pairs) sayal brown, more or less mixed with fuscous; light dorsal stripes grayish white, the median pair tinged with buff; sides of body light pinkish cinnamon or pinkish buff; thighs smoke gray, more or less washed with light buff; feet pale pinkish buff; tail above fuscous black, overlaid with cinnamon buff; tail beneath, sayal brown to clay color, bordered with blackish brown and cinnamon buff; underparts creamy

[75] Mus. Vert. Zool. [78] Mus. Vert. Zool., 18.

white. *Worn winter pelage:*[79] Similar to summer pelage, but general tone of upper parts more grayish, especially in worn (spring) specimens in which the buff tones are greatly faded or nearly obliterated; head and rump more grayish; under surface of tail fading to cinnamon buff or pinkish buff.

Molt.—The spring molt occurs rather early in this race; a male specimen from Mountainview, Wyo., May 28, is in worn winter pelage, with a patch of new pelage appearing in the middle of the back; another male from Sage Creek, near

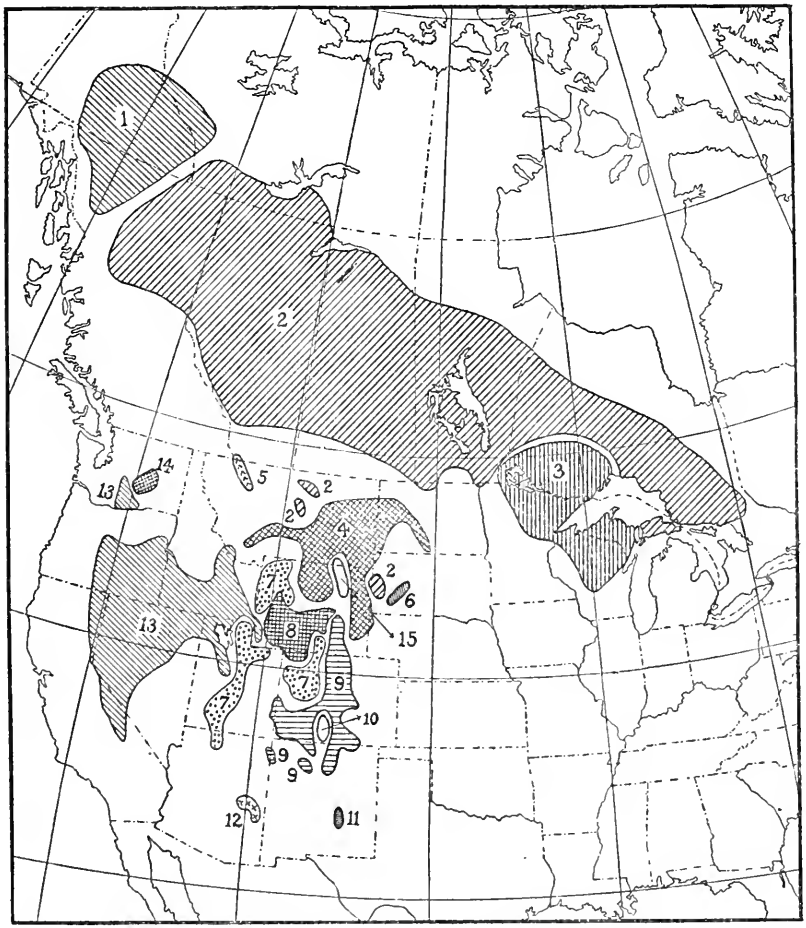

FIGURE 4.—Distribution of the subspecies of *Eutamias minimus*. 1, *E. minimus caniceps;* 2, *E. minimus borealis;* 3, *E. minimus jacksoni;* 4, *E. minimus pallidus;* 5, *E. minimus oreoceles;* 6, *E. minimus cacodemus;* 7, *E. minimus consobrinus;* 8, *E. minimus minimus;* 9, *E. minimus operarius;* 10, *E. minimus caryi;* 11, *E. minimus atristriatus;* 12, *E. minimus arizonensis;* 13, *E. minimus pictus;* 14, *E. minimus grisescens;* 15, *E. minimus confinis*

Lone Tree, Wyo., June 5, has about the anterior half of the body covered with fresh summer pelage.

Skull.—Size small; brain case evenly rounded and rather deep (not conspicuously flattened); zygomata not widely expanded (often nearly parallel to axis of skull); nasals terminating posteriorly about on the same plane with ends of premaxillaries; audital bullæ moderately inflated.

Measurements.—Average of 10 adults from southwestern Wyoming: Total length, 186.4 (178–190); tail vertebræ, 86.3 (80–90); hind foot, 29 (28–30); ear

[79] Specimens in fresh winter pelage not seen.

from notch, 10.7 (10–12). *Skull:* Average of 8 adults from Green River, Wyo.: Greatest length, 29.8 (28.7–30.4); zygomatic breadth, 17 (16.1–17.4); cranial breadth, 13.9 (13.3–14.6); interorbital breadth, 6.7 (6.2–7); length of nasals, 8.8 (8.1–9.3).

Remarks.—The least chipmunk was the second of the North American species to receive a name; it was not recognized, however, by the early writers, being considered to be the young of *Eutamias quadrivittatus*, and not until 1890, when Allen revived the name and used it in place of *pallidus* for the pale forms of Wyoming and Montana, did it come into common use.

This race occupies a comparatively limited area and is surrounded on all sides by other forms of the species, with all of which it intergrades. In the foothills of the Uinta Mountains and on the western slopes of the Wind River Mountains it passes gradually into the darker form, *consobrinus*; in the Casper Mountains and along the western border of the Medicine Bow Range it intergrades with *operarius;* in the Green Mountains, a small isolated range in central Wyoming, it shows approach to *operarius* in the darkening of the colors, although this colony is entirely surrounded by typical *minimus;* in the valley of the North Platte, between Casper and Douglas, and in the Wind River Valley near Fort Washakie, intergradation with *pallidus* takes place; and in extreme western Wyoming, between Fossil and Border, *minimus* passes into *pictus*.

Specimens examined.—Total number, 218, as follows:

Colorado: Bear River (at Sand Creek), Routt County, 1;[80] Craig, Routt County, 4;[80] Douglas Spring, Routt County, 1;[80] Ladore, 1; Lay, 2;[81] Lily, 1; Snake River, Routt County (near Lower Bridge), 8;[82] Snake River (20 miles west of Baggs, Wyo.), 1; Snake River (south of Sunny Peak), 2.

Wyoming: Bear River Divide (14 miles north of Evanston), 7; Big Piney, 1; Bitter Creek, Sweetwater County (Kinney Ranch), 40;[83] Bridger Pass, 6; Canyon Creek (12 miles south of Alcova), 2; Casper, 5; Cumberland, 7; Douglas, 7; Eden, 1; Ferris Mountains, 4; Fontenelle, 7; Fort Bridger, 13; Fort Steele, 3; Fremont Lake, 1;[80] Green River (exact location not stated), 6; Green River (Junction of New Fork), 8; Green River (4 miles north of Linwood, Utah), 1; Green River City, 14; Green Mountains (8 miles east of Rongis), 1; Henry Fork (mouth Burnt Fork), 1; Henry Fork (5 miles west of Lone Tree), 1; Independence Rock; 1, Kemmerer, 9; Lost Soldier (8 miles southeast), 1; Little Sandy River, 1;[84] Maxon, 1; Mountainview, 6; Muddy Creek (near Big Sandy Creek), 1; Opal, 3; Rattlesnake Mountains, 10; Rawlins, 1;[85] Sage Creek, Uinta County, 7; Saratoga, 2; Sheep Creek (Albany County), 5;[86] Spring Creek (10 miles west of Marshall), 1; Springvalley, 1; Steamboat Mountain (15 miles north of Superior), 4; Sulphur Springs (near Muddy Creek, Carbon County), 1; Sun, 4; Superior, 2.

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[80] E. R. Warren coll.
[81] E. R. Warren coll., 1; Colo. Agr. College, 1.
[82] E. R. Warren coll., 6; Amer. Mus. Nat. Hist., 1; Colo. Agr. College, 1.
[83] Amer. Mus. Nat. Hist., 35.
[84] Mus. Comp. Zool.
[85] Univ. Mich.
[86] Carnegie Mus.

EUTAMIAS MINIMUS PICTUS (ALLEN)

GREAT BASIN CHIPMUNK

(PLS. 6, N; 10, N)

Tamias minimus pictus Allen, Bul. Amer. Mus. Nat. Hist. 3: 115, June, 1890.
Tamias minimus melanurus Merriam, North Amer. Fauna No. 4, p. 22, October 8, 1890 (Blackfoot, Idaho).
Eutamias pictus Merriam, Proc. Biol. Soc. Washington 11: 190, 194, July 1, 1897.
Eutamias minimus pictus Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 42, December 27, 1901.

Type.—Collected at Kelton, Utah, October 25, 1888, by Vernon Bailey; ♂ adult, skin and skull; No. 186459, United States National Museum (No. $\frac{4882}{5629}$, Merriam collection; original number, 342).

Geographic distribution.—Great Basin region of northwestern Utah, southern Idaho, Nevada (except southeastern part), and eastern and central Oregon; north to central Washington and central Idaho (Lemhi); east to extreme southwestern Wyoming; south to Nephi, Utah, and Olancha Peak, Calif.; west to Klamath Lake, Oreg., Mono Lake, Honey Lake, and Olancha Peak, Calif. *Zonal range:* Upper Sonoran; 2,000 feet (Yakima County, Wash.) to 10,500 feet (White Mountains, Calif.) altitude. (Fig. 4.)

Characters.—Similar to *Eutamias m. minimus*, but general tone of upper parts more grayish, especially on the rump and thighs; tail more blackish (less tawny) above, overlaid with a paler shade of buff; paler beneath, the median portion often much obscured by the blackish borders.

Color.—*Summer pelage:* Head smoke gray, more or less mixed with light pinkish cinnamon; median dorsal stripe blackish, margined with sayal brown; outer dark dorsal stripes snuff brown varied with blackish; outer pair of light dorsal stripes white; inner pair grayish white, mixed with sayal brown; sides pinkish cinnamon, soon fading to light pinkish cinnamon; rump and thighs smoke gray; feet grayish white, washed with pale pinkish buff; tail above blackish brown, the hairs tipped with pinkish buff; tail beneath, light pinkish cinnamon or pale avellaneous, bordered with blackish and edged with pale pinkish buff (the median area often largely overlaid with blackish hairs); under parts creamy white. *Winter pelage:* Closely similar to that of *minimus*, but averaging slightly more grayish dorsally, and paler on under side of tail. Similar to summer pelage of *pictus* but upper parts more extensively grayish (less buffy), especially on head, nape, and shoulders.

Molt.—A male specimen from Inyo Mountains, Calif., June 26, is in greatly worn winter pelage, with a small patch of new pelage appearing in the middle of the back; an adult female from White Mountains, Calif., July 8 shows the new pelage coming in irregularly in patches over the back. The fall molt is well shown by a specimen (♀ adult) from Burns, Oreg., October 9, in which the gray winter pelage is seen covering the rump and hinder back.

Skull.—Practically identical with that of *minimus*.

Measurements.—Average of 10 adults from Kelton, Promontory, and Nephi, Utah: Total length, 186.1 (175–200); tail vertebræ, 85.6 (82–90); hind foot, 29 (27.5–30); ear from notch, 10.6 (10–11.5). *Skull:* Average of eight adults from Kelton and Nephi, Utah: Greatest length, 29.9 (28.8–30.4); zygomatic breadth, 16.5 (16.1–17.1); cranial breadth, 13.2 (13.1–13.8); interorbital breadth, 6.4 (6.3–6.6); length of nasals, 9.1 (8.4–9.9). *Weight:* Average of 10 adults, 35 grams (30.3–37.7) (*Fide* Grinnell and Storer, 1924, p. 177).

Remarks.—This race has a very wide distribution and shows relatively little variation over its entire range. The colony from the west side of the Columbia River, in the Yakima region, although apparently isolated from the rest of the subspecies (fig. 4), shows closer resemblance to the typical form than to *grisescens*. Some of the specimens from Mabton, however, show approach to the latter in the broad, gray, median dorsal stripes. Intergradation with *minimus* takes place in extreme western Wyoming (at Border, Cokeville, Sage, and Fossil).

This subspecies is preeminently an inhabitant of the sagebrush plains, but in many places it ascends into the foothills and under these conditions usually becomes darker, thus approaching *consobrinus* in characters. This condition is well shown by specimens from Fairfield and Nephi, Utah, and Montpelier, Idaho. A single specimen from Donovan, Mont., is typical *pictus*, indicating that this form has pushed eastward from Idaho across the divide. At Dillon, Mont., a few miles farther east, *pictus* meets the range of *pallidus*, specimens from that place being considered intermediate between the two races.

Specimens examined.—Total number, 858, as follows:

California: Alturas, 2;[87] Amedee, 10; Beckwith Pass, Lassen County, 4; Benton, Mono County, 4;[87] Bishop Creek, Inyo County (7,000 feet altitude), 1; Bridgeport, Mono County, 1; Browneli, 15; Bunchgrass Spring (Lassen County), 3; Cedarville, 1; Chat, 2; Davis Creek (Modoc County), 1; Fort Sage Mountain (Lassen County), 4;[88] Honey Lake (15 miles south), 1; Hot Springs, Mono County, 1;[88] Inyo Mountains, 20;[89] Junction, Mono County, 1; Long Valley, Lassen County, 3; Madeline, 1;[87] Madeline Divide, 3; Mammoth, Mono County, 3; Menache Meadows (5 miles southwest of Olancha Peak), 2; Milford (Honey Lake), 1; Mono Lake, 71;[90] Mount Hebron, 14; Olancha Peak (9,000 to 9,750 feet altitude), 2;[91] Owens River (head), 1; Owens Valley (Benton), 2; Pitt River (south fork, 4,100 feet altitude), 1; Plumas Junction, Lassen County, 1;[87] Tuledad Canyon (northeast corner of Lassen County), 2; Vinton (Sierra Valley), 5;[91] Walker Lake, Mono County, 1; Warner Mountains, 8; White Mountains, 66.[92]

Idaho: American Falls, 9; Arco, 1; Big Lost River, 18; Birch Creek (including mountains east of Birch Creek Valley), 21; Blackfoot, 13; Bridge, Cassia County, 2; Deer Flats (near Caldwell), 2; Dickey, 3; Dubois, 2; Idaho Falls, 2; Junction, 2; Juniper, Oneida County, 2; Lemhi, 7; Lemhi Valley, 1; Little Lost River, 5; Malad City, 3; Minidoka, 6; Montpelier, 2; Nampa, 3; Orchard, Ada County, 2; Pahsimeroi Mountains, 1; Pahsimeroi Valley, 7; Patterson, 1; Pocatello, 6; Riddle (15 miles southeast), 1; Salmon Valley (near Sawtooth City), 1; Shelley, 2; Shoshone, 6; Silver City, 3; Twin Lakes, Snake River Desert (20 miles north of Minidoka), 2.

Montana: Donovan, 1.

Nevada: Arc Dome, 1; Austin, 16; Badger, 3; Bull Run Mountains, 2; Carlin, 1;[93] Carson, 4; Cloverdale Creek, 1; Cottonwood Range, 2; Double Springs, Douglas County, 1;[88] Elko, 3; Gardnerville, 1;[94] Golconda, 2; Granite Creek (Humboldt County), 3; Halleck, 40; Holbrook, Douglas County, 1;[88] Little Owyhee River, 7; Manhattan, 1; Monitor Mountains, (25 miles southwest of Eureka), 2; Monitor Valley (30 to 50 miles north of Belmont), 2; Mountain City, Elko County, 10; Mount Magruder, 6; Mount Siegel, Douglas County, 4;[95] Palisade, 8; Pine Forest Mountains, 26;[87] Pyramid Lake, 2; Queen Station, Owens Valley, 1; Quinn River Crossing, 22;[87] Reese River (at line between Lander and Nye Counties), 6; Reese River (head), 6; Reno, 1; Ruby Mountains, 2; Silver Creek, Lander County, 2; Silver Peak Mountains (near summit), 1; Sugar Loaf, Douglas County, 3;[88] Summit Lake, Humboldt County, 3; Verdi, 3; Virgin Valley, Humboldt County, 3; Washoe County (15 miles southeast of Lower Lake, California), 1; Wells, 10; White Rock Valley (30 miles southwest of Austin), 1; Winnemucca, 1.

Oregon: Alvord Valley, 1; Arnold Ice Cave (16 miles southeast of Bend), 2; Baker, 8;[96] Beulah, 2; Bone Springs, Sheephead Mountains (Malheur County), 3; Buchanan, 2; Burkemont, Baker County, 1;[95] Burns, 18; Camp Creek (Crook County), 2; Cedar Mountains (Malheur County), 3; Christmas Lake (15 miles north), 1; Cold Springs, Malheur County (southeast of Riverside), 1; Cord (6 miles west), 1; Cow Creek Lake,

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[87] Mus. Vert. Zool.
[88] Mus. Comp. Zool.
[89] Mus. Vert. Zool., 4.
[90] Mus. Vert. Zool., 23.
[91] Mus. Vert. Zool., 1
[92] Mus. Vert. Zool., 56.
[93] Univ. Mich.
[94] Acad. Nat. Sci. Philadelphia.
[95] Amer. Mus. Nat. Hist.
[96] Univ. Mich., 7; Amer. Mus. Nat. Hist., 1.

Malheur County, 1; Crane, 3; Crooked Creek (near Rome), 1; Diamond, 2; Foster, Harney County, 2;[97] Fremont, 4; Ironside, 20;[95] Jordan Valley, Malheur County, 1; Lake Alvord, 4; Lost Creek Canyon, Lake County, 2;[97] Lost River, Klamath Basin, 5; Mahogany Mountain, Malheur County, 3; Malheur County, 8;[95] McDermitt, 5; Narrows, 10; Ontario, 9; Prineville, 6; Riverside, 8; Rock Creek Sink (Harney County), 5; Rome, 2; Ryegrass, Owyhee Desert, 4; Silver Lake, 2; Skull Spring, Malheur County, 8; Steens Mountains, 3; Tule Lake, 1; Tumtum Lake, 9; Vale, 3; Voltage, 6.

Utah: Kelton, 8; Mantua, 1; Nephi, 6; Promontory, 2.

Washington: Bickleton (10 miles northeast), 1; Columbia River (10 miles south of Priest Rapids), 1; Ellensburg, 5; Mabton, 13; North Yakima, 8; Wiley City (10 miles west of Yakima), 3.

Wyoming: Border, 4; Cokeville, 5; Fossil, 7; Sage, 2.

EUTAMIAS MINIMUS GRISESCENS Howell

Coulee Chipmunk

(Pls. 6, m; 10, m)

Eutamias minimus grisescens Howell, Journ. Mamm. 6: 52, February 15, 1925.

Type.—Collected at Farmer, Douglas County, Wash. July 31, 1897, by J. Alden Loring; ♂ subadult, skin and skull; No. 89701, United States National Museum (Biological Survey collection); original number, 4539.

Geographic distribution.—Coulee region of eastern Washington, east of the Columbia River; south to Pasco. (Fig. 4.)

Characters.—Similar to *Eutamias minimus pictus*, but smaller, especially the hind feet; coloration decidedly more grayish and less buffy; dark dorsal stripes relatively narrow and median pair of light stripes much broader; tail averaging paler and more grayish.

Color.—*Summer pelage* (type, July 31): Head smoke gray, mixed with light pinkish cinnamon; facial stripes chætura drab shaded with pale sayal brown; median dorsal stripe narrow, black, bordered with sayal brown, becoming less blackish anteriorly; other dark dorsal stripes also narrow (the lateral stripes slightly broader), sayal brown, shaded with fuscous; median pair of light stripes broad, smoke gray; outer pair of light stripes narrower, white; ears hair brown externally, broadly margined posteriorly with light buff and washed on anterior margin with sayal brown; inner surface of ear light ochraceous buff; sides smoke gray, faintly washed with pale pinkish buff; feet pinkish buff; tail above, blackish, overlaid with pale smoke gray; tail beneath, pinkish buff, becoming paler and more grayish toward tip, bordered with blackish and tipped with pale smoke gray; underparts grayish white.

Skull.—Similar to that of *E. minimus pictus*, but averaging slightly narrower with shorter nasals.

Measurements.—Average of seven (adult and subadult) from type region: Total length, 177 (167–188); tail vertebræ, 78.7 (74–87); hind foot, 26.8 (26–28); ear from notch, 10.6 (10–11). *Skull:* Average of four (adult and subadult) from type region: Greatest length, 29.7 (29.3–30.2); zygomatic breadth, 15.9 (15.6–16.3); cranial breadth, 13.2 (13–13.4); interorbital breadth, 6.6 (6.5–6.7); length of nasals, 8.5 (8.3–8.9).

Remarks.—This race apparently occupies a very restricted area in eastern Washington, being found in its typical form only in the "Coulee" region east of the Columbia River.

Intergradation with *pictus* takes place in the Yakima region, west of the Columbia River.

Specimens examined.—Total number, 11, as follows:

Washington: Coulee City, 3; Douglas, 1; Farmer, 2; Moses Coulee, 1; Pasco, 4.

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[95] Amer. Mus. Nat. Hist. [97] A. H. Helme coll.

EUTAMIAS MINIMUS CARYI Merriam

Cary's Chipmunk

(Pls. 6, d; 10, d)

Eutamias minimus caryi Merriam, Proc. Biol. Soc. Washington 21: 143, June 9, 1908.

Type.—Collected at Medano Ranch, San Luis Valley, Colo., October 24, 1907, by Merritt Cary; ♂ subadult, skin and skull; No. 150740, United States National Museum (Biological Survey collection); original number, 1176.

Geographic distribution.—San Luis Valley, Colo. (limits of range unknown). *Zonal range:* Upper Sonoran. (Fig. 4.)

Characters.—Closely similar to *Eutamias m. minimus*, but general tone of upper parts slightly more grayish in winter pelage; shoulders and rump more extensively grayish; hind feet slightly larger.

Color.—Winter pelage (October 24): Head light drab, washed with pinkish cinnamon in front of eyes; stripe through eye usually blackish, becoming sayal brown at base of ear; other facial stripes sayal brown, the light stripes grayish white; ears fuscous, margined with sayal brown anteriorly, and with a large grayish white patch on anterior border; nape and shoulders washed with smoke gray; median dorsal stripe blackish, margined with sayal brown; other dark dorsal stripes sayal brown, mixed with fuscous black; median pair of light stripes smoke gray, outer pair white; sides light pinkish cinnamon; rump and thighs smoke gray; feet pinkish buff; tail above, fuscous, overlaid with pinkish buff; beneath, sayal brown to clay color, fading to cinnamon buff; under parts white. *Summer pelage* (topotype, June 22; tail in worn winter pelage): Closely similar to *minimus* in corresponding pelage; sides richer, and shoulders and thighs less grayish (more cinnamon) than in winter pelage.

Skull.—Practically identical with that of *minimus*.

Measurements.—Average of 12 adults from type locality: Total length, 192.6 (186–200); tail vertebræ, 87.9 (83–96); hind foot, 30.2 (29–31); ear from notch, 10.1 (9–11). *Skull:* Average of 10 adults from type locality: Greatest length, 30 (29.6–30.8); zygomatic breadth, 16.9 (16.4–17.2); cranial breadth, 13.9 (13.4–14.7); interorbital breadth, 6.6 (6–7); length of nasals, 9 (8.7–9.3).

Remarks.—Cary's chipmunk is very closely related to typical *minimus* with which it agrees almost exactly in coloration in summer pelage, but is distinctly more grayish in winter. Its range, however, is widely separated from that of *minimus*, since it is confined to the bottom of the San Luis Valley and is entirely surrounded by the darker and larger subspecies, *operarius*, occupying the adjacent mountains. Intergradation with *operarius* is indicated by specimens from the mouth of Mosca Pass, at 8,200 feet altitude.

Specimens examined.—Total number, 28, as follows:

Colorado: Medano Ranch (15 miles northeast of Mosca), 24;[98] Mosca, 2;[99] San Luis Lake, 2.[99]

EUTAMIAS MINIMUS PALLIDUS (Allen)

Plains Chipmunk

(Pls. 6, e; 10, e)

Tamias quadrivittatus b. var. *pallidus* Allen, Proc. Boston Soc. Nat. Hist. 16:289, 1874.

Tamias asiaticus var. *pallidus* Allen, Monog. North Amer. Rodentia: U. S. Geol. Surv. Terr. 11: 793, 1877 (part).

Eutamias pallidus Cary, Proc. Biol. Soc. Washington 19: 87–88, June 4, 1906.

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[98] E. R. Warren coll., 11. [99] E. R. Warren coll.

Type (lectotype).—Collected at Camp Thorne (near Glendive), Mont., July 18, 1873, by J. A. Allen; skin and skull; No. $\frac{11656}{38311}$, United States National Museum; original number, 200. Type locality fixed by Cary (1906, p. 88).

Geographic distribution.—Plains region of eastern Montana, northern and eastern Wyoming, western North Dakota, western South Dakota, and extreme northwestern Nebraska; north to the Missouri River in Montana; east to the Missouri River in North Dakota; south to the valley of the North Platte in eastern Wyoming and to the Wind River Basin in western Wyoming; west to Meagher and Sweet Grass Counties, Mont., and to the foothills of the Wind River Mountains, Wyoming. *Zonal range:* Upper Sonoran and Lower Transition; 4,500 to 7,500 feet altitude. (Fig. 4.)

Characters.—Closely similar in color to *Eutamias m. minimus*, but underside of tail averaging paler; size decidedly larger.

Color.—*Summer pelage* (July and August): Head pale smoke gray, mixed with pinkish buff; median dorsal stripe blackish, bordered with sayal brown; other dark dorsal stripes sayal brown mixed with fuscous; median pair of light stripes pale smoke gray; outer pair white; sides light pinkish cinnamon; rump and thighs smoke gray, tinged with pale buff; feet pinkish buff; tail above, fuscous black overlaid with pale pinkish buff; beneath, pinkish cinnamon or pinkish buff, bordered with fuscous black and edged with pale pinkish buff. *Winter pelage* (May 29): Head, nape, shoulders, rump, thighs, and median pair of light dorsal stripes dark smoke gray; two outer pairs of dark dorsal stripes mixed fuscous and sayal brown, the general tone near bister; sides pinkish buff; underside of tail between clay color and sayal brown; otherwise as in summer.

Molt.—An adult male specimen from Big Timber, Mont., June 22, is in worn winter pelage, with the new summer pelage beginning to appear in scattered patches over the back; an adult female from Bighorn Basin, Mont., July 18, is likewise in greatly worn winter pelage, with the new pelage appearing on the sides of the head and neck and in a patch in the middle of the back; another female from Marmarth, N. Dak., July 31, has the anterior portion of the body completely covered with fresh pelage, the rump and hinder back still in worn and faded winter pelage.

Skull.—Similar in general proportions to that of *minimus*, but decidedly larger; closely similar, also, to that of *borealis;* audital bullæ averaging slightly larger.

Measurements.—Average of 12 adults from eastern Montana: Total length, 208.4 (197–223); tail vertebræ, 96.7 (91–104); hind foot, 33.1 (32–34); ear from notch, 13 (12–14.5). *Skull:* Average of 10 from eastern Montana: Greatest length, 32.7 (32–34.2); zygomatic breadth, 18.6 (17.8–19.2); cranial breadth, 14.9 (14.5–15.5); interorbital breadth, 7.4 (7.1–7.8); length of nasals, 10.1 (9.8–10.3). *Weight:* One subadult male from Sanish, N. Dak., 38 grams.

Remarks.—This pale race was recognized and named by Allen as early as 1874, but later was referred by him to *minimus* (Allen, 1890, p. 110). Cary (1906, pp. 87–88), restored *pallidus* and treated it as a full species, fixing the type locality at Camp Thorne, Mont. It resembles *minimus* very closely in coloration but is decidedly larger.

Intermediates between *pallidus* and *minimus* occur in the upper Bighorn Basin, the Owl Creek Mountains, and in the valley of the North Platte between Casper and Douglas, Wyo. A specimen from the foothills of the Laramie Mountains, 15 miles southwest of Wheatland, Wyo., shows approach to *operarius*, while numerous specimens intermediate between *pallidus* and *borealis* have been examined from the foothills of the Black Hills near Elk Mountain and Belle Fourche, S. Dak., the foothills of the Little Rockies near Zortman, Mont., and from Crow Agency, Mont. A small series from Sioux County, Nebr., is nearly typical *pallidus*, although from their proximity to the range of *cacodemus*, one would expect to find intermediates between these two races in this region.

Specimens examined.—Total number, 310, as follows:

Montana: Alzada, 1; Ashland, 1; Big Timber, 2; Big Timber Creek (8–10 miles north of Big Timber), 2; Billings, 20; Calf Creek (Custer County), 1; [1] Camp Thorne, Yellowstone River, 2; Columbus, 1; Crow Agency, 10; Darnell's Ranch, Dawson County (on Missouri River), 2; Dillon, 4; Dry Creek (22 miles southwest of Cohagen), 1; Ekalaka, 6; Fort Custer, 4; Jensen's Ranch, Musselshell County, 1; [2] Judith River, 1; Lame Deer, 4; Laurel (8 miles northwest), 1; Little Bighorn River (14 miles south of Crow Agency), 1; Miles City, 1; Moorhead, 17; Musselshell, 6; [3] Painted Robe Creek, Yellowstone County, 3; Piney Buttes, 7; Powderville, 7; Ringling, 2; Roundup, 11; Sage Creek, Bighorn Basin, 5; Sioux National Forest (8 miles east of Sykes), 2; Sumatra, 3; Sunday Creek, 1; Sykes (5 miles east), 2; Terry (10 miles north), 4; Yellowstone River, 3.

Nebraska: Glen, Sioux County, 3; [4] Harrison (6 miles northwest), 5; Monroe Canyon, Sioux County, 1; [4] Sowbelly Canyon, Sioux County, 1; [4] Warbonnet Canyon, Sioux County, 8.[5]

North Dakota: Buford, 10; Goodall, 3; Grinnell, 14; Marmarth, 5; Medora, 5; North Dakota National Forest, 2; Oakdale, 10; Palace Buttes (6 miles north of Cannon Ball), 5; Parkin, 3; Quinion, 1; Sentinel Butte, 1; Williston, 7.

South Dakota: Belle Fourche, 1; Edgemont, 1; Elk Mountain (20 miles north, at 6,000 feet altitude), 6.

Wyoming: Arvada, 7; Bitter Creek, near Powder River, 1; Bridger Creek (head), 2; Fort Washakie, 6; Greybull, 4; Guernsey, 1; Hyattville, 1; Jackeys Creek (3 miles south of Dubois), 3; Laramie County, 1; [6] Manderson (10 miles south), 1; Merino, 3; Moorcroft, 8; Newcastle, 2; North Platte River, 1; [7] Otter Creek, Bighorn Basin, 2; Otto, 5; [1] Owl Creek Mountains, 4; Pine Ridge, 3; Powder River (at mouth of Clear Creek), 2; Powder River Basin (near Pumpkin Buttes), 2; Rawhide Butte (Goshen County), 3; Sheridan, 3; Ten Sleep (10 miles south and 15 miles west), 3; Thornton, 2; Upton, 2; Wheatland (15 miles southwest), 1; Willow Creek (10 miles southwest of Thermopolis), 1; Wind River (near mouth of Meadow Creek), 1; Wind River Basin (near Wood Flat), 4.

EUTAMIAS MINIMUS CACODEMUS Cary

Badlands Chipmunk

(Pls. 6, f; 10, f)

Eutamias pallidus cacodemus Cary, Proc. Biol. Soc. Washington 19: 89, June 4, 1906.

Type.—Collected at head of Corral Draw, Sheep Mountain, Big Badlands, South Dakota, September 2, 1905, by Merritt Cary; ♂ adult, skin and skull; No. 138137, United States National Museum (Biological Survey collection); original number, 682.

Geographic distribution.—Badlands of the Cheyenne River in southwestern South Dakota. *Zonal range:* Upper Sonoran. (Fig. 4.)

Characters.—Similar to *Eutamias minimus pallidus* but much paler; tail and hind feet relatively longer; ears smaller.

Color.—Summer pelage (August): Head tilleul buff varied with pale smoke gray; facial stripes cinnamon, shaded with sayal brown; the stripes bordering the crown often mixed with olive brown; ears pinkish buff, becoming grayish white on posterior border; nape more or less washed with pale smoke gray; dark dorsal stripes cinnamon or pinkish cinnamon, shaded with fuscous, the median stripe darkest and sometimes distinctly black, especially on posterior half; median pair of light stripes pale smoke gray, outer pair white; rump and thighs smoke gray, tinged with pale buff; sides pinkish buff or light pinkish cinnamon; feet pinkish buff or light pinkish buff; tail above, fuscous black, heavily overlaid with pale pinkish buff; tail beneath, pinkish buff or light pinkish cinnamon,

[1] Amer. Mus. Nat. Hist.
[2] Mont. State College.
[3] Mont. State College, 4.
[4] Univ. Nebr.
[5] Carnegie Mus. 1; Univ. Nebr., 7.
[6] Kans. Univ. Mus.
[7] Mus. Comp. Zool.

bordered with fuscous and edged with pale pinkish buff; underparts creamy white. *Worn winter pelage* (May): Similar to the summer pelage, but general tone of upper parts more grayish (less ochraceous), the tail beneath about cartridge buff, edged with grayish white.

Skull.—Similar to that of *pallidus* but averaging smaller; considerably larger than that of *minimus*.

Measurements.—Average of seven adults from type locality: Total length, 214.6 (210–225); tail vertebræ, 102 (97–105); hind foot, 34.6 (34–35); ear from notch, 11.7 (10.5–13). *Skull:* Average of 12 adults from Cheyenne River region: Greatest length, 32.3 (31.4–33.4); zygomatic breadth, 18.3 (17.5–19); cranial breadth, 14.8 (14.2–16.5); interorbital breadth, 7 (6.6–8.2); length of nasals, 9.9 (9.2–10.4).

Remarks.—The Badlands chipmunk is the palest known member of the genus; it has a rather limited range in the Badlands along the Cheyenne and White Rivers in South Dakota, in a region of whitish alkaline soil and very scanty vegetation. It doubtless intergrades with *pallidus* wherever their ranges meet.

Specimens examined.—Total number, 32, as follows:

South Dakota: Cheyenne River Badlands, 13; Corral Draw, Pine Ridge Indian Reservation, 12;[8] Sheep Mountain (head of Corral Draw), 7.

EUTAMIAS MINIMUS CONFINIS Howell

Bighorn Chipmunk

Eutamias minimus confinis Howell, Journ. Mamm. 6: 52, February 15, 1925.

Type.—Collected at head of Trapper Creek (8,500 feet altitude), west slope of Bighorn Mountains, Wyo., June 7, 1910, by Merritt Cary; ♀ adult, skin and skull, No. 168957, United States National Museum (Biological Survey collection); original number, 1956.

Geographic distribution.—Upper slopes of the Bighorn Mountains, Wyo. (7,000 to 10,500 feet). (Fig. 4.)

Characters.—Similar to *consobrinus* but larger; upper parts in winter pelage more buffy (less grayish) particularly on the thighs and buttocks; median pair of light dorsal stripes strongly mixed with buff (less clear gray); dark dorsal stripes blackish, mixed with ochraceous tawny (in *consobrinus* nearly russet); hind feet paler; in summer pelage, dark dorsal stripes averaging less blackish and thighs more buffy. Compared with *pallidus:* Upper parts, sides, and under surface of tail decidedly darker. Compared with *oreoœctes:* Closely similar in color, but ears showing conspicuous blackish patches; postauricular patches less conspicuous and more buffy (less whitish); nape usually washed with smoke gray; hind feet paler (less tawny). Compared with *borealis:* Upper parts more grayish (less tawny); dorsal stripes less blackish; sides and tail paler.

Color.—*Summer pelage* (September): Head mixed cinnamon and pale smoke gray, and bordered with a fuscous black stripe; dark facial stripes fuscous black, shaded with tawny; light facial stripes buffy white; anterior portion of ears fuscous black; posterior portion smoke gray; postauricular patches rather small (often inconspicuous), buffy white; nape usually more or less washed with smoke gray; dark dorsal stripes black or fuscous black, more or less shaded or mixed with tawny or tawny-olive; light dorsal stripes creamy white, the median pair sometimes pale smoke gray; sides of body pale tawny olive or clay color; thighs and buttocks pale Saccardo's umber, shaded with fuscous; feet pinkish buff; tail above, black, mixed with clay color; tail beneath, clay color, bordered with black; underparts creamy white. *Worn winter pelage* (June): General tone of upper parts paler and more grayish than in summer; sides of body pinkish buff; thighs smoke gray, washed with tawny olive; hind feet paler.

Molt.—The midsummer molt apparently begins late in July; two adult females taken July 25 are still in winter pelage, while a third one taken the same day shows new summer pelage covering the anterior two-thirds of the back and most of the sides. Quite likely some of the males begin to molt earlier than this date.

Skull.—Similar to that of *pallidus* and of *oreoœctes*, but averaging smaller; decidedly larger and relatively broader than that of *consobrinus*.

[8] Amer. Mus. Nat. Hist., 10; Field Mus. Nat. Hist., 2.

Measurements.—Average of 11 adults from Bighorn Mountains: Total length, 203 (198–210); tail vertebræ, 91.5 (88–95); hind foot, 32.3 (31–33); ear from notch, 12.7 (11.5–14). *Skull:* Average of 10 adults from same localities: Greatest length, 31.7 (30.9–32); zygomatic breadth, 18 (17.3–18.5); cranial breadth, 15.7 (15.4–16.1); interorbital breadth, 7.2 (6.8–7.5); length of nasals, 9.9 (9.4–10.5).

Remarks.—The Bighorn chipmunk is closely related to *pallidus*, which occupies the surrounding plains, but like all the mountain forms in this group it is darker than the plains form. It is also closely similar to *oreocetes* of the high mountains of northern Montana, but differs from it in a few minor characters, and occupies an area widely separated from the range of that race. From *consobrinus*, which occupies the high mountains in western Wyoming, it differs both in size and color.

Specimens examined.—Total number, 29, as follows:

Wyoming: Bighorn Mountains, 29 (including head of Trapper Creek, Bighorn County, 15; head of Canyon Creek, Washakie County, 11; head of north fork of Powder River, Johnson County, 1; 20 miles from Sheridan, 2).

EUTAMIAS MINIMUS CONSOBRINUS (ALLEN)

WASATCH CHIPMUNK

(PLS. 2, B; 6, B; 10, B)

Tamias minimus consobrinus Allen, Bul. Amer. Mus. Nat. Hist. 3: 112, June, 1890.

Eutamias minimus consobrinus Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 42, December 27, 1901.

Eutamias lectus Allen, Brooklyn Inst. Mus. Science Bul. 1: 117, March 31, 1905 (Beaver Valley, Utah).

Eutamias consobrinus clarus Bailey, Proc. Biol. Soc. Washington 31: 31, May 16, 1918. (Swan Lake Valley, Yellowstone National Park, Wyo.).

Type.—Collected in Parleys Canyon, Wasatch Mountains, near present site of Barclay, Utah, October 31, 1888, by Vernon Bailey; ♂ adult, skin and skull; No. 186456, United States National Museum (No. $\frac{4883}{5630}$, Merriam collection); original number, 361.

Geographic distribution.—Western Wyoming, extreme eastern Idaho, northern and south-central Utah, north-central Arizona, and northwestern Colorado; north to the Beartooth Mountains, southern Montana; east to the Wind River Mountains, Wyo., and Grand and Gunnison Counties, Colo.; south to Sapinero, Colo., and the Kaibab Plateau, Ariz.; west to the Wasatch and Beaver Mountains, Utah. *Zonal range:* Transition and Canadian; 6,200 feet (Meeker, Colo.) to 11,800 feet (La Sal Mountains, Utah). (Fig. 4.)

Characters.—Similar to *Eutamias m. minimus* but much darker throughout, the dorsal and facial stripes more blackish, and the upper parts and sides more rufescent.

Color.—*Summer pelage* (July and August): Crown and occiput mixed smoke gray and ochraceous tawny, bordered on each side with a fuscous stripe; facial stripes fuscous or fuscous black, mixed with tawny, the ocular stripe darkest; postauricular patches rather small, grayish white; median dorsal stripe black, bordered with tawny; outer dark dorsal stripes mixed blackish and tawny; median pair of light stripes grayish white, often clouded with tawny; outer pair white; rump and thighs smoke gray, washed with cinnamon buff; sides ochraceous tawny or light sayal brown; feet light pinkish cinnamon or pinkish buff; tail above, fuscous black, overlaid with cinnamon buff; tail beneath, snuff brown, bordered with fuscous black and edged with cinnamon buff; underparts grayish white, faintly tinged with buff. *Winter pelage* (September 27): General tone of upper parts and sides more grayish (less tawny) than the summer pelage; head, nape, median pair of light dorsal stripes, rump, and thighs about mouse gray, slightly mixed with tawny; dark dorsal stripes bister; sides sayal brown.

Molt.—An adult female from Inkom, Idaho, June 20, shows the summer pelage appearing somewhat irregularly over the anterior portion of the back and sides; another female from Surveyors Park, near Pinedale, Wyo., July 21, has the molt about half completed.

Skull.—Closely similar to that of *minimus*, averaging slightly larger.

Measurements.—Average of 15 adults from Wasatch and Uinta Mountains, Utah: Total length, 192.8 (181–201); tail vertebræ, 87.2 (80–94); hind foot, 29.9 (29–31); ear from notch, 11.4 (10.5–12). *Skull:* Average of eight adults from Wasatch Mountains: Greatest length, 30.3 (30–31); zygomatic breadth, 16.9 (16.3–17.5); cranial breadth, 14.2 (13.4–14.6); interorbital breadth, 6.7 (6.5–7); length of nasals, 9.3 (9–10.1).

Remarks.—The Wasatch chipmunk has an extensive range in the Rocky Mountain region and is apparently separated into several more or less isolated colonies. (See map.) There is considerable individual variation in the subspecies, but no differences correlated with geographic distribution have been discovered.

Comparison of the type of *E. lectus* Allen with a series of seven topotypes shows it to be referable to *consobrinus;* the type of *consobrinus* is exactly matched by a topotype of *"lectus"*; the series of *"lectus"* as a whole is slightly paler, especially on the rump and thighs, than a comparable series of *consobrinus*, thus showing approach to *pictus;* the same differences are shown, also, by a series from the Kaibab Plateau, Ariz.

E. consobrinus clarus of Bailey is also referred to the present race, it being considered intermediate between *consobrinus* and *pallidus*. The type of *"clarus"* is in fresh fall pelage (September 13) and is very slightly paler than September specimens of *consobrinus* from the Wasatch Mountains, the tails being of the same color.

The present race intergrades with *minimus* on the western slopes of the Wind River Mountains and the northern slopes of the Uinta Mountains; with *pictus* on the western slopes of the Wasatch Mountains; and with *operarius* at many places in western Colorado and eastern Utah.

Specimens examined.—Total number, 447, as follows:

Arizona: Bright Angel Spring, Kaibab Plateau, 1; De Motte Park, Kaibab Plateau, 9; Tunitcha Mountains, 6.

Colorado: Allenton, Eagle County, 9;[9] Almont, 1; Axial Basin, 2; Baxter Pass, Book Plateau, 1; Big Beaver Creek, Rio Blanco County, 5;[10] Buffalo Pass Road, Jackson County (altitude, 10,430 feet), 3;[11] Cameron Pass, Jackson County, 1;[11] Canadian Creek, 7; Cedar Springs, Routt County, 2;[11] Chambers Lake, Larimer County, 3;[11] Coyote Basin, Routt County, 1;[11] Crawford, Delta County, 1;[11] Crested Butte, 11;[12] Eagle, Eagle County, 2;[11] Egeria Pass, Routt County, 2;[11] Elkhead Mountains (20 miles southeast of Slater), 1; Forest Reserve Camp, Gunnison County, 2;[11] Grand Lake, Grand County, 2;[11] Gypsum, 2; Hahn Peak, 1; Hell Creek, Jackson County, 2;[11] Homestead Ranch, Jackson County, 7;[13] Kremmling, 2;[11] Kremmling (12 miles north), 1; Lay, 1; McCoy Road, Grand County, 1;[11] Meeker, 14;[14] Minturn, Eagle County, 1;[11] Mount Meeker, 1;[15] Mount Whitely, 3; Mount Zirkel, Jackson County, 3;[16] Mud Springs, Garfield County, 6;[17] Oak Creek, Routt County, 1;[11] Pearl, 1; Rabbit Ear Mountains (Arapahoe Pass), 7; Rangely, 1; Red Cliff, Eagle County, 1;[11] Rio Blanco, 1; Roan Plateau (5–14 miles southeast of Dragon, Utah), 3; Sapinero, 3; Sheep-

[9] E. R. Warren coll., 5; Colo. Agr. College, 1; Amer. Mus. Nat. Hist., 2; Univ. Wis., 1.
[10] E. R. Warren coll., 4; Amer. Mus. Nat. Hist., 1.
[11] E. R. Warren coll.
[12] E. R. Warren coll., 9; Mus. Comp. Zool., 2.
[13] Colo. Mus. Nat. Hist.
[14] E. R. Warren coll., 7; Amer. Mus. Nat. Hist., 3.
[15] Amer. Mus. Nat. Hist.
[16] E. R. Warren coll., 2; Colo. Mus. Nat. Hist., 1.
[17] E. R. Warren coll., 5; Amer. Mus. Nat. Hist., 1.

horn Pass, Grand County, 9;[18] Steamboat Springs, 7;[19] Sulphur Springs, Grand County, 20;[20] Twin Lakes, 1; White River (20 miles south of Rangely), 1; White River Plateau (25 miles southeast of Meeker), 9; Yampa, 3;[21] Yarmany Creek, Eagle County, 1.[11]

Idaho: Crow Creek (head), 1; Gray Lake (10 miles east), 1; Inkom, 1; Irwin (10 miles southeast), 2; Montpelier Creek, 1; Swan Lake, 6.

Montana: Yellowstone, Gallatin County, 1.[22]

New Mexico: Chuska Mountains, 1; Lukachukai Mountains (8,000 feet altitude), 7.

Utah: Baldy Ranger Sta., Manti Nat. Forest, 3; Barclay, 5; Beaver Mountains, 15; Beaver Valley, 7;[23] Blacksmith Creek, 4; Buckskin Valley, 1; Coalville, 1; Currant Creek, Uinta Forest, 8; Ephraim, 2; Fairfield, 15; Fish Lake Plateau, 10; Laketown, 2; Panguitch, 1; Panguitch Lake, 2; Parawan Mountains (Brian Head), 17; Park City, 7; Salt Lake City (Fort Douglas), 1; Thurber, 1; Uinta Mountains (south of Fort Bridger, Wyoming), 10; Uncompahgre Indian Reservation, 1; Wasatch Mountains (18 miles east of Salt Lake City), 1; Wasatch Mountains (near Soldier Summit), 1.

Wyoming: Beartooth Lake, 8; Big Sandy, 6; Bridger Peak, 3; Bronx, Fremont County, 4;[24] Bunsen Peak, Yellowstone Park, 1; Canyon, Yellowstone Park, 2; Elk, Jackson Hole, 1;[15] Evanston, 9; Firehole River, Yellowstone Park, 1; Fremont Peak, 4; Jackson, 5; Kendall (12 miles north), 8; La Barge Creek (9,000 feet altitude), 1; Lake Fork, Wind River Mountains, 4; Lake Station, Yellowstone Park, 2; Little Sandy Creek, 2; Lone Tree, 4; Merna, 9; Needle Mountain, 5; Pinedale, 4; Riverside, 5; Smith Fork, Lincoln County (7,000 to 8,000 feet altitude), 3; Snow Pass, Yellowstone Park, 1; South Pass City, 2; Stanley, 7; Summit Lake, Yellowstone Park, 2; Surveyor Park (12 miles northeast of Pinedale), 3; Swan Lake Valley, Yellowstone Park, 1; Teton Pass, 7; Thayne, 1; Valley, Park County, 1; Whirlwind Peak (near Pahaska Tepee), 9.

EUTAMIAS MINIMUS OPERARIUS Merriam

Lesser Colorado Chipmunk

(Pls. 6, c; 10, c)

Tamias quadrivittatus Allen, Bul. Amer. Mus. Nat. Hist. 3: 97, June, 1890 (part); not *Sciurus quadrivittatus* Say.

Eutamias amœnus operarius Merriam, Proc. Biol. Soc. Washington 18: 164, June 29, 1905.

Type.—Collected at Gold Hill, Colo. (altitude, 7,400 feet), October 8, 1903, by Vernon Bailey; ♀ adult, skin and skull; No. 129808, United States National Museum (Biological Survey collection); original number, 8160.

Geographic distribution.—Mountains of southern and eastern Colorado, northern New Mexico, and southeastern Wyoming; north to the Laramie and Casper Mountains, Wyo.; south to the Pecos River and Gallinas Mountains, N. Mex.; west to Uncompahgre Plateau and Monticello, Utah. *Zonal range:* Transition and Canadian; 6,500 to 13,300 feet altitude.[25] (Fig. 4.)

Characters.—Closely similar to *Eutamias minimus consobrinus*, but hind foot slightly and skull decidedly larger; color of sides averaging more intensely tawny; tail broader and more bushy, the under surface slightly darker and less

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[11] E. R. Warren coll.
[15] Amer. Mus. Nat. Hist.
[18] E. R. Warren coll., 7; Amer. Mus. Nat. Hist., 2.
[19] E. R. Warren coll., 6; Amer. Mus. Nat. Hist., 1.
[20] E. R. Warren coll., 12; Amer. Mus. Nat. Hist., 3; Univ. Wis., 2; Colo. Agr. College, 1.
[21] E. R. Warren coll., 2; Amer. Mus. Nat. Hist., 1.
[22] D. R. Dickey coll.
[23] Amer. Mus. Nat. Hist., 1 (type of "*lectus*").
[24] Mus. Comp. Zool.
[25] Specimens from Truchas Peak, N. Mex., at 13,300 feet, and from Culebra Mountain, N. Mex., at 13,200 feet.

mixed with blackish. Compared with *borealis:* Dark dorsal stripes paler (less blackish); light stripes more whitish (less mixed with tawny); rump and thighs more grayish (less ochraceous).

Color.—*Summer pelage* (July and August): Head and upper parts essentially as in *consobrinus* (see p. 16), the sides varying from tawny to ochraceous tawny; tail above fuscous black, overlaid with clay color and broadly edged with the same (fading to pale pinkish buff); tail beneath, sayal brown or ochraceous tawny, bordered with fuscous black and edged with clay color; under parts grayish white, sometimes washed with buff. *Winter pelage* (October): Similar to the summer pelage, but colors on back duller and less contrasted, the light stripes more grayish (less intensely white); sides about clay color; tail beneath, sayal brown edged with cinnamon buff.

Molt.—The beginning of the summer molt is shown by a specimen (♂ adult) from Golden, Colo., June 20, in which the new pelage shows in scattered patches over the anterior back and sides; an adult female from Springhill, Wyo., July 30, has the new summer pelage covering about the anterior half of the upper parts.

Skull.—Similar to that of *consobrinus*, but decidedly larger.

Measurements.—Average of 20 adults from Gold Hill and Estes Park, Colo.: Total length, 196.5 (184–212); tail vertebræ, 88 (80–98); hind foot, 30.7 (30–32); ear from notch, 11.5 (11–12). *Skull:* Average of 14 adults from Estes Park, Ward, and Gold Hill, Colo.: Greatest length, 32 (31.5–32.7); zygomatic breadth, 17.7 (17.1–18.7); cranial breadth, 14.8 (13.8–15.2); interorbital breadth, 7.4 (7–8.3); length of nasals, 9.8 (9–10.5).

Remarks.—This chipmunk resembles the larger *E. quadrivittatus* so closely in general appearance that the two were long confused under one name. This confusion was, of course, increased by the fact that the two species occur together over a large part of their ranges and are very similar in habits. Allen's *Tamias quadrivittatus* of his second revision (Allen, 1890, p. 97) refers almost entirely to this form; at that time only 37 Colorado specimens of this genus were available, none of which was from the type locality of *quadrivittatus*. Some years later, Doctor Merriam, after having secured large series of specimens from various parts of Colorado, showed conclusively that there are two species of chipmunks in the mountains of that State and that the name *quadrivittatus*, so long used for the present species, should properly be applied to the larger species. (Merriam, 1905, p. 163.)

The only constant differences in coloration between these two races are the paler feet, less tawny (more grayish) rump and thighs, and slightly paler under surface of tail in *operarius*, but these differences can hardly be relied on to distinguish every specimen; however, the ears and hind feet of *operarius* are decidedly smaller, and the skull may be distinguished from that of *quadrivittatus* at a glance by its much smaller size and relatively shorter and broader brain case.

The present form bears a striking resemblance, also, as pointed out by Merriam, to *E. amœnus amœnus*, the resemblance extending also to the skull characters, which are practically identical. That these resemblances, however, are accidental, and not indicative of close relationship, is clearly shown by the fact that *operarius* belongs in the *minimus* group, intergrading with both *consobrinus* and *minimus*, while *amœnus* is a member of a quite different group and intergrades with *luteiventris* in Idaho and eastern Oregon. Members of the two groups occur together in many localities in Wyoming, Idaho, Washington, Oregon, and California. *E. minimus operarius* differs from *E. a. amœnus* in its smaller ears, slightly longer tail, paler feet, slightly paler sides, and slightly less blackish upper surface of tail; in winter pelage the median pair of dorsal stripes are more whitish (less grayish), but in summer pelage, this character is less pronounced.

Intergradation with *minimus* occurs along the western slopes of the Medicine Bow Mountains, Wyo.; with *pallidus* along the eastern slopes of the Laramie Mountains; and with *consobrinus* at many points in western Colorado, notably at Coulter, Silverton, Coventry, and Lone Mesa (near Dolores). Specimens from Crestone and the mouth of Mosca Pass, Colo., apparently show intergradation with *caryi*, being noticeably paler than typical *operarius*, though the skulls are little, if any smaller than those of *operarius*.

A specimen from Uncompahgre Plateau, southern Mesa County, Colo., is very tawny on the back and sides, including all the dark dorsal stripes except the median one; it thus bears a striking resemblance to *E. quadrivittatus hopiensis*, which occupies the same region, but in size and skull characters it agrees closely with *operarius*, to which it is provisionally referred.

Large series of this species from northern New Mexico (Pecos Baldy, Jemez Mountains, Gallinas Mountains, Tres Piedras, Halls Peak, and Bear Canyon, near Trinchera Pass) show approach to *atristriatus* in having more blackish dorsal stripes and larger skulls than typical *operarius*. Some of the skulls are as large as those of *atristriatus*, while others are nearer to *operarius* in size. The series as a whole seems nearer to *operarius*.

Specimens examined.—Total number, 492, as follows:

Colorado: Antonito, 4; Beaver Creek, Park County (near Fairplay), 4;[26] Berthoud, 2; Black Hawk, 2; Blanca, 2;[26] Boreas Pass, Summit County, 6;[27] Boulder, 6;[28] Boulder County, 6; Breckenridge, Summit County, 1;[26] Cascade, 1; Chromo, 2;[29] Colorado Springs, 17;[30] Como, 2; Conejos Canyon, 1; Conejos River (8,300 feet altitude), 2; Coulter, 5; Coventry, 4;[26] Crestone, 4;[26] Culebra Canyon, Costilla County, 2;[26] Cumbres, 1; Del Norte, 1; Devils Gulch, Larimer County, 1;[31] Dillon, Summit County, 1;[31] Dixie Lake, Boulder County, 3;[29] Elbert, 1;[26] Elkhorn, 2; Elk Mountains, 1; Estes Park, 44; Fairplay, 1;[32] Fisher Peak, Las Animas County, 2; Florida, 12; Florissant, 2;[26] Fort Garland, 4; Fort Massachusetts, 2; Golden, 9;[33] Gold Hill, 15; Grays Peak, 16;[34] Halfway, El Paso County, 1;[35] Hardscrabble Canyon, Custer County (7 miles above Wetmore), 1;[26] Hermit, 1; Hot Springs (Middle Park), 1; Idaho Springs, 2; Kokomo, Summit County, 3;[26] Lake City, 4; Lake Fork, 2; Lake Moraine, El Paso County, 4;[36] Log Cabin, Larimer County, 3;[37] Littleton, 2;[26] Livermore, 1; Lone Mesa, 25 miles north of Dolores, 1; Longs Peak, 29; Madenos Canyon, Saguache County, 2; Madenos Creek (head), 4; Mesa Verde, 1; Michigan Creek, Park County, 2; Minnehaha, El Paso County, 1;[35] Montgomery [base Mount Lincoln], 5;[32] Mosca Creek, Saguache County, 2;[26] Mosquito Gulch, Park County, 2;[26] Mount Lincoln, Park County, 1;[26] Mount McLellan 4; Navajo River, Archuleta County, 2;[29] Nederland, 2; North Park, 1; Osier, 4;[29] Pagosa Springs, 3;[31] Palmer Lake, Douglas County, 1;[31] Palmer Lake, El Paso County, 8;[29] Pando, Eagle County, 1;[26] Pinewood, Larimer County, 1; Poncha Pass, Chaffee County, 2;[26] Querida, Custer County, 3;[26] St. Elmo, 3; Salida, 2;[26] San Acacio, Costilla County, 3;[26] Sangre de Cristo Range (24 miles east of Hooper) 1;[29] Sangre de Cristo Pass, 1; Silverton, 7; Somerset, 1; South Platte, 1;[38] South Platte River (north fork), 2;[32] Tarryall Creek, Park County

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[26] E. R. Warren coll.
[27] E. R. Warren coll., 4; Colo. Agr. College, 1; Mus. Vert. Zool., 1.
[28] Acad. Nat. Sci. Philadelphia, 2.
[29] Colo. Mus. Nat. Hist.
[30] E. R. Warren coll., 11; Mus. Comp. Zool., 2; Amer. Mus. Nat. Hist., 3; Univ. Wis., 1.
[31] Colo. Agr. College.
[32] Mus. Comp. Zool.
[33] Kans. Univ. Mus., 3; Colo. Agr. College, 2; Colo. Mus. Nat. Hist., 2; E. R. Warren coll., 1.
[34] Kans. Univ. Mus.
[35] Univ. Mich.
[36] E. R. Warren coll., 2; Mus. Vert. Zool., 1; Mus. Comp. Zool., 1.
[37] Colo. Agr. College, 2; E. R. Warren coll., 1.
[38] State Hist. and Nat. Hist. Soc. (Colo.).

(8,700 feet altitude), 1;[26] Tennessee Pass, Lake County, 4;[26] Tercio, Las Animas County, 4;[26] Trinidad, 1; Turkey Creek, Jefferson County, 1;[29] Uncompahgre Plateau (5 miles south of Unaweep Canyon), 1; Ute Peak, Montezuma County, 7;[29] Virginia Dale, Larimer County, 1;[31] Ward, 7; West Paradox Valley, 9.[29]

New Mexico: Arroyo Hondo, Taos County, 1; Bear Canyon (near Trinchera Pass), 16; Brazos, 1; Catskill, 5; Costilla Pass, 10; Culebra Mountain (13,200 feet altitude), 1; Gallinas Mountains, 3; Halls Peak, 7; Hondo Canyon, 1; Hopewell, 3; Jemez Mountains, 4; Labelle, 1; Las Vegas, 1;[34] Long Canyon (3 miles north of Catskill), 5; Pecos Baldy, 11; Pecos River (near Willis), 1; Road Canyon (7 miles southwest of Catskill), 1; Santa Fe (10 miles northeast), 1; Tres Piedras, 4; Truchas Peak (13,300 feet altitude). 1; Twining, 4.

Utah: La Sal Mountains (11,000 feet altitude), 2; Monticello, 2.

Wyoming: Bear Creek, Albany County (3 miles southwest of Eagle Peak), 5; "Black Hills" [Laramie Mountains], 2; Bluffs, near Pole Creek, Laramie Mountains, 1;[32] Casper Mountains (7 miles south of Casper), 3; Eagle Peak, Albany County, 1; Islay (6 miles west), 4; Laramie Mountains (10 miles east of Laramie), 6; Medicine Bow Mountains, 6; Pole Mountain (15 miles southeast of Laramie), 2; Sherman, 2;[39] Shirley, 2; Shirley Mountains, 7; Springhill (12 miles north of Laramie Peak), 9; Woods, Albany County, 1.

EUTAMIAS MINIMUS ATRISTRIATUS Bailey

Black-striped Chipmunk

(Pls. 6, h; 10, h)

Eutamias atristriatus Bailey, Proc. Biol. Soc. Washington 26: 129, May 21, 1913.

Type.—Collected at Penasco Creek, 12 miles east of Cloudcroft, Sacramento Mountains, N. Mex. (altitude, 7,400 feet), September 6, 1902, by Vernon Bailey; ♀ adult, skin and skull; No. 119028, United States National Museum (Biological Survey collection); original number, 7953.

Geographic distribution.—Sacramento Mountains, southern New Mexico. *Zonal range:* Transition; 7,000 to 8,000 feet altitude. (Fig. 4.)

Characters.—Similar to *Eutamias minimus operarius*, but dark dorsal stripes broader and more blackish; sides averaging paler; underparts washed with buff; ears and tail longer; skull larger; facial stripes prominent, fuscous black, mixed with tawny or russet, the ocular stripe nearly black.

Color.—*Summer pelage* (September 6): Head fuscous black, sprinkled with grayish white and cinnamon; dark dorsal stripes black, narrowly bordered with ochraceous tawny, the three median ones very broad; light dorsal stripes white, the median pair mixed with tawny; sides sayal brown (possibly somewhat darker in fresh pelage); rump and thighs mixed smoke gray and cinnamon buff; feet light pinkish cinnamon; tail above fuscous black, mixed with pinkish cinnamon and edged with light pinkish cinnamon; tail beneath, sayal brown, bordered with fuscous black and edged with light pinkish cinnamon; underparts whitish, washed with pinkish buff. *Immature pelage:* Sides darker than in adults, about snuff brown.

Skull.—Similar to that of *operarius* but averaging larger.

Measurements.—Average of four adults from type locality: Total length, 212.5 (203–220); tail vertebræ, 99.5 (94–114); hind foot, 31.9 (31.5–32); ear from noteh, 13.9 (13–15). *Skull:* Greatest length, 33 (31.9–33.9); zygomatic breadth, 18.3 (17.9–18.9); cranial breadth, 14.7 (13.9–15.9); interorbital breadth, 7 (6.4–7.3); length of nasals, 10.3 (10–11.1).

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[26] E. R. Warren coll.
[29] Colo. Mus. Nat. Hist.
[31] Colo. Agr. College.
[32] Mus. Comp. Zool.
[34] Kans. Univ. Mus.
[39] Field Mus. Nat. Hist.

Remarks.—This chipmunk has a restricted range in the Sacramento Mountains, where it occurs in the yellow-pine zone in company with the much larger *E. cinereicollis canipes*. Although its range is widely separated from that of its nearest relative, *operarius*, there is sufficient overlapping of characters to consider this form a subspecies of *minimus* (see remarks under *operarius*, p. 50).

Specimens examined.—Total number, 10, as follows:

New Mexico: Cloudcroft (6–12 miles east), 8; Penasco, 2.

EUTAMIAS MINIMUS ARIZONENSIS Howell

Lesser Arizona Chipmunk

(Pls. 6, l; 10, l)

Eutamias minimus arizonensis Howell, Journ. Mamm. 3: 178, August 4, 1922.

Type.—Collected on the Prieto Plateau, at south end of Blue Range, Greenlee County, Ariz., September 7, 1914, by E. G. Holt; ♂ adult, skin and skull; No. 205869, United States National Museum (Biological Survey collection); original number, 384.

Geographic distribution.—The White Mountains and Prieto Plateau, eastern Arizona. *Zonal range:* Canadian: 8,000 to 11,280 feet altitude. (Fig. 4.)

Characters.—Similar in size and cranial characters to *Eutamias minimus atristriatus;* nearest in color to *E. m. consobrinus*, but general tone more grayish (less tawny), the shoulders frequently washed with pale smoke gray (as in *E. cinereicollis*); tail more bushy, with color of under surface brighter tawny (about as in *operarius*).

Color.—*Summer pelage* (type, September 7): Crown and occiput smoke gray, mixed with cinnamon (the general tone grayish); sides of nose washed with clay color; dark facial stripes fuscous, the median one fuscous black, all more or less mixed with tawny; light facial stripes grayish white; ears fuscous, bordered on posterior margin with grayish, the inner surface sprinkled with tawny hairs; nape and shoulders washed with smoke gray; dark dorsal stripes blackish, edged with tawny, and all but the median stripe more or less mixed with tawny; median pair of light stripes smoke gray, sparingly mixed with tawny; outer pair white; sides between sayal brown and clay color, interrupted behind forelegs by a wash of smoke gray; rump and thighs hair brown, washed with clay color, forefeet pinkish buff; hind feet pinkish cinnamon, the toes pinkish buff; tail above, mixed fuscous and tawny, edged with cinnamon buff; tail beneath, mikado brown, bordered with fuscous and edged with cinnamon buff; under parts creamy white.

Molt.—In an adult female specimen from the summit of Thomas Peak, Ariz. (11,280 feet), September 12, summer pelage covers about two-thirds of the body, the rump and hinder back still retaining worn winter pelage.

Skull.—Similar in size and shape to that of *atristriatus*, but averaging slightly shorter; similar to that of *operarius* but averaging larger with relatively narrower brain case.

Measurements.—Average of 11 adults from White Mountains and Prieto Plateau, Ariz.: Total length, 208.2 (196–220); tail vertebræ, 93.5 (87–97); hind foot, 32.2 (30–33.5); ear from notch, 11.4 (10–13). *Skull:* Average of 10 adults from same localities: Greatest length, 32.5 (31.9–33.1); zygomatic breadth, 18.3 (18–18.6); cranial breadth, 14.5 (14.2–14.9); interorbital breadth, 7.1 (6.4–7.6); length of nasals, 10.1 (9.5–10.4).

Remarks.—This chipmunk has a rather restricted range and is apparently isolated from the other races of the species to which it belongs. It occurs over a part of the range of *E. cinereicollis cinereicollis* and so closely resembles that species in color that it has until recently escaped recognition.

The sides are slightly paler and the nose less heavily washed with clay color than in *cinereicollis*, but in all other markings the resemblance between the two species is remarkable. *E. m. arizonensis*, however, is decidedly smaller, with much shorter ears and hind feet; while the skull closely resembles that of *atristriatus* and is widely different in size and proportions from those of *cinereicollis*.

This remarkable resemblance between two forms occupying the same area is duplicated in the case of *quadrivittatus* and *operarius* in Colorado and New Mexico.

Specimens examined.—Total number, 23, as follows:

Arizona: Alpine, Apache County, 1; Horseshoe Cienega (White River), 2; Marsh Lake, White Mountains, 2; Prieto Plateau (south end Blue Range), 4; White Mountains, 14.[40]

EUTAMIAS MINIMUS OREOCETES Merriam

Timberline Chipmunk

(Pls. 6, G; 10, G)

Eutamias oreocetes Merriam, Proc. Biol. Soc. Washington 11: 207, July 1, 1897.
Eutamias minimus oreocetes Howell, Journ. Mamm. 3: 183, August 4, 1922.

Type.—Collected on Summit Mountain (at timberline), north of Summit Station (on Great Northern R. R.), Mont., June 14, 1895, by Vernon Bailey; ♀ adult, skin and skull; No. 72468, United States National Museum (Biological Survey collection); original number, 5024.

Geographic distribution.—Known at present only from near timberline in Glacier National Park, Mont. *Zonal range:* Hudsonian. (Fig. 4.)

Characters.—Size medium (about the size of *operarius*); similar to *pallidus* but tail and hind foot shorter; upper parts and sides darker; dorsal stripes more blackish; tail darker beneath. Compared with *borealis:* Similar in size but tail shorter and slightly darker beneath; dorsal stripes (except median one) paler; ears usually without black spots; hind feet paler.

Color.—*Summer pelage* (incomplete, July 25): Head smoke gray, shaded with cinnamon and bordered on each side with a snuff brown stripe; submalar stripe sayal brown; light facial stripes grayish white; ears pale smoke gray on posterior half, sayal brown on anterior base, without conspicuous blackish patches; postauricular patches large, grayish white; median dorsal stripe black, the others fuscous black, all more or less shaded with sayal brown; light dorsal stripes grayish white; sides sayal brown or clay color; feet grayish white, faintly washed with pinkish buff; tail above, fuscous black, overlaid with cinnamon buff; tail beneath, sayal brown edged with cinnamon buff; underparts creamy white. *Worn winter pelage* (June and July): Similar to the summer pelage but general tone decidedly more grayish (less tawny); median dorsal stripe black, the other dark dorsal stripes chætura black, mixed with cinnamon; median pair of light dorsal stripes pale smoke gray; outer pair white; rump and thighs smoke gray; sides pinkish buff; front feet grayish white; hind feet soiled whitish, faintly tinged with ivory yellow; tail above, fuscous black, mixed with cinnamon and overlaid with pinkish buff; tail beneath, cinnamon, bordered with fuscous black and edged with pinkish buff; underparts creamy white. *Young pelage* (Piegan Pass, Mont., August 4): Similar to the worn winter pelage, but dorsal stripes (except median one) more brownish (mikado brown, mixed with fuscous, the general tone near warm sepia); tail paler beneath (between cinnamon buff and pinkish buff).

Molt.—The midsummer molt begins (at least in adult females) in July; a nursing female from Glacier Park, Mont., July 25, is still in winter pelage, while another taken the same day shows new pelage covering the anterior two-thirds of the body.

[40] Amer. Mus. Nat. Hist., 3; Field Mus. Nat. Hist., 4.

Skull.—Closely similar to that of *borealis* but averaging slightly shorter and brain case broader; similar, also, to that of *pallidus* but slightly smaller with smaller audital bullæ.

Measurements.—Average of four adults from type region: Total length, 197.2 (193–201); tail vertebræ, 88 (82–90); hind foot, 31.8 (31–32); ear from notch, 11.4 (10–12.5). *Skull:* Average of three adult females from type region: Greatest length, 32.3 (32.1–32.6); zygomatic breadth, 18.4 (18–18.9); breadth of brain case, 15.8 (14.8–16.4); length of nasals, 10.1 (9.7–10.6).

Remarks.—By reason of the small number of specimens available it is impossible satisfactorily to characterize this form. Most of the specimens are in worn winter pelage, there being but one in fresh summer pelage, and that not entirely complete. So far as indicated by the scanty material this chipmunk is intermediate in coloration between *borealis* and *pallidus*, nearer to the latter. The range of *oreocetes* probably meets that of *borealis* or approaches it closely in the mountains of southwestern Alberta,[41] and further collecting in western Montana and Alberta will doubtless result in extending its known range. Apparently its range does not meet that of *pallidus*.

Specimens examined.—Total number, 8, as follows:

Alberta: Waterton Lake, 2.[42]
Montana: Indian Pass, Glacier National Park, 3; Piegan Pass, Glacier National Park, 2; Summit Mountain, 1.

EUTAMIAS MINIMUS BOREALIS (ALLEN)

NORTHERN CHIPMUNK

(PLS. 6, 1; 10, 1)

[*Tamias asiaticus*] var. *borealis* Allen, Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr. 11: 793, 794, August, 1877 (part).

Tamias quadrivittatus borealis Allen, Bul. Amer. Mus. Nat. Hist. 3: 107 (type fixed, p. 109), June, 1890.

Tamias quadrivittatus neglectus Allen, Bul. Amer. Mus. Nat. Hist. 3: 106, June, 1890 (Montreal River, Ontario).

Eutamias quadrivittatus borealis Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 44, December, 1901.

Eutamias borealis Preble, North Amer. Fauna No. 27, p. 167, October 26, 1908.

Type.—Collected at Fort Liard, Mackenzie [about 1860], by W. L. Hardisty; skin with broken skull inside and portion of tail missing; No. 6506, United States National Museum; original number, 1086.

Geographic distribution.—Interior Canada, from southern Mackenzie (Fort Simpson and Great Slave Lake) south over northeastern British Columbia, the greater part of Alberta, Saskatchewan, Manitoba, and Ontario to northern North Dakota (Turtle Mountains) and the eastern end of Lake Superior; also isolated colonies in the eastern part of the northern peninsula of Michigan, in the Black Hills of South Dakota, Bear Lodge Mountains of Wyoming, and the Big Snowy, Bear Paw, and other ranges in central Montana; west to the foothills of the Rocky Mountains in Alberta and to Tatletuey Lake, northern British Columbia; east to the Mattagami River and Lake Nipissing, eastern Ontario. *Zonal range:* Canadian and Transition.[43] (Fig. 4.)

Characters.—Similar to *Eutamias minimus operarius* but with slightly larger skull and longer tail and hind feet; general tone of upper parts more tawny (less grayish), the dark stripes more blackish and the light stripes more mixed with

[41] *Eutamias borealis* is known from Mount Forget-me-not, about 40 miles southwest of Calgary.
[42] Nat. Mus. Canada.
[43] Occurs in Transition Zone in the Black Hills, S. Dak.

ochraceous (less whitish or grayish); rump buffy instead of grayish; sides of body and ventral surface of tail averaging paler.

Color.—Type (apparently in summer pelage):[44] Crown and occiput mixed grayish white and cinnamon, the general tone drab; stripe from nose to eye fuscous black, the other facial stripes about snuff brown; light facial stripes soiled whitish; ears fuscous, the posterior portion soiled whitish; dark dorsal stripes black, edged with tawny; light dorsal stripes creamy white, the median pair moderately sprinkled with tawny; sides sayal brown; rump and thighs buffy brown; front feet pinkish buff; hind feet cinnamon buff; tail above, fuscous black, overlaid with pinkish buff; tail beneath, sayal brown, margined with fuscous black and edged with pinkish buff; underparts creamy white, tinged with pale buff. *Winter pelage:*[45] Very similar to the summer pelage, but general tone of upper parts more grayish (less tawny) and sides somewhat paler.

Molt.—A specimen (♀) from Brulé Lake, Alberta, July 4, a male from Rocky Mountains, near Henry House, Alberta, July 17, and a female from Zortman, Mont., July 25, are in the midst of the summer molt, the new pelage covering about the anterior half of the upper parts; a female from Babine Mountains, British Columbia, August 12, has nearly completed the summer molt, the rump and hinder back being the only parts of the body not renewed.

Skull.—Similar to that of *pallidus*, but brain case slightly narrower and more evenly rounded (less flattened); similar also to that of *operarius* but averaging slightly larger.

Measurements.—Average of 11 adults from Slave River, northern Alberta and southern Mackenzie: Total length, 217.4 (212–222); tail vertebræ, 101.7 (97–110); hind foot, 31.3 (31–32); ear from notch, 12.7 (12–13.5). *Skull:* Average of eight adults from Slave River region: Greatest length, 33 (32.5–33.5); zygomatic breadth, 18.3 (17.8–18.6); cranial breadth, 14.5 (14.4–14.8); interorbital breadth, 7.1 (7–7.4); length of nasals, 10.3 (10.1–10.7). *Weight:* One adult from Walhalla, S. Dak., 52.6 grams.

Remarks.—The northern chipmunk was recognized and named by Doctor Allen in his first monograph of the group (1877, p. 793, 794) being considered at that time a race of the Asiatic chipmunk (*E. asiaticus*). No type was selected at the time the species was named, but in 1890, in his second revision of the genus, Doctor Allen (1890, p. 107) designated as a type (that is, lectotype) No. 6506, United States National Museum collection, from Fort Liard, Mackenzie. The status of the species has remained in doubt since that date on account of the absence of this type from the National Museum collection (Preble, 1908, p. 167). It has recently come to light again, however, and has been available for comparison in the present study.

This race has an extensive range in Canada and appears, also, on isolated mountain ranges in Montana and South Dakota. A large series from the Black Hills, S. Dak., is indistinguishable from Mackenzie and Alberta specimens except that the under surface of the tail averages slightly darker (more reddish); many specimens, however, are almost exactly alike in all respects, including cranial characters. In the foothills of this range, intergradation with *pallidus* occurs, as shown by numerous specimens from Sundance, Wyo., and Elk Mountain and Belle Fourche River, S. Dak. Similar intermediates between *borealis* and *pallidus* occur in the Big Snowy, Bear Paw, and Moccasin Mountains, Mont. In a series of 18 specimens from the Little Rockies near Zortman, Mont., the majority are typical *borealis*, but two specimens are noticeably paler, showing approach to *pallidus*.

A series from Indian Head, Saskatchewan (June), have the undersurface of the tail decidedly paler than comparable specimens of

[44] A specimen from Athabaska River, Alberta (30 miles above Athabaska Landing), September 8, agrees closely with the type; one from Fort Smith, Mackenzie, June 28, is somewhat more tawny above, the sides being ochraceous tawny and the median pair of light dorsal stripes rather heavily mixed with the same color.

[45] Specimen from Fort Grahame, British Columbia, September 25.

borealis from Fort Smith, Mackenzie, thus probably showing approach to *pallidus*. Intergradation with *caniceps* occurs in the region between Telegraph Creek and Thudade Lake, northern British Columbia.

Material recently acquired from the type region of *E. neglectus* proves to be indistinguishable from *borealis*. The type specimen of *neglectus* was taken by Agassiz, July 5, 1868, on the eastern shore of Lake Superior near the mouth of Montreal River, Ontario. It has evidently been made over from a dried or salted skin; the terminal half of the tail is missing, and the color of the sides is several shades darker than in typical specimens of *borealis* and is even deeper in tone than specimens of the richly colored form from Wisconsin. This, however, is probably the result of soaking when the skin was remade, since changes of this character are known to occur when specimens of chipmunks and squirrels are made over from salted skins. The under surface of the tail matches the type of *borealis* exactly and shows no approach to the darker form of Wisconsin and Minnesota.

There is now available a series of 7 specimens from the type region of *neglectus*—5 taken by W. E. Clyde Todd early in July at Missinaibi, about 80 miles north of the type locality, and 2 taken by J. Dewey Soper in early October, at Ridout, about the same distance east of the type locality.

The Missinaibi specimens are in unworn winter pelage and are absolutely typical of *borealis*, showing no approach to *jacksoni*. The Ridout specimens are in summer pelage, the tails considerably worn, but they also are closely matched by the type and other specimens of *borealis*.

Other specimens from the Mattagami and Kapuskasing Rivers, somewhat farther north, confirm this decision, and a series of six specimens from Rossport, on the north shore of Lake Superior, are likewise referable to *borealis*. At Nipigon, however, a short distance to the westward, *jacksoni*, the richly colored form of Minnesota and Wisconsin, appears. In a series of eight specimens from Oxford House, Manitoba, three have tails as red as those of *jacksoni*, with which they agree closely. The rest of the series, however, agree with *borealis*, and on geographical considerations they should apparently be referred to this form. More material from the region between Oxford House and Lake Superior may result in a different decision as to the proper allocation of these specimens. A series of 11 specimens in unworn summer pelage from Seney, northern Michigan, are typical *borealis;* others from Alger, Schoolcraft, and Chippewa Counties are more or less intermediate between *borealis* and *jacksoni* but seem best referred here.

Three melanistic specimens have been examined from the mountains near the head of Tatletuey Lake, British Columbia. Preble states that about half of the individuals seen in this region are practically pure black, the remainder being of normal coloration.

The present form meets the range of *E. amœnus luteiventris* in western Alberta, both occurring at Banff and Canmore, and although they bear considerable resemblance to each other, there is no evidence that they intergrade. *E. borealis* is paler than *E. luteiventris* on the head, back, sides, feet, and upper surface of tail; the sides of the face and neck are more whitish (washed with ochraceous in *luteiventris*); the belly is clear creamy white, with no trace of buff; the ears are smaller and the skull smaller, with shorter rostrum and more rounded brain case.

Specimens examined.—Total number, 443, as follows:

Alberta: Athabaska Landing, 1; Athabaska River, 4; (Grand Rapids, 2; House River, 1; 30 miles above Athabaska Landing, 1); Battle River (Ferry Point), 1;[46] Banff, 6;[47] Brulé Lake, 2; Camrose, 4;[48] Canadian National Park, 4;[49] Canmore, 7;[50] Christina River, 1;[51] Donalda, 1;[46] Eagle Butte, 13;[53] Edmonton, 7;[52] Fort McMurray, 2; Grand Cache River (about 60 to 70 miles north of Jasper House), 5; Henry House, 5; Jasper Park, 8;[53] Lake Athabaska (mouth of MacFarlane River), 1;[55] McLeod River, 1; Moose Creek, 1; Mount Forget-me-not, 1;[53] Muskeg Creek (about 90 miles north of Jasper House), 2; Nuquilon Lake, 1;[46] Peace Point, Peace River, 1;[51] Peace River Landing, 5;[53] Prairie Creek (altitude, 3,500 feet), 4; Red Deer, 6; Red Deer River (Little Sandhill Creek and near Red Deer), 5;[53] Red Deer River (junction Blindman River), 5;[54] Rocky River (east branch), 1;[55] Slave River (10 to 25 miles below Peace River), 9; Smith Landing, Slave River, 7; Smith Portage, 1; Smoky River (Grand Cache), 1; South Edmonton, 9; Stony River (20 miles north of Jasper House), 1; Sturgeon River (25 miles north of Edmonton), 1; Upper Sulphur River, 2.

British Columbia: Babine (8 miles west), 1; Babine Mountains, 1; Bear Lake (site of Fort Connolly), 1; Chapa-atan River (mountains near head), 1; Driftwood River (15 miles northwest of Tacla Lake), 1; Finley River (head, near Thudade Lake), 1; Fort Grahame, 2; Hudson's Hope, 1; Ingenika River (mountains near head), 1; Tacla Lake (north end, site of Bulkley House), 1; Tatletuey Lake, 4; Tucheeda Lake, 1; Wapiti River (head), 1.

Mackenzie: Fort Liard, 1; Fort Resolution, 4;[47] Fort Simpson, 1; Fort Smith, 9; Hay River, Great Slave Lake, 1; Salt River, 1.

Manitoba: Antler and Souris Rivers, junction, 5;[53] Aweme, 4;[53] Brandon, 1;[56] Carberry, 1;[55] Grand Rapids, 2;[57] Huns Valley, 2;[58] Max Lake, Turtle Mountains, 2;[53] Nelson River, 2;[55] Oxford House, 12.

Montana: Bear Paw Mountains (20 miles southeast of Fort Assiniboine), 5; Big Snowy Mountains, 9; Judith Mountains (7 miles northeast of Lewistown), 1; Moccasin Mountains (5 miles northwest of Hilger), 2; Tyler (4 miles west), 1; Zortman, 18.

Michigan: Alger County, 3;[59] Chippewa County, 5;[59] Floodwood, Schoolcraft County, 2;[59] Michigamme, 3; Seney, 11;[60] Vermilion, Chippewa County, 2;[59] Whitefish Point, Chippewa County, 4.[59]

North Dakota: Fort Pembina, 1; Turtle Mountains, 17;[61] Walhalla, 3.

Ontario: Franz, 2;[62] Gull Bay, Lake Nipigon, 1;[63] Iroquois Falls, 2;[62] Kapuskasing, 5;[63] Kapuskasing River, 5;[64] Lake Abitibi, 3;[63] Mattagami River (Smoky Portage), 1;[64] Minaki, 2;[62] Missinaibi, 5;[64] Missinaibi River (Green Hill Portage and St. Peters Portage), 8;[64] Moose River (Gypsum Rocks), 1;[64] Nagagami, 2;[62] Ridout, 2;[46] Rossport, 6.[56]

Saskatchewan: Athabaska Lake (Poplar Point and mouth MacFarlane River), 2; Battle Creek, 4;[53] Borden, 1; Broadview, 2;[46] Carlton, 6; Fort Walsh, 1;[53] Indian Head, 15;[65] Wingard, 10.

South Dakota: Buffalo Gap, 1; Custer, 8; Deadwood, 19; Dumont, 1; Fort Meade, 1; Glendale, Custer County, 9;[55] Hill City, 3; Rapid City, 1; Redfern, 5; Savoy, 3; Squaw Creek, Custer County, 1.[55]

Wyoming: Bear Lodge Mountains, 3; Devils Tower, 4; Newcastle, 2; Sundance, 8.

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[46] J. Dewey Soper coll.
[47] Mus. Comp. Zool., 2.
[48] J. Dewey Soper coll., 2; W. E. Saunders coll., 2.
[49] Amer. Mus. Nat. Hist., 2.
[50] Nat. Mus. Canada, 2.
[51] John C. Phillips coll.
[52] Nat. Mus. Canada, 3; Acad. Nat. Sci. Philadelphia, 2; J. Dewey Soper coll., 2.
[53] Nat. Mus. Canada.
[54] Amer. Mus. Nat. Hist., 4; Mus. Comp. Zool., 1.
[55] Amer. Mus. Nat. Hist.
[56] W. E. Saunders coll.
[57] Univ. Iowa.
[58] J. H. Fleming coll.
[59] Univ. Mich.
[60] Mus. Comp. Zool.
[61] Amer. Mus. Nat. Hist., 5.
[62] M. M. Green coll.
[63] Royal Ontario Mus.
[64] Carnegie Mus.
[65] Nat. Mus. Canada, 4.

EUTAMIAS MINIMUS CANICEPS Osgood

Yukon Chipmunk

(Pls. 6, j; 10, j)

Eutamias caniceps Osgood, North Amer. Fauna No. 19, p. 28, October 6, 1900.
Eutamias borealis caniceps Preble, North Amer. Fauna No. 27, p. 169, October 26, 1908.

Type.—Collected at Lake Lebarge, Yukon, July 13, 1899, by W. H. Osgood; ♀ adult, skin and skull; No. 99200, United States National Museum (Biological Survey collection); original number, 603.

Geographic distribution.—Southern Yukon, southwestern Mackenzie, and northwestern British Columbia; north to Macmillan River, east to Nahanni River Mountains, south to Ispatseeza River, northern British Columbia, west to Lake Bennett and Lake Lebarge;[66] northern limits imperfectly known. *Zonal range:* Canadian. (Fig. 4.)

Characters.—Similar to *Eutamias minimus borealis*, but head more grayish (less ochraceous); sides slightly paler; upper parts averaging more grayish in general tone; tail much paler beneath; hind foot larger.

Color.—*Summer pelage* (July): Head smoke gray, sparingly washed with cinnamon; median pair of light dorsal stripes smoke gray, narrowly edged with sayal brown; sides clay color, shading to sayal brown at border of lateral stripes; tail above, fuscous black, overlaid and edged with pale pinkish buff; tail beneath, clay color; otherwise as in *borealis*. *Winter pelage* (September 18): Similar to the summer pelage but dorsal area slightly paler and sides about pinkish buff.

Molt.—An adult male specimen from Caribou Crossing, Yukon, June 26, has nearly completed the spring molt, the rump being the only portion of the body still in winter pelage; in an adult female from the same locality, June 28, the molt is not quite so far advanced.

Skull.—Practically the same as that of *borealis*.

Measurements.—Average of five adults from Bennett, British Columbia:[67] Total length, 216.8 (203–225); tail vertebræ, 95 (84–99); hind foot, 33.6 (33–34); ear from notch, 12.6 (12–14). *Skull:* Average of seven adults from type region (Lake Lebarge and Lake Marsh): Greatest length, 33.4 (32.9–33.5); zygomatic breadth, 18.5 (18.2–19); cranial breadth, 14.6 (14.3–15); interorbital breadth, 7 (6.8–7.3); length of nasals, 10.4 (10–10.7).

Remarks.—The Yukon chipmunk is a fairly well-marked race of *minimus*, closely related to *borealis*, and intergrading with it in northern British Columbia.

Specimens examined.—Total number, 126, as follows:

British Columbia: Atlin (Hot Springs, Wilson Creek, and Pike River), 10;[68] Bennett City, 13; Cheonnee Mountains, 1;[69] Ispatseeza River (near head), 1; Lake Bennett, 1; Level Mountain, 2;[69] McDame Post, Dease River, 8; Raspberry Creek (near head of first south fork of Stikine River), 1;[69] Stikine River (near head), 5;[68] Telegraph Creek, 41;[70] Teslin Lake, 10.[71]

Mackenzie: Nahanni River Mountains, 4.

Yukon: Caribou Crossing, Yukon River, 4; Lake Lebarge, 13; Lake Marsh, 5; Macmillan River, 2; Rink Rapids, Yukon River, 4; Semenow Hills, Yukon River, 1.

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[66] The occurrence of chipmunks—doubtless this species—near Klukwan in Chilkat Valley, Alaska, is reported by E. P. Walker on the authority of an intelligent native.
[67] The type series from Lake Lebarge are without external measurements.
[68] Provincial Mus., Victoria, British Columbia.
[69] Amer. Mus. Nat. Hist.
[70] Amer. Mus. Nat. Hist., 39.
[71] Nat. Mus. Canada.

EUTAMIAS MINIMUS JACKSONI Howell

Lake Superior Chipmunk

(Pls. 6, k; 10, k)

Tamias quadrivittatus neglectus Allen, Bul. Amer. Mus. Nat. Hist. 3: 106, June, 1890 (in part—specimens from Minnesota).

Eutamias quadrivittatus neglectus Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 44, December 27, 1901 (and of authors generally).

Eutamias borealis neglectus Hollister, Bul. Wisconsin Nat. Hist. Soc. 6: 139, October, 1908.

Eutamias minimus jacksoni Howell, Journ. Mamm. 6: 53, February 15, 1925.

Type.—Collected at Crescent Lake, Oneida County, Wis., September 7, 1917, by H. H. T. Jackson; ♂ adult, skin and skull; No. 227423, United States National Museum (Biological Survey collection); original number, 927.

Geographic distribution.—Northern Michigan (except extreme eastern end); northern Wisconsin, northeastern Minnesota, and adjacent part of southwestern Ontario; north to Lac Seul, Ontario (possibly to Oxford House, Manitoba [72]); east to Nipigon, Ontario; west to Kalmar, Ontario, south to Juneau County, Wis. (Fig. 4.)

Characters.—Similar to *Eutamias minimus borealis*, but upper parts and tail more intensely tawny; head and facial stripes slightly darker; median pair of dorsal stripes more strongly tinged with sayal brown; tail darker, both above and below.

Color.—*Summer pelage* (type, September 7): Top of head mixed cinnamon, fuscous black, and whitish, the general tone brownish drab; dark facial stripes blackish, shaded with sayal brown; ears mixed fuscous and sayal brown on anterior portion; soiled grayish white on posterior half; interior surface clothed with brownish hairs; postauricular patches pale smoke gray; dark dorsal stripes black, the central stripe extending forward to the crown; median pair of light dorsal stripes grayish white, strongly mixed with sayal brown; outer pair creamy white, edged with sayal brown; sides ochraceous tawny; thighs and flanks buffy brown; feet pale cinnamon buff; tail above fuscous black, heavily overlaid with ochraceous tawny; tail beneath, ochraceous tawny, bordered with fuscous black, but tipped with ochraceous tawny; underparts white (the plumbeous bases of hairs showing through. *Winter pelage* (September 24 and June 9): Similar to the summer pelage, but somewhat paler and more grayish (less tawny); top of head with more white and less cinnamon in the mixture; median dorsal stripes drab gray (with less sayal brown in mixture); feet pale smoke gray, very faintly tinged with pale pinkish buff; sides pale ochraceous tawny.

Molt.—A specimen (♀ adult) from Herbster, Wis., June 20, shows the new summer pelage covering the anterior half of the body; another female from Rib Hill, Wis., July 11, shows the molt nearly completed, the rump and hinder back still retaining the winter pelage.

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

Measurements.—Average of 11 adults from northern Wisconsin (Oneida, Vilas, and Oconto Counties): Total length, 202.1 (198–209); tail vertebræ, 88.8 (82–95); hind foot, 31.8 (31–33); ear from notch, 12.6 (11.5–14.5). *Skull:* Average of 10 adults from Wisconsin: Greatest length, 32.6 (31.8–33.2); zygomatic breadth, 18.1 (17.7–18.5); cranial breadth, 14.3 (13.9–15.2); interorbital breadth, 7.2 (6.8–7.6); length of nasals, 10.3 (9.8–11.3).

Remarks.—This is the form that Doctor Allen intended to characterize when he named *neglectus*. He had at that time only 7 specimens—2 from Montreal River near the eastern end of Lake Superior, 2 from North Pacific Junction, Minn., and 3 from Escanaba, Mich. (the last in too poor condition for comparison). Unfortunately he selected one of the specimens from Montreal River as the type, and

[72] See remarks under *Eutamias minimus borealis*, p. 55–56.

(as explained in detail on p. 56) this proves to be inseparable from *borealis*. Had he chosen one of the Minnesota specimens for a type, the name would stand for the richly colored form inhabiting northern Wisconsin, Minnesota, and Michigan, but in the light of present knowledge, there seems to be no other course than to place *neglectus* in the synonymy of *borealis* and provide a new name for the form currently known as *neglectus*.

The present form is the most richly colored race of the *minimus* group and the combination of heavy black stripes and bright tawny sides and tail make it one of the handsomest members of the genus. Intergradation with *borealis* takes place in the northern peninsula of Michigan (specimens from the eastern end of the peninsula being typical *borealis*) and in southwestern Ontario. Material is needed from many parts of western Ontario and eastern Manitoba before the range of this form can be worked out in detail.

Specimens examined.—Total number, 178, as follows:

Michigan: Brown Lake, Dickinson County, 6;[73] Cisco, 1;[73] Crooked Lake, Gogebic County, 1;[73] Escanaba, 3; Houghton, 1;[73] Lindsley Lake, Gogebic County, 1;[73] Little Girls Point, Gogebic County, 2;[73] Mud Lake, Gogebic County, 1;[73] Poor Lake, Gogebic County, 2;[73] Porcupine Mountains, Ontanagon County, 9.[73]

Minnesota: Clear Lake Portage, Lake County, 2;[74] Ely, 1; Itasca County (Twp. 61 N., R. 26 W.), 1; North Pacific Junction, 2; Tower, 7; Two Harbors, 3.

Ontario: Ignace, 1;[75] Kalmar, 2;[75] Lac Seul, 1;[76] Nipigon, 4.[77]

Wisconsin: Basswood Lake, Bayfield County, 1; Camp Douglas, 50;[78] Crescent Lake, Oneida County, 8; Florence 2; Herbster, 7; Holcombe, 3; Kelley Lake, Oconto County, 2; Lake St. Germain, Vilas County, 4; Lakewood, 5; Mamie Lake, Vilas County, 13; McAllister, 1; Mellen, 1; Mercer, 3; Moen Lake, Oneida County, 1;[79] Namekagon Lake, Bayfield County, 2; North Pelican Lake, Oneida County, 1;[79] Ogema, 7; Orienta, 1; Rhinelander, 7;[80] Rib Hill, Marathon County, 3; Solon Springs, Douglas County, 5.

EUTAMIAS AMŒNUS GROUP

EUTAMIAS AMŒNUS (ALLEN)

[Synonymy under subspecies]

Diagnosis.—Closely similar in general to *Eutamias minimus*,[81] size small to medium; hind foot 29.5 millimeters (*monoensis*) to 35 millimeters (*canicaudus, ludibundus, felix,* and *caurinus*); skull length, 31.3 millimeters (*amœnus*) to 35.6 millimeters (*canicaudus*); skull of the same general shape as that of *E. minimus* and in many of the races practically indistinguishable one from the other; color of sides ranging from pinkish cinnamon (*affinis*) or cinnamon buff (*monoensis*), through sayal brown to tawny and ochraceous tawny (*luteiventris, ludibundus,* and *felix*); dark dorsal stripes black or fuscous black, often shaded or mixed with tawny, ochraceous tawny, or cinnamon; median pair of light dorsal stripes smoke gray or pale smoke gray, usually more or less mixed with cinnamon or tawny; outer pair of light stripes clear creamy white, sometimes (in *felix*) mixed with ochraceous tawny; rump and thighs cinnamon, pinkish cinnamon, cinnamon buff or ochraceous tawny, mixed in each case with smoke gray; hind feet varying from light pinkish cinnamon through cinnamon buff to sayal brown;

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[73] Univ. Mich.
[74] Univ. Minn.
[75] W. E. Saunders co.
[76] Nat. Mus. Canada.
[77] Mus. Comp. Zool.
[78] Amer. Mus. Nat. Hist., 37; Mus. Comp. Zool., 2; E. R. Warren coll., 2.
[79] E. R. Warren coll.
[80] Univ. Wis., 4.
[81] Certain forms in the two groups (for example, *Eutamias a. amœnus* and *E. minimus operarius*) inhabiting widely separated areas are so closely similar in both external and cranial characters that many specimens are difficult to identify without recourse to the locality label.

under surface of tail pinkish buff, pinkish cinnamon, clay color, cinnamon, sayal brown, tawny, or ochraceous tawny.

EUTAMIAS AMŒNUS AMŒNUS (ALLEN)

KLAMATH CHIPMUNK

(PLS. 5, G; 9, G)

Tamias amœnus Allen, Bul. Amer. Mus. Nat. Hist. 3: 90, June, 1890.
Tamias quadrivittatus amœnus Merriam, North Amer. Fauna No. 5, p. 44, July 30, 1891.
Eutamias amœnus Merriam, Proc. Biol. Soc. Washington 11: 194, July 1, 1897.
Eutamias amœnus propinquus Anthony, Bul. Amer. Mus. Nat. Hist. 32: 6, March 7, 1913 (Ironside, Oreg.).

Type.—Collected at Fort Klamath, Oreg., May 16, 1887, by J. C. Merrill; ♀ adult, skin and skull; No. 186460, United States National Museum (No. $\frac{3469}{4096}$, Merriam collection).

Geographic distribution.—Central and eastern Oregon (except on the deserts and in the Blue Mountains) and southern Idaho; south in California through the Salmon and Trinity Mountains to South Yolla Bolly Mountain and in the Sierra Nevada to Sierra County; east to the Bannock Mountains and mountains east of Birch Creek, southeastern Idaho; north to the Columbia River, Oreg., and to Adams County, Idaho. *Zonal range:* Transition and Canadian; 4,000 to 9,000 feet altitude. (Fig. 5.)

Characters.—Closely similar in size and coloration to *Eutamias minimus operarius* but ears longer, tail averaging slightly shorter; hind feet and upper surface of tail slightly darker; sides averaging slightly deeper tawny.

Color.—*Summer pelage* (August): Top of head smoke gray, mixed with cinnamon; dark facial stripes fuscous, the median one fuscous black, all more or less mixed with tawny; ears fuscous black, broadly margined posteriorly with buffy white; dark dorsal stripes black, more or less mixed or margined with ochraceous tawny; median pair of light stripes pale smoke gray;[82] outer pair white; sides tawny or ochraceous tawny; rump and thighs smoke gray, washed with cinnamon buff; tail above, fuscous black, overlaid with clay color; tail beneath, cinnamon or sayal brown, margined with fuscous black and edged with clay color; feet light pinkish cinnamon; under parts creamy white, often washed with light buff. *Winter pelage* (October): Similar to the summer pelage but general tone duller, the median pair of light stripes darker (less whitish) and sides slightly paler—about sayal brown.

Molt.—The beginning of the spring molt is shown by an adult female specimen taken at Prineville, Oreg., June 4, in which the new summer pelage is appearing in irregular patches on the middle of the back; a male from Idaho City, Idaho, June 13, shows the summer pelage covering a little more than half of the anterior upper parts.

Skull.—Closely similar in size in proportions to that of *E. minimus operarius*.

Measurements.—Average of 20 specimens (adult and subadult) from type locality: Total length, 197.6 (181–218); tail vertebræ, 84.5 (78–90); hind foot, 31 (30–32); ear from notch, 13.8 (13–15). *Skull:* Average of 10 adults from type locality: Greatest length, 32 (31.3–32.6); zygomatic breadth, 17.8 (17.4–18.2); cranial breadth, 14.3 (13.8–14.7); interorbital breadth, 7.6 (7–8); length of nasals, 9.9 (9.3–10.5).

Remarks.—As already shown (see p. 49) this subspecies bears a striking resemblance to *E. minimus operarius* of Colorado, but their ranges do not meet and members of the two groups occur together in many places without any indication of intergrading.[83]

[82] Occasional specimens have these stripes mixed with cinnamon, and in several from southern Idaho (Edna and Stanley Lake) the median stripes are solid bright cinnamon; but since the majority of specimens from that region are normal, this variation is not considered a subspecific character.

[83] For example, *amœnus* and *pictus* in northern California, eastern Oregon, and southern Idaho; *luteiventris* and *consobrinus* in western Wyoming; and *canicaudus* and *grisescens* in eastern Washington.

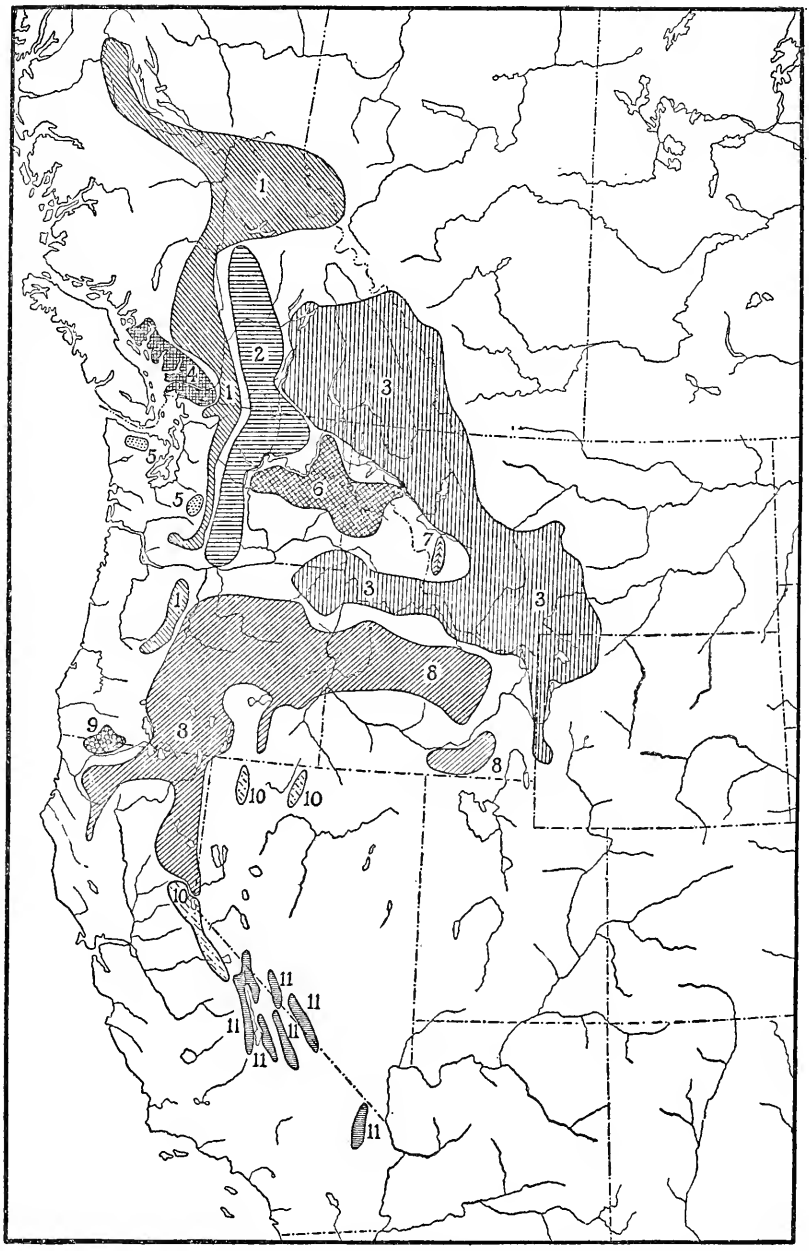

FIGURE 5.—Distribution of the subspecies of *Eutamias amœnus* and of *E. panamintinus*. 1, *E. amœnus ludibundus;* 2, *E. amœnus affinis;* 3, *E. amœnus luteiventris;* 4, *E. amœnus felix;* 5, *E. amœnus caurinus;* 6, *E. amœnus canicaudus;* 7, *E. amœnus vallicola;* 8, *E. amœnus amœnus;* 9, *E. amœnus ochraceus;* 10, *E. amœnus monoensis;* 11, *E. panamintinus*

The Klamath chipmunk has a wide distribution and is subject to considerable individual variation. In the Siskiyou Mountains of northern California it grades into subspecies *ochraceus*, a somewhat larger and more buffy form. Large series from the Trinity, Salmon, and Yolla Bolly Mountains, Calif., are nearest to *amœnus* but exhibit some of the characters of *ochraceus*; in the Yolla Bolly series the skulls are fully as large as those of *ochraceus*, though in coloration and external measurements the specimens are more like *amœnus*. In the northern Sierra—between Independence Lake and Donner—this race passes insensibly into *monoensis*. In the foothills of the Blue Mountains, eastern Oregon, and at many places in central Idaho (Goodrich, Tamarack, mountains east of Birch Creek, Lemhi Mountains, etc.) intergradation with *luteiventris* occurs.

The series of 12 specimens from Ironside, Oreg., on which *Eutamias propinquus* of Anthony was based, are clearly referable to *amœnus;* most of the series are quite indistinguishable from this race, either by coloration, size, or skull characters; the type specimen is considerably more ochraceous above, and is considered intermediate between *amœnus* and *luteiventris*.

Specimens examined.—Total number, 901, as follows:

California: American River (south fork, altitude 6,500 feet), 1; Bear Creek (head), Trinity County, 19;[84] Bear Flat, Shasta County, 1; Brownell, 2; Buck Ranch, Plumas County, 3; Bunchgrass Spring, Lassen County, 6; Canby, 2; Canby (20 miles northwest), 2;[84] Canyon Creek, Trinity County, 4; Castle Lake, Siskiyou County, 2;[84] Chaparal, Butte County, 39;[85] Deadfall Creek (head), Trinity County, 3;[84] Eagle Lake, 8;[86] Fort Bidwell, Modoc County, 16;[87] Fort Crook, 11; Goose Lake, 8; Goose Nest Mountain, Siskiyou County, 7; Grindstone Creek, Tehama County, 3; Grizzly Creek (head), Trinity County, 2;[84] Happy Camp, Modoc County (25 miles north of Lookout), 1; Hayden Hill, Lassen County, 1; Jackson Lake, Siskiyou County, 30;[84] Johnsville, Plumas County, 3;[84] Lake City, 2; Lassen Creek, Modoc County, 6; Lincoln Creek, Sierra County (6,200 feet altitude), 1; Little Shasta River (near head), 1;[84] mountains west of Long Valley, Lassen County, 1; Madeline Divide, Lassen County, 1; Madeline Plains, 2; McCloud, 3; McCloud River (near Bartle), 1; Millford, 1; Mohawk, Plumas County, 8;[88] Mount Lassen, 9; Mount Shasta, 65;[89] Picard, 11; Pine Creek, Lassen County, 1; Plumas County, 20 miles southwest of Quincy, 9; Prattville, Plumas County, 2; Red Rock, Lassen County, 1; Robbins Creek, Lassen County, 2; Rush Creek (head), Siskiyou County, 19;[84] Salmon River (south fork, 5,000 feet altitude), 4;[84] Salmon Mountains, 2; Saloon Creek Divide, Siskiyou County, 7;[84] Shasta County, 1; Shasta Valley, 1; Sierra Valley, 14; Sierraville, 3;[88] Sisson, 5; Squaw Creek Valley, Siskiyou County, 1; Sugar Hill, Modoc County, 9;[84] Susanville, 8; Trinity Mountains (east of Hoopa), 5; Warner Mountains (Dry Creek, Parker Creek, and Warren Peak), 34;[84] Webber Lake, Sierra County, 1; Wildcat Peak, Siskiyou County, 7;[84] Willow Creek Valley, Lassen County, 4;[85] Yolla Bolly Mountains, 43.[90]

Idaho: Albion, 5; Arco, 3; Bald Mountain Ranger Station (10 miles south of Idaho City), 2; Bannock Mountains (8 miles northeast of Inkom; 14 miles southeast of Pocatello; 8 miles west of Swan Lake), 11; Big Butte, Bingham County, 1; Big Lost River (head), 1; Birch Creek, 10 miles south of Nicholia, 5; mountains east of Birch Creek, 11; Blue Spring Hills (15 miles west of Malad), 1; Bridge, Cassia County, 8; Dickey, 1; Echo Crater, Snake River Desert (20 miles southwest of Arco), 1; Edna, 3; Goodrich, 3; Idaho City, 5; Ketchum, 6; Lardo, 2;

[84] Mus. Vert. Zool.
[85] Amer. Mus. Nat. Hist.
[86] Mus. Vert. Zool., 6.
[87] Amer. Mus. Nat. Hist., 14; Mus. Vert. Zool., 1; Colo. Agr. College, 1.
[88] Mus. Vert. Zool., 2.
[89] Mus. Vert. Zool., 9.
[90] Mus. Vert. Zool., 33.

Lost River Mountains, 16; Malad City, 2; New Meadows, Adams County, 2; Pahsimeroi Mountains, 3; Sawtooth City (near Alturas Lake), 1; Sawtooth (Alturas) Lake, 14; Stanley Lake, 5;[85] Tamarack, Adams County, 1.

Nevada: Washoe, 1.

Oregon: Antelope, Wasco County, 1; Austin, 1; Bear Creek Buttes, Crook County, 1; Beech Creek, Grant County, 7; Bend, Deschutes River, 8; Bourne, 3; Buchanan, 5; Burns, 9; Camp Creek, Crook County, 1; Cedar Mountains, 13; Christmas Lake (15 and 30 miles north), 2; Columbia River, 1;[91] Crane, 3; Crater Lake, 15; Crooked River, 20 miles south of Prineville, 2; Diamond Lake, 9; Drewsey, 1; Fort Klamath, 79; Foster, Harney County, 1;[92] Fremont, 4; Harney, 9; Haycreek, 6; Howard, 6; Ironside, 12;[85] Klamath Falls, 11;[93] Lakeview, 2; Lapine, 5; Lone Rock, 1; Lost Creek Canyon, Lake County, 3;[92] Maury Mountains, 4; McEwen, 1; Meacham, 7;[94] Mount Mazama (Anna Creek), 6; Naylox, 3; Ochoco Forest, 1; Paulina Lake, 4; Prineville, 9; Silverlake, 4; Sisters, 4; Steens Mountains, 25; Strawberry Mountains, 13; Swan Lake Valley, 3; Sycan Marsh, 2; Upper Klamath Marsh, 1; Warner Mountains, 7; West Sink Creek, Klamath County (12 miles east of Mount Thielson), 1; Yamsay Mountains, 2.

EUTAMIAS AMŒNUS OCHRACEUS Howell

Ochraceous Chipmunk

(Pls. 5, k; 9, k)

Eutamias amœnus ochraceus Howell, Journ. Mamm. 6: 54, February 15, 1925.

Type.—Collected in Studhorse Canyon, Siskiyou Mountains, Calif. (altitude, 6,500 feet), September 27, 1909, by N. Hollister; ♂ adult, skin and skull; No. 161049, United States National Museum (Biological Survey collection); original number, 3511.

Geographic distribution.—Siskiyou Mountains of California and Oregon. *Zonal range:* Transition and Canadian. (Fig. 5.)

Characters.—Similar to *Eutamias a. amœnus* but larger; upper parts more ochraceous (less grayish), especially on head and rump; dark dorsal stripes averaging more brownish (less blackish); median pair of light dorsal stripes more mixed with tawny or cinnamon (less clear gray); tail paler, both above and below. Similar to *E. a. luteiventris* but dark dorsal stripes less blackish (more brownish); postauricular patches larger and more distinct; under parts less heavily washed with buff.

Color.—*Summer pelage* (type, September 27): Top of head cinnamon, mixed with white, bordered on each side with bister; ocular stripe blackish, shaded with snuff brown; submalar stripe snuff brown, shaded with fuscous; light facial stripes grayish white; ears black, broadly margined on posterior border with buffy white and washed on anterior base with cinnamon; postauricular patches rather large, buffy white; dark dorsal stripes fuscous black, mixed with mikado brown; median pair of light stripes grayish white, sprinkled with mikado brown; outer pair of light stripes creamy white; sides sayal brown; rump and thighs mixed cinnamon and smoke gray; hind feet dull pinkish cinnamon, shading on toes to pinkish buff; tail above, fuscous black, overlaid with pinkish buff; tail beneath, between clay color and pinkish cinnamon, bordered with fuscous black and edged with pinkish buff; underparts dull whitish, faintly washed with pinkish buff. *Winter pelage:* Similar to the summer pelage but slightly darker, the sides about snuff brown.

Skull.—Similar to that of *E. a. amœnus* but averaging larger.

Measurements.—Average of 11 adults from the Siskiyou Mountains: Total length, 215.2 (209–225); tail vertebræ, 95.7 (90–107); hind foot, 32.9 (32–34); ear from notch, 14.2 (13–15.5). *Skull:* Average of seven adults from same

[85] Amer. Mus. Nat. Hist.
[91] Collected by J. K Townsend, probably near The Dalles.
[92] A. H. Helme coll.
[93] Carnegie Mus., 7.
[94] A. H. Helme coll., 4.

localities: Greatest length, 33 (32.5–33.5); zygomatic breadth, 18.3 (17.8–18.6); cranial breadth, 14.5 (14.4–14.9); interorbital breadth, 7.5 (7.2–7.8); length of nasals, 9.9 (9.5–10.5).

Remarks.—The ochraceous chipmunk, although restricted to a rather limited range, is a well-marked form, characterized by large size and ochraceous coloration. It is typical only in the Siskiyou Mountain region of northern California and southern Oregon and apparently does not range much northward of that region. Southward, in the Trinity and Salmon Mountains, it intergrades with *amœnus*, the specimens being referred to the latter race.

A large series from the Big Valley Mountains, Lassen County, Calif., is apparently best referable to this race, although the colony is isolated from the typical colonies of *ochraceus*, the intervening territory being occupied by typical *amœnus*. This series is nearest to *ochraceus* in coloration, although the undersides of the tails average paler, and a few specimens are less ochraceous above. They differ from *amœnus* in much larger size, both of skins and skulls. The underparts are more strongly washed with buff than in either *amœnus* or *ochraceus*, thus suggesting *luteiventris*. The skulls are somewhat smaller than in the latter form and the nasals are shorter.

Specimens examined.—Total number, 33, as follows:

California: Adin, 1; Big Valley Mountains, Lassen County, 14; Siskiyou Mountains (Studhorse Canyon), 3.
Oregon: Ashland Peak, 1; Lake Mountain, Josephine County, 2; Siskiyou, 12.

EUTAMIAS AMŒNUS MONOENSIS Grinnell and Storer

MONO CHIPMUNK

(Pls. 5, h; 9, h)

Eutamias amœnus monoensis Grinnell and Storer, Univ. California Publ. Zool. 17: 3, August 23, 1916.

Type.—Collected on Warren Fork of Leevining Creek (9,200 feet altitude), Mono County, Calif., September 25, 1915, by J. Grinnell; ♂ adult, skin and skull; No. 23380, Mus. Vert. Zool., Univ. of California; original number, 3709.

Geographic distribution—Sierra Nevada, Calif., from Nevada County south to Mammoth Pass; Pine Forest and Cottonwood Ranges, northern Nevada. *Zonal range:* Canadian; 6,000 to 9,500 feet altitude. (Fig. 5.)

Characters.—Similar to *Eutamias a. amœnus* but head slightly paler (more grayish), under side of tail paler (less intensely tawny); sides of body and edging of tail averaging paler.

Color.—*Summer pelage* (September): Top of head pale smoke gray, mixed with cinnamon; dorsal area practically as in *amœnus:* sides cinnamon, cinnamon buff, or sometimes ochraceous tawny; tail above, fuscous black, overlaid with light pinkish cinnamon; tail beneath, between sayal brown and clay color, bordered with fuscous black and edged with light pinkish cinnamon; underparts whitish, sometimes faintly washed with pale buff.

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

Measurements.—Average of 13 adults from type region (Leevining Creek, Mono Craters, and Walker Lake): Total length, 194.2, (186–205); tail vertebræ, 82.4 (73–92); hind foot, 31 (29.5–32); ear from notch, 13.3 (13–14). *Skull:* Average of 11 adults from type region (Leevining Creek, Mono Craters, and Mammoth): Greatest length, 32.6 (32.2–33.3); zygomatic breadth, 18 (17.5–18.5);

cranial breadth, 14.4 (13.9–15); interorbital breadth, 7.8 (7.3–8.1); length of nasals, 10 (9.5–10.3). *Weight:* Average of about 10 adults, 43 grams (37.9–48.7). [*Fide* Grinnell and Storer (1924, p. 177).]

Remarks.—The Mono chipmunk is a pale, grayish form of *amœnus*, the characters only moderately pronounced. Specimens from the Pine Forest Range, Nev., are best referred to this race, although apparently geographically isolated from the colony in the southern Sierra; they are even paler and more grayish than the type series, with paler hind feet, thus showing the extreme of the characters which differentiate *monoensis* from *amœnus*.

Intergradation with *amœnus* takes place in the Lake Tahoe region; specimens from Independence Lake, Nevada County, and Markleeville, Alpine County, being considered intermediate.

This chipmunk closely resembles *E. quadrivittatus frater* in summer pelage but may be distinguished by the paler color of the sides and of the ocular stripe, more buffy underparts, and smaller size.

Specimens examined.—Total number, 245, as follows:

California: Cisco, 22;[95] Donner, 41; Echo, Eldorado County, 7;[95] Emerald Bay, 6; Farringtons, Mono County (Bloody Canyon), 1; Gem Lake, Mono County, 1;[95] Hermit Valley, Calaveras County, 1;[96] Hope Valley, Alpine Conuty, 4; Independence Lake, 31;[97] Junction, Mono County [Hardy Station, 14 miles northwest of Bridgeport], 2; Lake Tahoe, 4;[98] Lake Valley, Placer County, 1;[99] Leevining Creek, Mono County, 4;[1] Mammoth, Sierra Nevada, 11; Markleeville, 7; McKinney, Lake Tahoe, 5; Mono Craters, 3;[95] Mono Lake, 5; Mount Tallac, 8; Owens River (head), 2; Pine City [near Mammoth Pass], 1; Pyramid Peak, Eldorado County, 5;[96] Silver Lake, Amador County, 6;[96] Silver Lake, Mono County, 1;[95] Soda Springs Station, Placer County, 1;[95] Sonora Pass, 1; Summit [Donner], 5; Tallac, 3;[2] Tioga Road, Mono County (9,400 feet altitude), 1;[95] Walker Lake, Mono County, 8;[95] Williams Butte, Mono County, 1;[95] Woodfords, Alpine County, 1.[96]

Nevada: Cottonwood Range, 1; Edgewood, Douglas County, 2;[96] Glenbrook, 5; Mount Sugar, 1;[2] Pine Forest Mountains, 36.[3]

EUTAMIAS AMŒNUS LUTEIVENTRIS (ALLEN)

BUFF-BELLIED CHIPMUNK

(PLS. 5, P; 9, P)

Tamias quadrivittatus luteiventris Allen, Bul. Amer. Mus. Nat. Hist. 3: 101, June, 1890.

Eutamias quadrivittatus luteiventris Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 44, December 27, 1901.

Type.—Collected at "Chief Mountain Lake" [Waterton Lake], Alberta (3½ miles north of the United States–Canada boundary),[4] August 24, 1874, by Elliott Coues; ♂ adult, skin and skull; No. $\frac{11991}{37996}$, United States National Museum; original number, 4596.

Geographic distribution.—Rocky Mountain region of southern Alberta, southeastern British Columbia, extreme northeastern and southeastern Washington, northern, central, and southeastern Idaho, western Montana, and northwestern Wyoming; north to Golden,

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[95] Mus. Vert. Zool.
[96] Amer. Mus. Nat. Hist.
[97] Mus. Vert. Zool., 29.
[98] Kans. Univ. Mus.
[99] Mus. Comp. Zool.
[1] Mus. Vert. Zool., 3.
[2] Acad. Nat. Sci. Philadelphia.
[3] Mus. Vert. Zool., 24.
[4] See Rept. U. S. Northern Boundary Comm., 1878, p. 313.

British Columbia, and Banff, Alberta; east to the Highwood and Crazy Mountains, Mont., and the Shoshone Range, Wyo.; south to the Salt River Mountains, Wyo.; west to Shuswap and Okanagan Lake, British Columbia, Thompson Falls, Mont., and through central Idaho to the Blue Mountains in northeastern Oregon and southeastern Washington. *Zonal range:* Transition and Canadian; 3,000 feet (Cranbrook, British Columbia) to 10,000 feet (Teton Mountains, Wyo.). (Fig. 5.)

Characters.—Similar to *Eutamias a. amœnus* but larger, with relatively longer tail; underparts heavily suffused with buff; general tone of upper parts more ochraceous (less grayish), especially on the head, sides of neck, and rump; postauricular patches more buffy (less whitish); light dorsal stripes less whitish; underside of tail slightly paler.

Color.—*Summer pelage* (August): Top of head cinnamon, mixed with smoke gray; dark facial stripes fuscous or fuscous black, the lower one broad and mixed with ochraceous tawny; light facial stripes whitish, usually tinged with cinnamon buff or light ochraceous buff; ears fuscous or fuscous black, broadly margined posteriorly with light buff, and washed at anterior base with ochraceous tawny; postauricular patches light buff or buffy white; sides of neck below ears strongly washed with ochraceous buff; dark dorsal stripes blackish, the outer ones often quite brownish from a mixture of tawny hairs; light dorsal stripes white, the median pair tinged with pale smoke gray, the outer pair often creamy white; rump and thighs dark smoke gray strongly mixed with cinnamon buff; sides tawny or ochraceous tawny; feet pinkish cinnamon or cinnamon buff; tail above, fuscous black overlaid with clay color; tail beneath, light ochraceous tawny, margined with fuscous black and edged with clay color; underparts cinnamon buff or light ochraceous buff. *Winter pelage* (Yellowstone Park, Wyo., October 29): Similar to summer pelage but upper parts more grayish, especially on the shoulders and rump; median pair of light stripes darker (less clear white); sides considerably paler—about clay color.

Molt.—A specimen (♀ adult) from Valley, Wyo., July 8, shows the summer molt just beginning; a female from Salt River Mountains, Wyo., August 19, shows the summer pelage coming in irregularly over the upper parts; another (unsexed) from Donovan, Mont., August 30, has the summer pelage coming in on the head and foreback. The beginning of the fall molt is well shown by a male specimen from Teton Pass, Wyo., September 8, in which the rump and hinder back are covered with fresh winter pelage, in sharp contrast to the brighter but only moderately worn summer pelage.

Skull.—Similar to that of *ochraceus* but averaging slightly larger; decidedly larger than that of *amœnus*.

Measurements.—Average of 10 adults from vicinity of type locality (Chief Mountain Lake, St. Marys Lake, Tobacco Plains, and Columbia Falls, Mont.): Total length, 221.5 (212–230); tail vertebræ, 101.8 (95–107); hind foot, 33.2 (32–34); ear from notch, 13.5 (12.5–14). *Skull:* Average of nine adults from northwestern Montana (St. Marys Lake, Tobacco Plains, and Upper Stillwater Lake): Greatest length, 34.2 (33.7–34.8); zygomatic breadth, 19 (18.5–19.3); cranial breadth, 15 (14.7–15.5); interorbital breadth, 7.5 (7.1–7.8); length of nasals, 10.7 (10.5–11.1).

Remarks.—The buff-bellied chipmunk has an extensive range in the Rocky Mountain region and exhibits little variation from its northern limit near Banff, Alberta, southward to west-central Wyoming; specimens of the series from Wyoming, however, have the tail slightly darker beneath than typical *luteiventris*, thus showing approach to *amœnus*. Intergrades with the latter race occur at many places where their ranges meet, notably in the Lemhi Mountains, Idaho, and the Blue Mountains, Oreg. In the series of 18 specimens from Lemhi Mountains, 10 have buffy underparts, like *luteiventris*, while 8 have whitish underparts, like *amœnus;* the skulls on the average are nearer to *luteiventris*. only one being as small as that of *amœnus*.

The series from the Blue Mountains is very puzzling, being variously intermediate between *luteiventris*, *amœnus*, and *canicaudus*. Specimens in summer pelage from Blue Creek, Wash., and the Wallowa Mountains, Oreg., are fairly typical *luteiventris*, the underparts being slightly less buffy than in Montana specimens. In a series of 15 from the plateau between Enterprise and Paradise, Oreg., about half of the specimens have white underparts, and the skulls are somewhat smaller, thus showing approach to *amœnus*.

On the northeast slopes of the Blue Mountains, in extreme southeastern Washington, *luteiventris* apparently grades into *canicaudus*. In northwestern Montana, however, these two forms do not intergrade, their ranges being sharply divided by Clarks Fork of the Columbia; on the north (or east) bank of this river, at Thompson Falls, *luteiventris* is common, but on the south bank its place is taken by typical *canicaudus*, which here reaches its eastern limit.

In northeastern Washington (Ferry County), on the eastern side of Okanagan Lake, and at Sicamous and Shuswap, British Columbia, *luteiventris* grades into *affinis*, most of the specimens from that region being so perfectly intermediate between the two forms as to make their assignment to one or the other very difficult. Intergradation with *ludibundus* seems probable, though not clearly shown by the material in hand; no specimens from the region between Banff and Henry House, Alberta, are available.

Throughout most of its range, *luteiventris* occurs in the same territory with either *ruficaudus* or *umbrinus*—both larger species with white underparts—and in western Wyoming it occurs, also, with *E. minimus consobrinus*, from which it may be distinguished by larger size, more buffy underparts and darker (more tawny) tail.

Specimens examined.—Total number, 622, as follows:

Alberta: Banff, 23; Burmis, 2;[6] Calgary (foothills, 40 miles west), 6;[5] Canmore, 7; Coleman, 6;[6] Crows Nest Pass, 2;[6] Laggan, 2;[7] Waterton Lake Park, 16.[6]

British Columbia: Cranbrook, 11;[8] Crows Nest, 2;[9] Elko, 2;[6] Fernie, 2;[6] Field, 3;[5] Glacier, 3;[10] Golden, 1; Monashee Divide, Gold Range, 9;[11] Okanagan, 14;[12] Okanagan Lake, 1;[6] Okanagan Landing, 12;[13] Revelstoke, 5;[14] Shuttleworth Creek, Okanagan, 2;[13] Shuswap, 20; Sicamous, 12; Tobacco Plains (=Newgate), 2; Trail, 6;[6] Vernon, 10.[5]

Idaho: Cabinet Mountains, 1; Craig Mountains, Lewis County, 8; Fiddle Creek (near Lucile), Idaho County, 3; Leadore, 1; Lemhi Valley, 1; Preuss Mountains (head of Crow Creek), 5; Priest Lake, 1; "Salmon River Mountains" (=Lemhi Mountains, 10 miles west of Junction), 20; Seven Devils Mountains, 7; Trude, 5;[15] Warm River, Fremont County, 7.[15]

Montana: Big Belt Mountains (4 miles south of Fort Logan), 4; Big Timber (14 miles south), 2; Birch Creek Canyon, Teton County, 1; Bozeman, 10; Bridger Range, 1; Buffalo, 9; Butte (8 miles east), 1;[15] Castle Mountains (4 miles east of White Sulphur Springs, 4; Chief Mountain [Waterton] Lake, 8; Columbia Falls, 6; Crazy Mountains, 6; Donovan, 1; Dry Creek, Gallatin County [near Gallop], 1; Eagle Creek

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[5] Acad. Nat. Sci. Philadelphia.
[6] Nat. Mus. Canada.
[7] W. E. Saunders coll.
[8] C. B. Garrett coll., 5; Provincial Mus., Victoria, British Columbia, 2.
[9] M. M. Green coll.
[10] Acad. Nat. Sci. Philadelphia.
[11] Mus. Comp. Zool.
[12] Mus. Comp. Zool., 5; Provincial Mus., Victoria, British Columbia, 3; Nat. Mus. Canada, 1.
[13] Provincial Mus., Victoria, British Columbia.
[14] Amer. Mus. Nat. Hist., 2; Nat. Mus. Canada, 3.
[15] D. R. Dickey coll.

[near Gardner], 5; East Gallatin River [near Hillsdale], 1; Emigrant, 2; Flathead Lake, 7; Helena, 15; Highwood Mountains, 3; Horse Plains [Plains], 2; Kalispell, 1; Kootenay River [on forty-ninth parallel], 1; Lake Como, Ravalli County, 1; Lennep, 1; Libby, 1; Little Belt Mountains, 17; Livingston, 1;[15] McLeod, 1; Midvale, Teton County, 2; Mystic Lake (in Gallatin Range), 2; National Bison Range (near Dixon), 2;[16] Pleasant Valley, 1;[11] Red Lodge, 1; Reed Point, 1; Robare, 2; Ruby Mountains, 10; St. Marys Lake, 7; Sula, 1; Superior, Mineral County, 1;[15] Thompson Falls, 2; Tobacco Plains [Newgate], 3; Upper Stillwater Lake, 1; Ward Peak, Madison County [Tobacco Root Mountains], 2; West Boulder Creek, 4; West Gallatin River (west fork), 10.

Oregon: Anthony, 12;[17] Cornucopia, 11; Elgin, 8; Joseph, 1;[18] Joseph Creek, Wallowa County, 5; Kamela, 6; Telocaset, 1; Wallowa Canyon, 7; Wallowa Lake, 10; Wallowa Mountains, 4; Whiskey Creek, Wallowa County, 4.

Washington: Anatone, 5; Blue Creek, Walla Walla County, 16; Blue Mountains (25 miles southeast of Dayton), 1;[19] Blue Mountains (21 and 35 miles southeast of Dayton), 4; Eureka, Ferry County [between Marcus and Republic], 3; Grande Ronde River (6 miles south of Anatone), 1; Humpeg Falls, Columbia County, 2;[19] Marcus (15 miles west), 1; Mud Springs, Columbia County, 1.[20]

Wyoming: Afton, Salt River Mountains, 1; Bunsen Peak, Yellowstone National Park, 1; Clarks Fork, Park County [near head], 11; Canyon, Yellowstone Park, 4; La Barge Creek (9,100 feet altitude), 1; Mammoth Hot Springs, Yellowstone Park, 2; Merna, 6; Moran, 9; Old Faithful, Yellowstone Park, 1; Pacific Creek, Lincoln County, 2; Pahaska, Park County [north fork Shoshone River, at Grinnell Creek], 23; Roaring Mountain, Yellowstone Park, 1; Salt River Mountains (10 miles southeast of Afton), 5; Stanley, 1; Teton Mountains, 21; Teton Pass, 16; Upper Geyser Basin, 2; Valley, Park County, 3; Yancey, Yellowstone Park, 1; Yellowstone Lake, 2;[11] Yellowstone Park (Apollinaris Spring), 1.[15]

EUTAMIAS AMŒNUS VALLICOLA Howell

Bitterroot Valley Chipmunk

(Pls. 5, o; 9, o)

Eutamias amœnus vallicola Howell, Journ. Mamm. 3: 179, August 4, 1922.

Type.—Collected on Bass Creek, near Stevensville, Mont. (altitude, 3,725 feet), March 23, 1910, by Clarence Birdseye; ♀ adult, skin and skull; No. 168027, United States National Museum (Biological Survey collection); original number, 1052.

Geographic distribution.—Known only from the Bitterroot Valley, Mont., and the foothills on either side. *Zonal range:* Transition; 3,000 to 4,500 feet altitude. (Fig. 5.)

Characters.—Similar to *Eutamias amœnus luteiventris*, but paler throughout, especially the head, upper parts of body, and under surface of tail.

Color.—Unworn winter pelage (type, March): Top of head, nape, shoulders, and median pair of dorsal stripes pale smoke gray, mixed with cinnamon; ears fuscous, margined posteriorly with smoke gray; postauricular patches creamy white; dark dorsal stripes blackish, margined with pinkish cinnamon, the outer pair and the lateral stripes slightly paler, and sprinkled with pinkish cinnamon; outer pair of light stripes clear white; sides between pinkish cinnamon and pinkish buff [clear pinkish buff in some specimens]; rump and thighs mixed pinkish cinnamon and smoke gray; hind feet light pinkish cinnamon; front feet a paler shade of the same; tail above, fuscous black, overlaid with pinkish buff;

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[11] Mus. Comp. Zool.
[15] D. R. Dickey coll.
[16] E. R. Warren coll.
[17] Mus. Vert. Zool., 10; E. R. Warren coll., 2.
[18] Carnegie Mus.
[19] Mus. Vert. Zool.
[20] State College Wash.

tail beneath, cinnamon buff or pinkish buff, margined with fuscous black and tipped with pinkish buff; underparts pale pinkish buff. *Summer pelage* (August): Similar to the winter pelage, but sides darker.

Skull.—Practically the same as that of *luteiventris*.

Measurements.—Average of 11 adults from Bitterroot Valley, Mont.: Total length, 215.4 (208–228); tail vertebræ, 95.4 (90–105); hind foot, 32 (31.5–33); ear from notch, 14 (13–15.5). *Skull:* Greatest length, 34.1 (33–34.9); zygomatic breadth, 19 (18.8–19.2); cranial breadth, 15.2 (14.7–15.5); interorbital breadth, 7.4 (7.1–7.5); length of nasals, 11.2 (10.4–11.8).

Remarks.—This subspecies apparently is confined to the Bitterroot Valley and the adjacent foothills, but since no specimens from the surrounding regions are available, the exact limits of its range are not known. Its pale coloration is well shown in the series in unworn winter pelage; in summer pelage the characters are less strongly marked.

Specimens examined.—Total number, 29, as follows:

Montana: Bass Creek, near Stevensville, 6; Corvallis, 3; Florence, 7;[21] Lolo, 6; Willow Creek, 7–10 miles east of Corvallis, 7.

EUTAMIAS AMŒNUS CANICAUDUS Merriam

Gray-tailed chipmunk

(Pls. 5, l; 9, l)

Eutamias canicaudus Merriam, Proc. Biol. Soc. Washington 16: 77, May 29, 1903.

Type.—Collected at Spokane, Wash., April 11, 1891, by C. P. Streator; ♀ adult, skin and skull; No. $\frac{27007}{34428}$, United States National Museum (Biological Survey collection); original number, 639.

Geographic distribution.—Eastern Washington, northern Idaho, and a small area in northwestern Montana; east to Clark Fork of the Columbia (opposite Thompson Falls, Mont.); west to the Columbia River; north to Marcus, Wash.; south to Orofino, Idaho, and the foothills of the Blue Mountains, southeastern Washington. *Zonal range:* Transition; 1,100 to 3,000 feet altitude. (Fig. 5.)

Characters.—Similar in size and coloration to *Eutamias amœnus luteiventris*, but sides and feet paler, tail paler and more grayish, underparts less buffy; median pair of light dorsal stripes more mixed with ochraceous tawny. Compared with *affinis:* General tone of upper parts more ochraceous (less grayish), especially on the head and rump; median pair of light stripes more mixed with ochraceous tawny; sides slightly paler and more ochraceous (less tawny); under parts more buffy; under side of tail paler (less tawny).

Color.—Summer pelage (August): Top of head cinnamon, mixed with smoke gray; dark dorsal stripes black, contrasting strongly with the light stripes; median pair of light stripes whitish, heavily mixed with ochraceous tawny or cinnamon; outer pair creamy white; rump and thighs cinnamon buff, mixed with smoke gray; feet light pinkish cinnamon; sides sayal brown; tail above, blackish, overlaid with pale smoke gray or pinkish buff; tail beneath, pinkish buff, bordered with blackish and edged with pinkish buff or pale pinkish buff; underparts whitish, washed with pinkish buff. *Winter pelage:* Similar to the summer pelage, but tail usually more grayish, edged with pale pinkish buff or pale smoke gray; sides paler, approaching pinkish buff. In the worn winter pelage (April and May) the ochraceous tones of the upper parts and sides are much faded, giving to the animal a distinctly drabby tone.

Molt.—The beginning of the spring molt is shown by an adult female specimen from Sprague, Wash., June 12, 1918, which is in greatly worn winter pelage, with a few small patches of summer pelage appearing on the hinder back. Another female from Prospect Creek, Mont., August 2, has the new summer pelage covering the head and anterior back.

[21] Montana State College, 6.

Skull.—Very similar to that of *luteiventris*, but averaging slightly longer.

Measurements.—Average of 13 adults from type region (Spokane, Spokane Bridge, and Fort Spokane): Total length, 227.2 (207–236); tail vertebræ, 104.4 (98–115); hind foot, 33.7 (33–35); ear from notch, 14 (13–15). *Skull:* Average of 10 adults from same localities: Greatest length, 34.6 (34.2–35.6); zygomatic breadth, 18.8 (18.5–19.2); cranial breadth, 15.1 (14.8–15.5); interorbital breadth, 7.4 (7.2–7.9); length of nasals, 10.7 (10.3–11).

Remarks.—The gray-tailed chipmunk occupies a comparatively limited area but its characters are well marked. It intergrades with *luteiventris* in the foothills of the Blue Mountains, southeastern Washington, and possibly also in extreme northeastern Washington, but at its eastern limit on Clark Fork of the Columbia, Mont., it apparently does not intergrade, the two typical forms occurring on opposite sides of the river. It resembles *affinis* rather closely, but at present is not known to intergrade with it, the two being separated by the Columbia River. In eastern Washington, this species occurs in the same region with *Eutamias minimus grisescens*, which it much resembles in color, but from which it differs in much larger size.

Specimens examined.—Total number, 132, as follows:

Idaho: Cœur d'Alene, 12; Fort Sherman, 4; Kingston, 1; Mission, Kootenai County, 2; Moscow, 6;[22] Osborn, 10.
Montana: Prospect Creek, near Thompson Falls, 11; Thompson Pass, 2.
Washington: Bonnie Lake, Spokane County, 1;[23] Cheney, 5; Colville, 9; Douglas, 5; Fort Spokane, 17; Garfield, 6; Kamiak Butte, Whitman County, 2; Marcus, 4; Marshall, 12; Pullman, 1;[24] Spangle, 1; Spokane, 7; Spokane Bridge, 7; Spokane River (south side), 1; Sprague, 6.

EUTAMIAS AMŒNUS AFFINIS (Allen)

Columbian Chipmunk

(Pls. 5, j; 9, j)

Tamias quadrivittatus affinis Allen, Bul. Amer. Mus. Nat. Hist. 3: 103, June, 1890.
Eutamias quadrivittatus affinis Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 44, December 27, 1901.

Type.—Collected at Ashcroft, British Columbia, July 3, 1889,[25] by Clark P. Streator; ♀ adult, skin and skull; No. $\frac{2019}{1500}$, American Museum of Natural History.

Geographic distribution.—Interior of southern British Columbia and central Washington; north to Lac la Hache, British Columbia; east to Okanagan Lake and Midway, British Columbia, and the Columbia River in central Washington; west to Lillooet, British Columbia, and the eastern slopes of the Cascade Range in Washington; south to the Columbia River, southern Washington. *Zonal range:* Transition; 1,000 feet (Oroville, Wash.) to 6,500 feet (Okanogan County, Wash.). (Fig. 5.)

Characters.—Similar to *Eutamias amœnus luteiventris*, but coloration of upper parts more grayish (less ochraceous) especially on the head and rump; outer pair of dorsal stripes clearer white; sides of body and feet paler; underparts whitish, usually without trace of buff. Similar to *ludibundus*, but paler and more grayish above; light dorsal stripes clear white; sides and tail paler; underparts more whitish.

Color.—*Summer pelage* (August): Top of head light pinkish cinnamon mixed with smoke gray; postauricular patches prominent, grayish white; median pair

[22] Amer. Mus. Nat. Hist., 2.
[23] W. T. Shaw coll.
[24] State College of Washington.
[25] As recorded on original label; not "June 18," as given in original description.

of light dorsal stripes pale smoke gray; outer pair white; median dark dorsal stripes fuscous black, edged with cinnamon, the outer pair fuscous; sides pinkish cinnamon or sayal brown; rump and thighs smoke gray, faintly washed with light pinkish cinnamon; feet cinnamon buff; tail above, fuscous mixed with cinnamon and bordered with cinnamon buff; tail beneath, sayal brown or clay color, bordered with fuscous black and edged with cinnamon buff; underparts creamy white. *Winter pelage* (Republic, Wash., November): Very similar to the summer pelage but head, shoulders, and median pair of light dorsal stripes tinged with pale drab gray; underparts faintly washed with pinkish buff.

Molt.—The beginning of the summer molt is shown by a specimen (♂) from Stormy Peak, Wash., July 6, 1918, in which the new pelage is growing in patches on the back and shoulders; two adult females from Signal Peak, Wash., July 24 and 29, are still in worn winter pelage, with no sign of molting, and a female from Mount Aix, Wash., September 6, shows the summer pelage just beginning to appear in small patches on the fore back.

Skull.—Closely similar to that of *canicaudus;* slightly longer than that of *luteiventris.*

Measurements.—Average of seven adults from type locality: Total length, 212.6 (205–220); tail vertebræ, 93.6 (89–101); hind foot, 33.3 (33–34); ear from notch, 13.7 (12.5–14.8). Average of 8 adults from Molson, Wash.: Total length, 221.7 (216–230); tail vertebræ, 97.7 (95–100); hind foot, 33.7 (33–35). *Skull:* Average of nine adults from type locality: Greatest length, 34.6 (33.9–35.5); zygomatic breadth, 19.2 (18.7–19.6); cranial breadth, 15 (14.6–15.3); interorbital breadth, 7.3 (7–7.8); length of nasals, 11.2 (10.8–11.6).

Remarks.—The Columbian chipmunk is a pale race of *amœnus,* about the size of *canicaudus* or *ludibundus;* it occupies a comparatively narrow strip in the dry interior of southern British Columbia and northern Washington, intergrading with *luteiventris* on the east and with *ludibundus* on the north and west. Most of the large series from the eastern side of Okanagan Lake, British Columbia, are moderately washed with buff on the underparts and are therefore referred to *luteiventris.* A series of 12, however, collected by J. A. Munro and labeled "Okanagan," are more whitish beneath and are best referred to *affinis.* Intermediates between the present form and *ludibundus* have been examined from Similkameen and Lillooet, British Columbia, and from Blewett Pass (Kittitas County) and Bauerman Ridge (near Tungsten Mine), Wash. Specimens from Chelan and Entiat, Wash., are more tawny above and have slightly darker tails than typical *affinis,* thus showing approach to *ludibundus;* specimens from Wenatchee and Goldendale, Wash., while nearly like *affinis* in color, have somewhat shorter skulls, thus approaching *amœnus.*

This chipmunk, as pointed out by Allen in the original description, bears a striking resemblance to *E. quadrivittatus* of Colorado, but the two have no connection, being separated by other very distinct forms in both of the groups to which they belong. Allen's remarks (1890, p. 104–105), were based on a misconception of the characters of true *quadrivittatus,* which explains his statement that *affinis* is larger than *quadrivittatus. E. affinis* has a slightly shorter hind foot and smaller skull than *quadrivittatus,* and differs also, in having a more grayish (less ochraceous) rump, and paler hind feet and under surface of tail.

Specimens examined.—Total number, 326, as follows:

British Columbia: Ashcroft, 21;[26] Cariboo Lake (near Kamloops), 6; Clinton, 7;[27] Cranbrook, 2;[28] Grand Prairie, 1;[29] Hedley, 6;[31] Hope (Gordon's Ranch), 1;[30] Hope-Princeton Summit, 6;[31] Kamloops, 19;[31] Lac la Hache, 2;[32] Lena Valley (Martin's Ranch), 1;[29] Lillooet, 2;[31] Midway, 5;[31] Nicola River, 1;[33] Nicola Valley, 2;[33] Okanagan Valley, 23[34] (including 6 from Schoonover Mountain, 2 from Incaneep Creek, and 1 from Sheep Creek); Penticton, 2;[31] Princeton, 4;[31] Similkameen, 11;[35] Spence's Bridge, 1;[30] Vaseaux Lake, 2.[36]

Washington: Bald Mountain, Okanogan County, 3; Bauerman Ridge (near Tungsten Mine), 8; Bumping Lake, Yakima County, 3; Chelan, 15; Chopaka Mountain (altitude, 5,700 feet), 4; Cleveland, 8; Conconully, 7; Conrad Meadows, Yakima County, 2; Easton, 14; Entiat River, 20 miles from mouth, 12; Fort Simcoe (8 miles southwest), 1; Glenwood, 1; Goldendale, 1; Goose Prairie, Bumping River, 1;[37] Grand Dalles (10 miles north), 2; Hart Lake, Chelan County, 1; Hedley, Sterling Creek, 6;[31] Keremeos, 8;[31] Lake Chelan (head), 6; Lake Cle Elum, 3; Loomis, 1; Lucerne, 1; Lyle (12 miles north), 6; Mazama, 2; Molsan, 8; McAllister Meadows, Tieton River (altitude 3,000 feet), 4; Mount Adams, 4; Mount Aix (altitude 6,500 feet), 10; Mount St. Helens, 1;[37] Naches River (40 miles from mouth), 2; Okanogan (5 miles southwest), 1; Omak Lake (Okanogan County), 2; Orono (opposite on west bank Columbia River), 1; Oroville, 1; Osoyoos-Bridesville Summit, 6;[31] Republic, 5; Sheep Mountains, Okanogan County, 4; Signal Peak, Yakima Indian Reservation, 19; Stehekin, 2; Stormy Peak, Chelan Mountains, 1; Tieton River (south fork, altitude 4,200 feet), 2;[37] Twisp, 4; Tunk Mountain, Okanogan County, 5; Wenatchee, 3; Wenatchee Lake, 1; Westbridge, 1.[31]

EUTAMIAS AMŒNUS LUDIBUNDUS Hollister

Hollister's Chipmunk

(Pls. 5, n; 9, n)

Eutamias ludibundus Hollister, Smithsonian Misc. Coll. 56: 1, December 5, 1911.

Type.—Collected at Yellowhead Lake, British Columbia (3,700 feet altitude), August 29, 1911, by N. Hollister; ♀ adult, skin and skull; No. 174225, United States National Museum; original number, 3987.

Geographic distribution.—Central, eastern, and southwestern British Columbia and extreme west-central Alberta; south through western Lillooet (district) and on both slopes of the Cascades as far as central Oregon; northern and western limits imperfectly known, but north at least to Hazelton, British Columbia, and head of Smoky River, Alberta. *Zonal range:* Canadian. (Fig. 5.)

Characters.—About the size of *Eutamias amœnus affinis;* tail averaging relatively shorter than that of *luteiventris;* ears averaging smaller than in either *affinis* or *luteiventris;* similar in color to *luteiventris* but head and rump slightly more grayish (less ochraceous); underparts mainly white (rather than buff), and tail averaging darker tawny beneath. Compared with *affinis:* Upper parts decidedly more ochraceous (less grayish); sides and tail darker. Compared with

[26] Amer. Mus. Nat. Hist., 8; Acad. Nat. Sci. Philadelphia, 4.
[27] Acad. Nat. Sci. Philadelphia, 6; Nat. Mus. Canada, 1.
[28] M. M. Green coll.
[29] Provincial Mus., Victoria, British Columbia.
[30] Mus. Comp. Zool.
[31] Nat. Mus. Canada.
[32] Acad. Nat. Sci. Philadelphia.
[33] W. E. Saunders coll.
[34] Nat. Mus. Canada, 2; Provincial Mus. British Columbia, 21.
[35] Provincial Mus., British Columbia, 10; Nat. Mus. Canada, 1.
[36] J. Dewey Soper coll.
[37] State College Wash.

E. minimus borealis: Total length about the same, but tail averaging slightly shorter and hind foot considerably larger; skull slightly larger and relatively broader across zygomata, the rostrum longer and narrower; sides of body, hind feet, and under surface of tail darker; light dorsal stripes clearer white (less mixed with cinnamon); rump and thighs more grayish (less ochraceous).

Color.—*Summer pelage* (August): Top of head mixed pinkish cinnamon and grayish white; sides of face more or less washed with pinkish buff; facial stripes fuscous or bister, shaded with cinnamon; dark dorsal stripes black or fuscous black, thinly edged with sayal brown; median pair of light dorsal stripes grayish white or smoke gray, more or less mixed, especially on fore back, with sayal brown or ochraceous tawny; outer pair creamy white; rump and thighs cinnamon buff, mixed with smoke gray; sides ochraceous tawny or tawny; feet cinnamon buff or clay color; tail above, fuscous black, mixed with ochraceous tawny, and bordered with cinnamon buff; tail beneath, tawny or ochraceous tawny, bordered with fuscous black and edged with cinnamon buff; underparts grayish white, faintly tinged with pinkish buff.

Molt.—The summer molt is shown by an adult female from Henry House, Alberta, July 8, and an adult male from North Fork of Moose River, British Columbia, July 21, in which the new summer pelage covers about two-thirds of the dorsal region. An adult female from Babine, British Columbia, taken August 16, is in worn winter pelage, with no indications of a molt. No specimens showing a fall molt have been found in the material examined.

Skull.—Very similar to that of *luteiventris*, averaging slightly shorter; also similar to that of *affinis*, but shorter.

Measurements.—Average of 11 adults from type region (Yellowhead Lake and Moose Lake, British Columbia, and Henry House, Alberta): Total length, 217 (205–230); tail vertebræ, 96.4 (91–108); hind foot, 33.5 (32–35); ear from notch, 12.2 (11.2–13). *Skull:* Average of nine adults from Yellowhead Lake, Moose Lake, and Moose River, British Columbia: Greatest length, 33.8 (33–34.4); zygomatic breadth, 19 (18.4–19.5); cranial breadth, 15 (14.3–15.6); interorbital breadth, 7.6 (7.4–7.8); length of nasals, 10.9 (10.1–11.5).

Remarks.—Hollister's chipmunk is the most northerly ranging member of the *amœnus* group; it is closely related to both *affinis* and *luteiventris*, being darker than the former and whiter beneath than the latter. It is also exceedingly close in size and coloration to *caurinus*, differing chiefly in paler head, darker sides, and slightly darker under surface of tail. The greater part of the range of *ludibundus* is widely separated from that of *caurinus*, but in the Cascades north of Mount Rainier the two forms meet and doubtless intergrade. In southwestern British Columbia the present form occurs in a comparatively narrow strip of country west of the Fraser River, thus separating the ranges of *affinis* and *felix*. Specimens from Lillooet, British Columbia, show intergradation with *affinis*, one specimen in the series being almost typical of the latter form. A specimen from Brackendale, near Howe Sound, is typical; another from the same place strongly approaches *felix* in intensity of coloration, but the tail is paler beneath, as in *ludibundus*. Two specimens in full winter pelage from Port Moody, British Columbia, taken by Professor Macoun, are typical of *ludibundus*, although others from there in summer pelage are referable to *felix*. Were it not for the extensive range of this chipmunk in central and eastern British Columbia, where it is widely separated from the range of *felix*, the southern British Columbia specimens might be considered to be intermediates between *felix* and *affinis* (which they really are), and the form allowed to pass without a name.

Specimens examined.—Total number, 200, as follows:

Alberta: Henry House, 13; Jasper Park, 13;[38] Smoky River (head), 1.
British Columbia: Alta Lake, New Westminster district, 2;[39] Babine (8 miles west), 1; Barkerville, 1; Brackendale, 2; Burrard Inlet, 1;

[38] Nat. Mus. Canada.
[39] Kenneth Racey coll.

"Cariboo" [158 Mile House, *fide* Allan Brooks], 2; Coalmont, 1;[39] Fraser River, near mouth of north fork, 1; Hazelton, 6;[40] Hope, 4;[41] Lillooet, 13;[42] McGillivary Creek (Lillooet district), 2;[38] Mons, 2;[39] Moose Lake, 16; Moose River, 5; Nita Lake, New Westminster district, 1;[39] Port Moody, 2;[43] Spences Bridge, 1;[38] Second Summit (on United States–Canada boundary, west of Skagit River), 4; Telkwa, 4;[38] Vanderhoof, 5;[38] Yellowhead Lake, 5.

Oregon: Mill Creek, 20 miles west of Warmsprings, 6; Mount Hood, 5; O'Leary Mountain (10 miles south of McKenzie Bridge), 2; Three Sisters, 3; Wapinitia, 11; Warm Springs River (2,400 feet altitude), 2.

Washington: Austin Pass, Mount Baker, 2;[44] Barron, Whatcom County, 21; Buck Creek Pass, 2; Hannegan Pass, Whatcom County, 2; Hidden Lakes, Okanogan County, 4; Lyman Lake (Chelan County), 1; Mount Baker (north fork Glacier Creek), 1;[44] Mount Rainier, 4 (Glacier Basin and Reflection Lake); Mount St. Helens, 4; Mount Stuart (altitude 3,500 feet), 5; Pasayten River, Okanogan County (altitude 3,900 feet), 4; Skagit River, Whatcom County (mouth of Ruby Creek), 1; Stevens Pass, Chelan County, 1; Suiattle River (altitude 6,500 feet), 1; Swamp Creek, Whatcom County, 1;[44] Trout Lake, Mount Adams, 4; Twin Sister Lakes (near Cowlitz Pass), 1; Winchester Mountain (Twin Lakes), 4.

EUTAMIAS AMŒNUS FELIX (RHOADS)

TAWNY CHIPMUNK

(PLS. 5, M; 9, M)

Tamias quadrivittatus felix Rhoads, Amer. Nat. 29: 941, October, 1895.
Eutamias quadrivittatus felix, Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 44, December 27, 1901.

Type.—Collected on Church Mountain, New Westminster district, British Columbia (long. 121° 50′ W.), near the international boundary, August 13, 1895, by Allan Brooks;[45] ♀ adult, skin and skull; No. 9355, Academy of Natural Sciences of Philadelphia (formerly No. 2355, collection S. N. Rhoads); original number, 467.

Geographic distribution.—Coast region of southern British Columbia, from the Mount Baker Range, near the United States-Canada boundary, north at least to Malaspina Inlet; northern limits unknown. *Zonal range:* Canadian and Transition; sea level to 5,700 feet altitude. (Fig. 5.)

Characters.—Similar to *Eutamias amœnus ludibundus*, but upper parts strongly suffused with ochraceous tawny, the head and rump much darker; light dorsal stripes much mixed with ochraceous and the underparts clouded with buff; ears larger. Compared with *luteiventris:* Upper parts much darker (more tawny); sides of face and neck more strongly ochraceous tawny; underparts less intensely buffy; tail darker (more rufescent) both above and below; ears slightly larger.

Color.—Top of head mixed cinnamon and smoke gray; dark facial stripes bister; light facial stripes soiled whitish, tinged with buff; sides of nose and cheeks cinnamon buff; sides of face and body deep ochraceous tawny; dark dorsal stripes

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[38] Nat. Mus. Canada.
[39] Kenneth Racey coll.
[40] Mus. Vert. Zool.
[41] Mus. Comp. Zool.
[42] Provincial Mus., Victoria, British Columbia, 9; Nat. Mus. Canada, 4.
[43] Amer. Mus. Nat. Hist., 1; Nat. Mus. Canada, 1.
[44] State College Wash.
[45] Allan Brooks states (1902, p. 240) that the type specimen was collected on "Lumsden Mountain on forty-ninth parallel, due north of Mount Baker." Major Brooks, in correspondence, informs the writer that he intended to spell this Indian name "Liumsden," and this is evidently the same name as Lihumitson, which appears as the name of the creek just to the west of Church Mountain on a map of New Westminster and Yale districts published in 1914 by the British Columbia Department of Lands; the region is now known as Lihumption Park. The altitude given by Brooks (7,000 feet) is erroneous, for Church Mountain is only 5,700 feet high.

black; median pair of light stripes smoke gray, more or less mixed with cinnamon or ochraceous tawny, especially on shoulders and fore back, where the tawny color prevails; outer pair buffy white, mixed with cinnamon; rump and thighs ochraceous tawny, shaded with fuscous and sprinkled with smoke gray; front feet pinkish cinnamon; hind feet between cinnamon and sayal brown; tail above, fuscous black, heavily mixed with ochraceous tawny; tail beneath, dark ochraceous tawny, bordered with fuscous black; underparts pinkish buff or light pinkish cinnamon, the tawny color of the sides often encroaching on the belly.

Molt.—The summer molt is shown by two adult female specimens from Mount Baker Range, British Columbia, August 22 and 31, in which the new summer pelage covers only the anterior half of the body. The tail, however, appears to be in new pelage. An adult female from Port Moody, British Columbia, July 30, is in badly worn and faded winter pelage, with no sign of the beginning of the molt.

Skull.—Closely similar to those of *luteiventris* and *ludibundus* but zygomata slightly more expanded posteriorly.

Measurements.—Average of 10 adults from type locality: Total length, 224.7 (215–245); tail vertebræ, 93.8 (90–105); hind foot, 34.1 (33–35); ear from notch, 14.4 (13–16). *Skull:* Average of eight adults from type locality: Greatest length, 34.2 (33.3–34.7); zygomatic breadth, 19.4 (19–19.8); cranial breadth, 15.1 (14.6–16.9); interorbital breadth, 7.5 (7.1–8.2); length of nasals, 10.7 (10.3–11.2).

Remarks.—The tawny chipmunk is the darkest and most richly colored of the races of *amœnus*, showing the usual characters developed by the forms occupying the humid belt of the northwest coast. It has not thus far been taken south of Mount Baker, Wash., but the limits of its range, both on the south and the north, are imperfectly known.

Apparently it ranges but a short distance in the interior; two specimens from Brackendale near the head of Howe Sound, British Columbia, show intergradation with *ludibundus* in having paler tails and more whitish bellies; one agrees with *felix*, the other with *ludibundus*, in the color of the upper parts. Specimens from "Second Summit," on the United States-Canada boundary are likewise intermediate between these two forms.

Specimens examined.—Total number, 59, as follows:

British Columbia: Cascade Mountains, 15 miles north of Mount Baker, 1; Howe Sound (Gibson Landing), 9; Lihumption Park, 7;[47] Lund, Malaspina Inlet, 2; Mount Baker Range [Church Mountain], 22;[46] Port Moody, 7; Skagit [River?], 1;[47] Tami Hy Creek [Long. 121° 45′, near United States boundary], 3.

Washington: Mount Baker; 2;[48] Mount Baker (Heather Meadows, 4,300 feet altitude), 3; [48a] Mount Hermon, Whatcom County, 2.[48a]

EUTAMIAS AMŒNUS CAURINUS Merriam

Olympic Chipmunk

(Pls. 5, 1; 9, 1)

Eutamias caurinus Merriam, Proc. Acad. Nat. Sci. Philadelphia, 1898 (October 4), p. 352.

Type.—Collected in the Olympic Mountains, Wash. (timberline, near head of Soleduck River), August 27, 1897, by C. Hart Merriam and Vernon Bailey; ♂ adult, skin and skull; No. 90636, United States National Museum (Biological Survey collection); original number, 6211.

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[46] Mus. Comp. Zool., 13.
[47] Nat. Mus. Canada.
[48] W. T. Shaw, coll. 1.
[48a] Edith Hardin coll.

Geographic distribution.—Olympic Mountains and Mount Rainier, Wash. *Zonal range:* Canadian; 3,500 to 8,000 feet altitude. (Fig. 5.)

Characters.—Very similar to *Eutamias amœnus ludibundus*, but head slightly darker; sides of face less washed with ochraceous; sides of body slightly paler, and underside of tail averaging paler but more mixed with blackish. Compared with *felix:* Upper parts and sides of head and body decidedly paler (less tawny); outer pair of dorsal stripes clearer white (less mixed with ochraceous); underside of tail paler. Compared with *ochraceus:* Upper parts less washed with tawny; sides paler; underside of tail less tawny and more mixed with blackish; hind feet larger; skull broader across zygomata.

Color.—*Summer pelage* (August and September): Head mixed cinnamon and smoke gray, the general tone near cinnamon drab; median (3) dark dorsal stripes blackish; outer pair about fuscous black; median pair of light stripes smoke gray, sprinkled with ochraceous tawny; outer pair white; sides light ochraceous tawny; front feet pinkish buff; hind feet cinnamon buff; tail above, fuscous black, mixed with cinnamon and edged with cinnamon buff; tail beneath, ochraceous tawny or sayal brown, bordered with fuscous black and tipped with cinnamon buff (the median portion often encroached upon by the fuscous black); underparts soiled whitish, tinged with pinkish buff.

Molt.—The summer molt is shown by an adult male specimen from Mount Rainier, July 10, in which the fresh summer pelage covers about half of the anterior upper parts, extending back on the sides to the flanks; the underparts show new pelage from the chin to a point just back of the forelegs and an isolated patch on the abdomen. An adult female from the same locality, August 4, still retains the old worn winter pelage, and another female taken August 2 shows the summer molt just beginning.

Skull.—Practically identical with that of *ludibundus*.

Measurements.—Average of 18 adults from Mount Rainier, Wash.[49]: Total length, 212 (205–224); tail vertebræ, 94.7 (88–105); hind foot, 33.3 (32–35); ear from notch, 14.1 (12.5–15). *Skull;* Average of eight adults from type locality: Greatest length, 33.9 (33.4–34.6); zygomatic breadth, 19.4 (19–19.7); cranial breadth, 14.7 (14.4–15); interorbital breadth, 7.3 (7.2–7.6); length of nasals, 10.6 (10.4–11.1).

Remarks.—The Olympic chipmunk is very closely related to *E. amœnus ludibundus;* the typical colony of *caurinus* is apparently isolated on the Olympic Peninsula from the other races of this species, but another colony, nearly indistinguishable from the typical form occupies Mount Rainier and intergrades in that region with *ludibundus* on the north and *ochraceus* on the south. Compared with these two races, *caurinus* is a dull-colored form, the sides less intensely tawny than in *ludibundus*, and the tail less tawny than in *ochraceus*.

The large series from Mount Rainier is referable as a whole to *caurinus*, but three specimens from Glacier Basin, on the northeast side of the mountain, are indistinguishable from *ludibundus*, to which they are referred.

Specimens examined.—Total number, 82, as follows:

Washington: Canyon Creek, Clallam County (3,550 feet altitude), 1; Dosewallips River (near head), 1; Mount Angeles (6,000 feet altitude), 5; Mount Carrie, Clallam County (6,000 feet altitude), 1; Mount Rainier, 49; Olympic Mountains (Boulder Lake), 6;[50] Olympic Mountains (Happy Lake), 14;[51] Olympic Mountains (head of Soleduck River, 5.

[49] This series, apparently of the same size as Olympic Mountain specimens, is used for measurements in place of the series of topotypes, because the measurements of the latter are taken to end of tail hairs and without claws.

[50] Field Mus. Nat. Hist.

[51] Field Mus. Nat. Hist., 6; Amer. Mus. Nat. Hist., 4; Mus. Comp. Zool., 2.

EUTAMIAS PANAMINTINUS (Merriam)

Panamint Chipmunk

(Pls. 6, p; 10, p)

Tamias panamintinus Merriam, Proc. Biol. Soc. Washington 8: 134, December 28, 1893.

Eutamias panamintinus Merriam, Proc. Biol. Soc. Washington 11: 194, July 1, 1897.

Type.—Collected in Johnson Canyon, Panamint Mountains, Calif. (about 6,000 feet altitude), April 3, 1891, by E. W. Nelson; ♂ adult, skin and skull; No. $\frac{27603}{39702}$, United States National Museum (Biological Survey collection); original number, 723.

Geographic distribution.—Lower slopes (Upper Sonoran and low Transition Zones) of the desert ranges of southeastern California and southwestern Nevada (White Mountains, Grapevine Mountains, Coso Mountains, Panamint Mountains, Providence Mountains, etc.); also on the east slope of the Sierra Nevada from Olancha Peak north to Bishop Creek. *Zonal range:* Upper Sonoran and low Transition; 6,000 to 9,500 feet altitude. (Fig. 5.)

Characters.—Apparently a member of the *amœnus* group; nearest to *Eutamias amœnus monoensis* but decidedly larger, with much larger skull; upper parts, tail, and sides darker tawny; dorsal stripes more tawny (less blackish); rump and thighs more extensively grayish. Compared with *E. quadrivittatus inyoensis:* Size smaller; facial stripes paler; dorsal stripes reddish rather than blackish; rump and thighs grayish instead of buffy.

Color.—*Summer pelage* (July): Top of head smoke gray, mixed with pinkish cinnamon and bordered with fuscous; ocular streak blackish, becoming mikado brown at base of ear; submalar stripe indistinct, mikado brown shaded with fuscous; ears mouse gray or smoke gray, shaded on posterior margin with buffy white (but not conspicuously contrasted as in most species); postauricular patches creamy white; dark dorsal stripes mikado brown, the median one shaded (usually rather faintly) with fuscous black; median pair of light stripes grayish white; outer pair creamy white; sides mikado brown, shading to sayal brown or cinnamon below; rump and thighs smoke gray, strongly contrasted with the back and sides; feet pinkish buff, tinged with smoke gray; tail above, fuscous black (the bases of the hairs pinkish cinnamon), overlaid with pinkish buff; tail beneath, sayal brown or clay color, bordered with fuscous black and tipped with pinkish buff; under parts buffy white. *Winter pelage* (April): Similar to the summer pelage but colors on back and sides duller and less contrasted; top of head near light drab; median dorsal stripe fuscous black, more or less mixed, especially anteriorly with sayal brown; outer pair of dark stripes sayal brown; median pair of light stripes smoke gray, mixed with pale buff; outer pair dull whitish; rump and hinder back smoke gray, shaded with cinnamon buff; underside of tail sayal brown.

Molt.—The winter pelage often becomes excessively worn by early summer, so that the dorsal stripes are entirely obliterated. An adult male specimen from White Mountains, Calif., June 9, and an adult female from Panamint Mountains, Calif., June 14, have the new summer pelage covering the shoulders and fore back. Two specimens (♂ and ♀) from Providence Mountains, Calif., June 1, 1902, are in full, fresh summer pelage, indicating apparently a very early molt.

Skull.—Similar to that of *E. amœnus ochraceus*, but averaging larger, with larger audital bullæ; smaller than that of *E. quadrivittatus inyoensis*, with flatter brain case, and relatively larger audital bullæ.

Measurements.—Average of 12 adults from type locality: Total length, 206.5 (198–220); tail vertebræ, 91.7 (85–102); hind foot, 31.9 (31–32.5); ear from notch, 14.7 (13.5–16). *Skull:* Average of 10 adults from type locality: Greatest length: 34.5 (34–34.8); zygomatic breadth, 18.8 (18.5–19.2); cranial breadth, 14.7 (14.3–15.3); interorbital breadth, 7.6 (7.1–8.1); length of nasals, 10.8 (10.4–11.5). *Weight:* Average of 58 specimens, 53.3 grams (45.5–67.2).

Remarks.—The Panamint chipmunk is a handsome species, characterized in summer pelage by bright tawny colors and a conspicuous

gray rump, and in winter pelage by much duller colors and even more gray on the rump. It is clearly a member of the *amœnus* group and somewhat resembles both *amœnus* and *monoensis* in general coloration; in cranial characters it most resembles *E. amœnus ochraceus*, but averages larger. Its range is complementary to the other members of the *amœnus* group, occupying, as it does, the outlying desert ranges of southeastern California and southwestern Nevada. On the eastern slopes of the Sierra Nevada it ranges north to within a short distance of the range of *monoensis* and the two may occur together at some places. *E. panamintinus* is known to occur at 7,000 feet altitude on Bishop Creek, while *monoensis* has been taken at 8,400 feet altitude near the head of Owens River. In the White and Inyo Ranges, Calif., *E. panamintinus* occurs with *E. quadrivittatus inyoensis*, their ranges overlapping between 7,600 and 8,400 feet altitude.

Specimens examined.—Total number, 260, as follows:

California: Argus Mountains, 15; Benton, Owens Valley, 6; [52] Bishop Creek, Sierra Nevada (7,000 feet altitude), 1; Carroll Creek, Inyo County (5,500 to 8,000 feet altitude), 15; [53] Coso Mountains, 4; Inyo Mountains, 27; [54] Cottonwood Creek, Inyo County (8,500 feet altitude), 1; [53] Little Cottonwood Creek, Inyo County (9,000 feet altitude), 1; [53] Little Onion Valley, 1; [53] Lone Pine, 1; New York Mountain, 1; Olancha (canyon 5 miles southwest), 1; Onion Valley, Inyo County, 3; [53] Panamint Mountains, 100; [55] Providence Mountains (about 24 miles northwest of Fenner), 4; Rock Creek, Mono County (21 miles northwest of Bishop), 2; [53] White Mountains, 67.[56]

Nevada: Grapevine Mountains, 4; Mount Magruder, 1; Queen Mill, White Mountains, 1; Queen Station, Owens Valley, 1; Silver Peak Mountains (6,800 to 9,000 feet altitude), 3.

EUTAMIAS QUADRIVITTATUS GROUP

EUTAMIAS QUADRIVITTATUS (Say)

[Synonymy under subspecies]

Diagnosis.—Size medium; hind foot 32–36 millimeters; skull length 34.5–36.8 millimeters; skull larger than that of any of the races of *minimus* or *amœnus*, but not appreciably different in shape from that of several of the races of *amœnus* (e. g., *affinis*, *ludibundus*, and *canicaudus*); head smoke gray or drab, more or less shaded with cinnamon or pinkish cinnamon; dark dorsal stripes black, fuscous black, russet, or mikado brown, often more or less shaded with tawny; light dorsal stripes creamy white or smoke gray, the median pair more or less mixed with cinnamon, sayal brown, or mikado brown; sides tawny, ochraceous tawny, russet, or cinnamon; rump and thighs smoke gray or hair brown, mixed with sayal brown, cinnamon, cinnamon buff, or pinkish buff; hind feet cinnamon, cinnamon buff, pinkish cinnamon, or pale smoke gray; under surface of tail tawny, ochraceous tawny, sayal brown, cinnamon, or cinnamon buff.

EUTAMIAS QUADRIVITTATUS QUADRIVITTATUS (Say)

LARGER COLORADO CHIPMUNK

(PLS. 2, A; 4, E; 8, E)

Sciurus quadrivittatus Say, in James, Long's Exped. to Rocky Mountains 2:45, 1823.

Spermophilus quadrivittatus F. Cuvier, Suppl. a l'hist. nat. Buffon 1:340, 1831.

T[amias] quadrivittatus Wagner, Suppl. Schreber's Sauget. 3:243, 1843.

Tamias quadrivitatus, var. *quadrivitatus* Allen, Proc. Boston Soc. Nat. Hist. 16: 289, 1874 (part).

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[52] Mus. Vert. Zool., 4.
[53] Mus. Vert. Zool.
[54] Mus. Vert. Zool., 20; Amer. Mus. Nat. Hist., 2.
[55] Mus. Vert. Zool., 39; Mus. Comp. Zool., 2; Amer. Mus. Nat. Hist., 2.
[56] Mus. Vert. Zool., 60.

Tamias asiaticus quadrivittatus Allen, Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr. 11: 793, 1877 (part).
Tamias quadrivittatus gracilis Allen, Bul. Amer. Mus. Nat. Hist. 3:99, June, 1890 (San Pedro, N. Mex.).
Eutamias quadrivittatus Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 43, December 27, 1901.
Eutamias quadrivittatus animosus Warren, Proc. Biol. Soc. Washington 22:105, June 25, 1909 (Irwin Ranch, Las Animas County, Colo.).

Type.—None designated; collected on the Arkansas River, Colo., about 26 miles below Canyon City, July 18, 1820 (Merriam, 1905, p. 163).

Geographic distribution.—Mountains and foothills of central Colorado and northern New Mexico; north to Estes Park, east to Tucumcari, N. Mex., and Kenton, Okla.; south to Manzano Mountains; west to Chuska Mountains, N. Mex., Silverton and Sapinero, Colo. *Zonal range:* Transition and Canadian; 5,000 to 10,800 feet altitude. (Fig. 6.)

Characters.—Size medium; external measurements about as in *Eutamias amœnus ludibundus* but ears larger; skull larger than that of any of the races of *amœnus* or *minimus;* coloration very similar to that of *E. minimus operarius*, but feet and underside of tail averaging paler.

Color.—*Summer pelage* (June–September): Head cinnamon, shading on crown to light drab or smoke gray; stripe through eye fuscous black, bordered with cinnamon; other facial stripes rather narrow, mixed cinnamon and fuscous; sides of nose and sometimes of face washed with clay color; ears fuscous or fuscous black, edged on anterior margin with ochraceous tawny and broadly margined posteriorly with grayish white; postauricular patches grayish white; dark dorsal stripes black, margined with ochraceous tawny, the outer pair sometimes mainly tawny; lateral stripe fuscous, fuscous black, or tawny; light dorsal stripes grayish white, the outer pair usually creamy white; sides ochraceous tawny, shading on shoulders to cinnamon; rump and thighs cinnamon buff mixed with smoke gray; front feet cinnamon buff; hind feet pinkish buff or pinkish cinnamon; tail above, fuscous black (the bases of the hairs cinnamon) overlaid with pinkish buff; tail beneath, ochraceous tawny or tawny, bordered with fuscous black and edged with pinkish buff; underparts creamy white. *Winter pelage* (October–December): Closely similar to the summer pelage, but median pair of light dorsal stripes more grayish (less clear white).

Molt.—An adult male specimen from Boulder, Colo., June 11, shows the new summer pelage coming in irregularly over the anterior back; an adult female from Copperton, N. Mex., July 13, is still in winter pelage, with the new pelage just beginning to appear in the middle of the back.

Skull.—Larger than that of any of the other Rocky Mountain chipmunks; much larger than that of *E. minimus operarius*, with relatively long and narrow brain case and long nasals.

Measurements.—Average of 10 adults from type locality: Total length, 222.3 (216–230); tail vertebræ, 99.9 (93–104); hind foot, 33.7 (33–35); ear from notch (dry), 15.4 (14.2–16.2). *Skull:* Average of 10 adults from type locality: Greatest length, 35.9 (34.6–36.6); zygomatic breadth, 19.6 (19.2–20.1); cranial breadth, 15.3 (14.9–16); interorbital breadth, 8 (7.5–8.3); length of nasals, 11.2 (10.7–11.9).

Remarks.—This chipmunk was the first of the American species to be named but, as already shown,[57] was for many years confused with the smaller *E. minimus operarius*. Indeed, it was not until 1905, nearly a century after the species was described, that its true characters were pointed out and the name *quadrivittatus* correctly assigned (Merriam, 1905, p. 163–164). As shown by Doctor Merriam, this species is the only chipmunk occurring in the region where Say procured the type specimen. Doctor Allen, in his revision of the group in 1890, assumed that a series of 12 specimens from Park County, Colo., represented *quadrivittatus*, and he therefore took this

[57] Under *Eutamias minimus operarius*, p. 49.

series as the basis of comparison. Most, if not all, of this series are referable to *operarius*,[58] as indeed, were the majority of the 37 specimens referred by him to *quadrivittatus*. The measurements given by Allen are those of *operarius* and the general concept of *quadrivittatus* at that time, therefore, was of a small animal. Proceeding on the

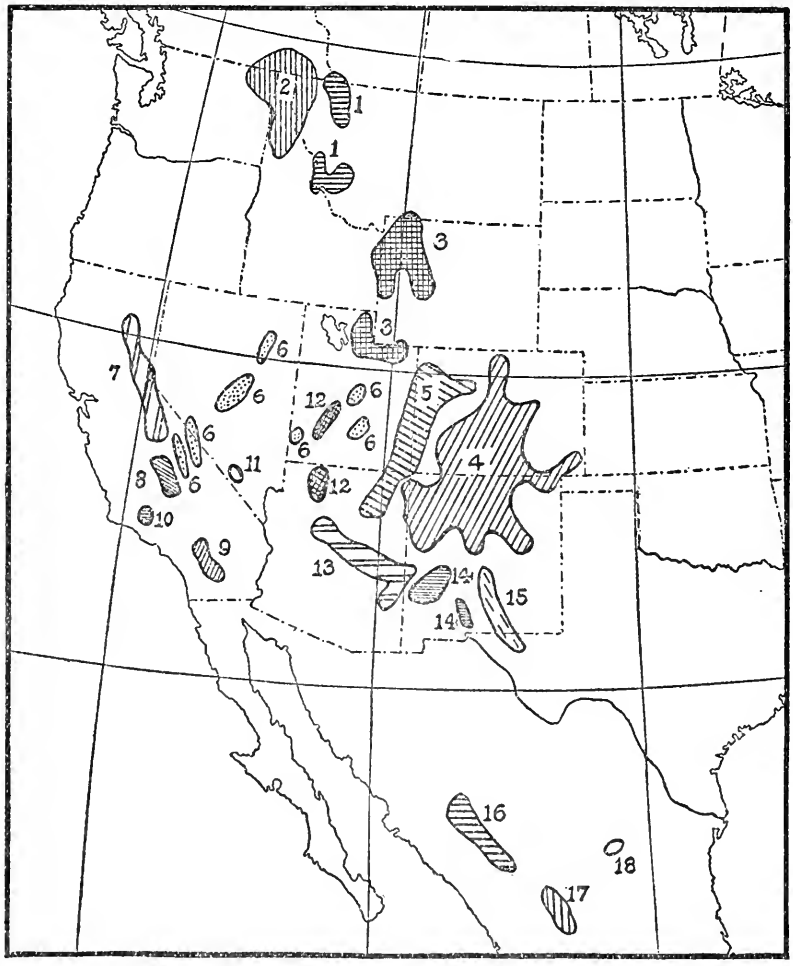

FIGURE 6.—Distribution of the species and subspecies of the *Eutamias quadrivittatus* group. 1, *E. ruficaudus ruficaudus;* 2, *E. ruficaudus simulans;* 3, *E. umbrinus;* 4, *E. q. quadrivittatus;* 5, *E. q. hopiensis;* 6, *E. q. inyoensis;* 7, *E. q. frater;* 8, *E. q. sequoiensis;* 9, *E. q. speciosus;* 10, *E. callipeplus;* 11, *E. palmeri;* 12, *E. adsitus;* 13, *E. cinereicollis cinereicollis;* 14, *E. cinereicollis cinereus;* 15, *E. cinereicollis canipes;* 16, *E. bulleri durangæ;* 17, *E. bulleri bulleri;* 18, *E. bulleri solivagus*

assumption that *quadrivittatus* was the smaller mountain form of Colorado, Doctor Allen named a series in bright summer pelage from San Pedro, N. Mex., as a subspecies, *gracilis*, referring to this form, also, a series in worn winter pelage from Apache County, Ariz., later described by Merriam as *Eutamias hopiensis*. When compared, the

[58] In the absence of skulls and external measurements it is impossible to identify all of them positively.

San Pedro series and a series of typical *quadrivittatus* from Canyon City, Colo., are found to be practically identical.

As pointed out under *operarius* (p. 49) the present form, although almost indistinguishable in color, is decidedly larger than *operarius*, and may be easily recognized by its much larger skull with more elongated brain case, or by its longer hind feet; the feet are also darker (more tawny) and the ears are larger.

The type of *E. quadrivittatus animosus* Warren, from Las Animas County, Colo., appears to be paler than typical *quadrivittatus* in comparable pelage, but since it is in a much worn and faded pelage, satisfactory comparisons are not possible. Several additional specimens from the type region in unworn spring pelage, however, agree closely with certain topotypes of *quadrivittatus*, as does also a specimen in summer pelage from Kenton, Okla.

Intergradation with *hopiensis* is shown by specimens from Blanco, La Jara Lake, and Chuska Mountains, N. Mex., and Tunitcha Mountains, Ariz.; indeed, some of the specimens in the type series of *hopiensis* are almost identical with *quadrivittatus*.

Specimens from the high mountains of northern Colorado (Estes Park, Longs Peak, and Gold Hill) average somewhat darker on the back and sides than typical *quadrivittatus*; the light dorsal stripes are also somewhat duller and the dark stripes less blackish, thus showing an approach to the characters of *umbrinus*. There is no direct evidence, however, of intergradation between these two forms, which are widely separated geographically by an area occupied in part by *hopiensis*.

Specimens examined.—Total number, 476, as follows:

Arizona: Fort Defiance (12 miles north), 5; Tunitcha Mountains (8,000 to 9,000 feet altitude), 4.

Colorado: Antonito (7 miles east), 1; Arkins, 1; Bayfield, 1; Bellevue, Larimer County, 1;[59] Bondad, 3;[60] Boulder, 13;[61] Buena Vista, 2; Buffalo Pass, Jackson County, 2;[62] Canyon City, 70; Cascade, 1; Chimney Gulch, Jefferson County, 1;[62] Chromo, 1;[60] Cochetopa National Forest, 6; Colorado Springs, 13;[63] Crested Butte Mountain (Gunnison County), 1;[62] Crestone, 1;[62] Divide, Teller County, 1;[62] Elkhorn, Larimer County, 3;[59] Estes Park, 14; Florida, La Plata County, 13;[64] Fort Collins, 1;[59] Freese's Station, Boulder County, 2;[59] Gaume's Ranch, northwest corner Baca County, 1;[62] Golden, 1;[62] Gold Hill, 11; Grand Lake (Grand County), 4;[62] Homestead Ranch, Jackson County, 1;[60] Horsetooth Gulch, Larimer County (southwest of Fort Collins), 1;[59] Howard, Fremont County, 5;[62] Irwin's Ranch, northeastern Las Animas County, 2;[65] Jimmie Creek, Las Animas County, 9;[60] Log Cabin, Larimer County, 1;[62] Long Canyon (near Martinsen), 1; Long's Peak, 11; McCoy, 1;[62] Madenos Canyon, Saguache County, 1;[62] Mosca Creek, Saguache County (8,200 feet altitude), 3;[62] Mount Zirkel, Jackson County (10,000 feet altitude), 2;[62] Pagosa Springs, 8; Palmer Lake (El Paso County), 1;[59] Pikes Peak Trail, 1; Querida, Custer County, 4;[62] Rist Canyon, Larimer County, 1;[59] St. Elmo, 1; Salida, 3;[62] San Acacio, Costilla County, 1;[62] Sapinero, 3; Silverton, 1; Sheephorn Pass, Grand County, 1;[62] Soldier Canyon, Larimer County, 1;[59] Spring Canyon (7 miles southeast of Fort Collins), 2;[59] Sulphur Springs, Grand County, 2;[62] Tarryall Creek Camp, Park County, 1;[62] Trinidad, 16;[66] Wagon Wheel Gap, 2;[62] Wetmore (Hardscrabble Canyon), 1.[62]

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[59] Colo. Agr. College.
[60] Colo. Mus. Nat. Hist.
[61] Acad. Nat. Sci. Philadelphia, 4.
[62] E. R. Warren coll.
[63] E. R. Warren coll., 9; Amer. Mus. Nat. Hist., 3; Mus. Comp. Zool., 1.
[64] Amer. Mus. Nat. Hist.
[65] E. R. Warren coll., 1; U. S. Nat. Mus. (type of "*animosus*"), 1.
[66] Colo. Mus. Nat. Hist., 5; E. R. Warren coll., 3.

New Mexico: Bernal, 1; Blanco, 2; Cabra Spring (10 miles north), 1; Canadian River (30 miles northwest of Tucumcari), 2; Carasal, Bernalillo County, 3;[67] Chuska Mountains, 14; Cienequilla, Taos County, 17; Copperton, 5; Costilla Pass, 3; Coyote Creek, Mora County, 2; Cuervo, 2; Dulce, 1; Emery Peak, Union County, 1; Folsom, 3; Gallinas Mountains (Rio Arriba County), 2; Glorieta, 2; Guadalupita, 2; Hondo Canyon, Taos County, 3; Horse Lake, 1; Jemez Mountains, 4; La Jara Lake, 2; Las Vegas (12 miles north), 1; Manzano Mountians, 31; Mora (10 miles south), 1; Moreno Valley, 3; Pecos, 2; Ribera, 3; Rinconada, 1; Rito de los Frijoles, 1;[68] Road Canyon (7 miles southwest of Catskill), 1; Sandia Mountains, 12; Mount Taylor, San Mateo Mountains (Valencia County), 22; San Pedro, 9; Santa Clara Canyon (Jemez Mountains), 3; Santa Fe (10 miles northeast), 1; Sierra Grande, 9; Taos, 1; Taos Mountains, 3; Taos Pass, 2; Taos Pueblo, 6; Tierra Amarilla, 2; Tres Piedras, 4; Tucumcari (25 miles west), 3; Twining (10,500 feet altitude), 1; Willis, 5; Zuni Mountains, 9.

Oklahoma: Kenton, 1.

EUTAMIAS QUADRIVITTATUS HOPIENSIS Merriam

Hopi Chipmunk

(Pls. 4, f; 8, f)

Eutamias hopiensis Merriam, Proc. Biol. Soc. Washington 18: 165, June 29, 1905.

Type.—Collected in Keam Canyon, Painted Desert, Ariz., July 27, 1894, by A. K. Fisher; ♀ adult, skin and skull; No. 67768, United States National Museum (Biological Survey collection); original number, 1688.

Geographic distribution.—Northeastern Arizona, extreme eastern Utah, and western Colorado; north to White River, Colo.; east to Eagle and western Gunnison Counties, Colo.; south to Keam Canyon, Ariz.; west to Keam Canyon, Ariz., and Bluff City, Utah (probably to the Colorado and Green Rivers). *Zonal range:* Transition; 4,500 to 7,000 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias quadrivittatus quadrivittatus* but coloration above more tawny; head paler; facial stripes more cinnamon (less blackish); dorsal stripes entirely tawny or only the median one black; ears more tawny, with less fuscous.

Color.—*Summer pelage* (July): Top of head drab gray, mixed with cinnamon buff on nose, bordered on sides of crown with sayal brown or snuff brown; facial stripes sayal brown or ochraceous tawny, with small blackish patches around the eye; ears ochraceous tawny anteriorly, pinkish buff or buffy white posteriorly, shading to chætura drab at the tip; dark dorsal stripes russet or tawny, the median one blackish in the center from about middle of back to rump; median pair of light dorsal stripes grayish white; outer pair creamy white; sides cinnamon shaded with ochraceous tawny; shoulders washed with pinkish cinnamon; rump and thighs cinnamon buff washed with pale smoke gray; feet pinkish cinnamon or light pinkish cinnamon; tail above, fuscous, mixed with cinnamon and overlaid with cinnamon buff; tail beneath, ochraceous tawny, bordered with fuscous and tipped with cinnamon buff; under parts creamy white. *Winter pelage* (November; Bluff City, Utah): Similar to the summer pelage but head and rump slightly darker; median dorsal stripe tawny, faintly shaded with fuscous; under surface of tail cinnamon.

Molt.—A specimen (♂ adult) from Keam Canyon, Ariz., May 26, is in badly worn winter pelage, with new summer pelage appearing irregularly over the entire back.

Skull.—Practically identical with that of *E. quadrivittatus quadrivittatus*.

Measurements.—Average of 10 adults from type locality: Total length, 224.7 (219–233); tail vertebræ, 101.2 (98–110); hind foot, 33.3 (32–34); ear from notch, 14.5 (13–16). *Skull:* Greatest length, 35.6 (34.7–36.5); zygomatic breadth, 19.7

[67] Mus. Comp. Zool.
[68] D. R. Dickey coll.

(19.3–20.2); cranial breadth, 15.1 (14.3–15.5); interorbital breadth, 8.1 (7.6–8.4); length of nasals, 11.1 (10.4–11.5).

Remarks.—The Hopi chipmunk is a brightly colored, tawny race of *quadrivittatus* in which the dark dorsal stripes are mainly tawny instead of black. Apparently the type locality (Keam Canyon, Ariz.) is just on the edge of the range of the form, for in the series of 25 specimens from there, not over half of them agree with the type in having the dorsal stripes tawny; the rest are nearer to *quadrivittatus* in this character, and some of them can scarcely be distinguished from that form; the heads of all, however, average distinctly paler. The home of this race in its purest form is in western Colorado and southeastern Utah and in specimens from that region the dorsal stripes (except the median one) are uniformly tawny.

Specimens are lacking from the region where this form meets the ranges of *E. adsitus* and *E. umbrinus*, and therefore its relationship with those species is not clear; at present, there is no evidence of intergradation with either of them.

A series of seven specimens from Yarmany Creek, near McCoy, Colo., are typical of this race, but in the same locality was taken a single specimen seemingly referable to *quadrivittatus*.

Specimens examined.—Total number, 129, as follows:

Arizona: Keam Canyon (80 miles north of Holbrook), 32; Lukachukai Mountains, 8; Tunicha Mountains, 3.

Colorado: Ashbaugh Ranch, Montezuma County, 2;[69] Atchee, Garfield County, 2;[69] Bedrock, Montrose County, 5;[70] Carbonera, Garfield County, 1;[69] Cortez, 5;[71] Coventry, 16;[72] De Beque, Mesa County, 1; Dotsero (Grand River Canyon), 1; Eagle, 1;[69] Four Corners (Montezuma County), 1;[73] Grand Junction, 13;[74] McCoy, 2; Mesa Verde (25 miles southwest of Mancos), 2; Rangely (20 miles southwest), 2; Rifle (8 miles north), 1; Roan Plateau (14 miles southeast of Dragon, Utah), 1; Sinbad Valley, 1; Somerset, 1; Ute Peak, Montezuma County, 1;[73] West Paradox Valley, 7;[73] White River (20 miles east of Rangely), 5; Yarmany Creek, Eagle County (near McCoy), 7.[75]

Utah: Bluff City, San Juan River, 8.[76]

EUTAMIAS QUADRIVITTATUS INYOENSIS Merriam

Inyo Chipmunk

(Pls. 4, 1; 8, 1)

Eutamias speciosus inyoensis Merriam, Proc. Biol. Soc. Washington 11: 202, 208, July 1, 1897.

Tamias callipeplus inyoensis Elliot, Field Columbian Mus. Pub. Zool. 3: 286, 1904.

Type.—Collected in Black Canyon, White Mountains, Inyo County, Calif. (altitude 8,200 feet), July 7, 1891, by E. W. Nelson; ♂ adult, skin and skull; No. $\frac{23387}{41462}$, United States National Museum (Biological Survey collection); original number, 1069.

Geographic distribution.—Higher mountains of the Great Basin in Nevada and southern Utah; west to the Inyo and White Mountains and the eastern slopes of the Sierra Nevada from Mount Whitney

[69] E. R. Warren coll.
[70] E. R. Warren coll., 3; Amer. Mus. Nat. Hist., 2.
[71] E. R. Warren coll., 4; Amer. Mus. Nat. Hist., 1.
[72] E. R. Warren coll., 7; Amer. Mus. Nat. Hist., 6.
[73] Colo. Mus. Nat. Hist.
[74] E. R. Warren coll., 6; Amer. Mus. Nat. Hist., 4; Mus. Comp. Zool., 2; Univ. Wis., 1.
[75] E. R. Warren coll., 6; Amer. Mus. Nat. Hist., 1.
[76] Amer. Mus. Nat. Hist., 6.

north to Mammoth Pass, Calif.; north in Nevada to the Ruby Mountains; east to Fish Lake Plateau and the Henry Mountains, Utah (but not in the Beaver Mountains). *Zonal range:* Canadian; 7,500 to 11,000 feet altitude. (Fig. 6.)

Characters.—Closely similar in summer pelage to *Eutamias quadrivittatus quadrivittatus*, but sides slightly darker; head more grayish (less cinnamon); outer pair of dark dorsal stripes more mixed with brownish; inside of ears washed with a paler shade of buff. Compared with *E. adsitus:* Upper parts paler, the median pair of light stripes broader and less mixed with tawny, the outer pair of dark stripes less blackish (more brownish); head more grayish, postauricular patches larger and paler (more whitish); tail more extensively tawny and less blackish (both above and below) with buffy instead of grayish edgings.

Color.—*Summer pelage* (July): Sides of nose pinkish cinnamon or cinnamon buff; top of head smoke gray or pale smoke gray, faintly washed, especially on nose, with pinkish cinnamon and bordered with a stripe of fuscous; ocular stripe black or fuscous black, shaded with verona brown; submalar stripe narrow, sayal brown; ears fuscous or chætura drab, shaded with mouse gray and bordered on posterior margin with buffy white; postauricular patches grayish white; median dorsal stripe pronounced, reaching to the crown between ears, black, margined with sayal brown; outer dark stripes blackish, heavily mixed with sayal brown or mikado brown; median pair of light stripes grayish white; outer pair pure white; lateral stripes obsolete; sides russet or tawny, shading to ochraceous tawny on sides of neck; thighs cinnamon buff, shaded with fuscous and smoke gray; feet cinnamon buff or light pinkish cinnamon; tail above, cinnamon mixed with fuscous black; tail beneath, cinnamon, cinnamon buff or ochraceous tawny, bordered with fuscous black and edged with pinkish buff; under parts creamy white. *Worn winter pelage* (Little Onion Valley, May):[77] Similar to the summer pelage but rump more grayish and sides slightly paler (dull sayal brown, shaded with cinnamon).

Molt.—In a specimen (♂ adult) from Monitor Mountains, Nev., June 9, the spring molt is in progress, the new pelage covering the head and most of the back; the rump, flanks, and tail are in worn winter pelage.

Skull.—Closely similar to that of *E. adsitus;* similar to that of *E. q. quadrivittatus* but rostrum somewhat narrower.

Measurements.—Average of 13 adults from White and Inyo Mountains: Total length, 224.3 (212–235); tail vertebræ, 97.7 (92–103); hind foot, 33 (32–34.5); ear from notch, 14.1 (13–16). *Skull:* Average of 10 adults from type locality: Greatest length, 35.8 (34.9–36.5); zygomatic breadth, 19.7 (19.2–20.2); cranial breadth, 15.6 (15.2–15.9); interorbital breadth, 8 (7.6–8.4); length of nasals, 11.2 (10.7–11.9).

Remarks.—The Inyo chipmunk is closely related to *E. quadrivittatus quadrivittatus* and intergrades with it in southeastern Utah; specimens from the Henry Mountains, Utah, being about as near one race as the other. At present, however, by reason of lack of material from extreme eastern Utah, geographical continuity of range has not been established. The Hopi chipmunk (*E. q. hopiensis*) is known from the lower zones in southeastern Utah and western Colorado, but it seems probable that either *quadrivittatus* or *inyoensis* will be found in the higher mountains east of the Green River Valley. Specimens in both summer and winter pelage from the Toyabe Mountains, Nev., are typical *inyoensis;* large series in winter pelage are at hand from the Ruby Mountains, Nev., and Pine Valley Mountains, Utah, and a small series in summer pelage from Parawan Mountains, Utah, and these agree closely with *inyoensis*, and apparently do not intergrade with *adsitus*.[78] This seems remarkable in view of the close geographical connection between the Pine Valley Mountains and the Beaver Mountains, the home of *adsitus*.

[77] Fresh winter specimens from type region not seen.

[78] The latter is readily distinguished by its narrower and more blackish tail with pale gray edgings.

Intergradation with *speciosus* occurs in the Mount Whitney region, intermediate specimens having been examined from Cottonwood Lakes and head of Big Cottonwood Creek.

Specimens examined.—Total number, 174, as follows:

California: Bishop Creek, Inyo County (9,000 feet altitude), 1; Bullfrog Lake, Fresno County, 3;[79] Cirque Peak, 1;[79] Cottonwood Lakes, Inyo County, 3;[79] Hockett Trail, Inyo County (8,500 feet altitude, south of Carroll Creek), 2;[79] Independence Creek (10,000 feet altitude), 1; Inyo Mountains, 11; Kearsarge Pass, 9;[79] Little Onion Valley, 3;[79] Mammoth Pass (9,800 feet altitude), 1;[80] Mount Whitney (head of Big Cottonwood Creek), 4; Onion Valley (Inyo County), 14;[79] White Mountains, 31.[81]

Nevada: Arc Dome, Toyabe Mountains, 2; Manhattan (Toquima Range), 1; Monitor Mountains (25 miles southwest of Eureka), 15; Reese River (head), 4; Ruby Mountains, 26; Toyabe Mountains, 2; White Mountains, 2.

Utah: Fish Lake Plateau, 6; Mount Ellen, Henry Mountains, 7; Parawan Mountains, 5; Pine Valley Mountains, 20.

EUTAMIAS QUADRIVITTATUS FRATER (ALLEN)

TAHOE CHIPMUNK

(PLS. 4, G; 8, G)

Tamias frater Allen, Bul. Amer. Mus. Nat. Hist. 3: 88, June, 1890.
Eutamias speciosus frater Merriam, Proc. Biol. Soc. Washington 11: 194, 202, July 1, 1897.

Type.—Collected at Donner, Calif., June 7, 1886, by C. A. Allen; ♀ adult, skin and skull; No. $\frac{13088}{5711}$, American Museum of Natural History.

Geographic distribution.—Upper slopes of the northern Sierra Nevada, California, from Mammoth Pass and upper San Joaquin River north to Lassen Peak and Eagle Lake. *Zonal range:* Canadian and Hudsonian; 5,000[82] to 10,700[83] feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias quadrivittatus inyoensis* but coloration above more tawny (less grayish); head darker and more tinged with ochraceous; light dorsal stripes strongly tinged with buffy (less clear white); facial stripes darker (more blackish); tail averaging shorter and slightly paler beneath; hind foot averaging longer. Compared with *E. speciosus:* Upper parts and sides suffused with a brighter and paler shade of tawny, the light stripes more buffy (less clear white); head more ochraceous; shoulders more tawny (less grayish); tail slightly longer, less blackish above, paler and less extensively black-tipped beneath; hind foot averaging longer and ear shorter.

Color.—Summer pelage (August and September): Top of head mixed cinnamon and smoke gray, bordered with sayal brown and fuscous; ocular stripe black; submalar stripe sayal brown, shaded with fuscous; postauricular patches grayish white; median dorsal stripe black, bordered with sayal brown; outer pair of dark stripes fuscous black, mixed with pale tawny or sayal brown; median pair of light stripes grayish white, more or less mixed with sayal brown; outer pair creamy white; sides ochraceous tawny, shading to pale russet, the shoulders often washed with cinnamon buff; rump and thighs mixed smoke gray and pinkish buff; feet pinkish buff; tail above, cinnamon or mikado brown, mixed with fuscous black and overlaid with pinkish buff; tail beneath, sayal brown or cinnamon, bordered with fuscous black and tipped with pinkish buff; underparts whitish, tinged with pale buff. *Winter pelage* (October–June): Similar to the summer pelage, but upper parts much more grayish and less tawny; rump and median pair

[79] Mus. Vert. Zool.
[80] Donald R. Dickey coll.
[81] Mus. Vert. Zool., 24.
[82] Specimens from Sierraville, Sierra County, and North Fork Mills, San Joaquin River, Fresno County.
[83] Specimens from near Vogelsang Lake, Yosemite Park, at 10,300 feet altitude and from head of Lyell Canyon at 10,700 feet.

of dorsal stripes often clear smoke gray; shoulders washed with the same; sides about clay color.

Molt.—The beginning of the summer molt is shown by a specimen (♀ adult) from Pine City, Mono County, Calif., July 26, in which the new pelage is appearing on the head and in a patch on the middle of the back.

Skull.—Practically identical with that of *speciosus*.

Measurements.—Average of 12 adults from type locality: Total length, 216.7 (204–231); tail vertebræ, 91.4 (86–100); hind foot, 34.6 (33–36); ear from notch, 14.2 (13–17). *Skull:* Average of 10 adults from Donner and Cisco, Calif.: Greatest length, 35.3 (34.5–36.2); zygomatic breadth, 19.4 (18.7–20); cranial breadth, 14.9 (14.6–15.2); interorbital breadth, 8 (7.3–8.5); length of nasals, 11.4 (10.7–12.2). *Weight:* Average of about 10 adults, 59.2 grams (52.3–66.1). (*Fide* Grinnell and Storer, 1924, p. 177.)

Remarks.—This race is most nearly related to *inyoensis*, from which it differs chiefly in more tawny upper parts; it has slightly more black on the tip of the tail than that form, but less than *speciosus*.

Specimens examined.—Total number, 418, as follows:

California: American River (south fork, near head), 1; Aspen Meadows, Tuolumne County, 8; Aspen Valley, Yosemite Park, 10;[84] Bloods, Calaveras County, 1;[85] California Mill (headwaters Fresno River), 3, Cascada, Fresno County, 3;[84] Chaparral, Butte County, 2;[86] Chinquapin, Yosemite Park, 3;[84] Cisco, 42;[87] Clouds Rest, Yosemite Park, 1;[84] Crane Flat, Mariposa County, 3;[84] Donner, 56; Eagle Lake, 1;[88] Echo Creek Basin, Yosemite Park, 1;[84] Echo, El Dorado County, 9;[84] Emerald Bay, 1; Fish Camp (Mariposa County), 2;[89] Fletcher Creek, (near Vogelsang Lake), Yosemite Park, 1;[84] Gentrys, Yosemite Park, 2;[84] Glen Aulin (Tuolumne River), Yosemite Park, 4;[84] Hermit Valley, Calaveras County, 7;[85] Highland Peak, Alpine County, 2; Hope Valley, Alpine County, 1;[84] Hot Springs, Mono County, 3;[90] Huntington Lake, Fresno County, 8;[84] Indian Canyon (east fork), Yosemite Park, 3;[84] Independence Lake, 4;[91] Kyburz Station, El Dorado County, 1;[84] Lake Tahoe, 3; Lake Tahoe Valley; 1;[84] Lake Tenaya, Yosemite Park, 6; Lassen Peak, 19; Leevining Creek (Warren Fork), Mono County, 1;[92] Lincoln Creek, Sierra County (7,000 feet altitude), 2; Lyell Canyon, Yosemite Park, 12;[92] Mammoth, Mono County, 10; Markleeville, 1; Mattie Lake, Yosemite Park, 1;[92] McKinney, 2; Merced Lake, 5;[92] Merced River (at 5,500 feet altitude, and near head), 3; Mount Dana, 2; Mount Lyell, 2; Mount Tallac, 6;[93] Mono Meadows, Yosemite Park, 8; Mono Pass, 1; Owens River (near head), 7; Pine City, Mono County, 1; Porcupine Flat, Yosemite Park, 18;[92] Prattville, 1;[85] Pyramid Peak, 20;[94] San Joaquin River (near head), 14; Sierraville, 1; Silver Lake, Amador County, 20;[85] Slippery Ford, El Dorado County, 2;[94] Sonora Pass, Mono County, 1;[90] Soquel Mill (headwaters north fork San Joaquin River), 3; Summit, Sierra County, 1; Sunrise Creek, Yosemite Park, 1;[92] Sierraville, 1;[92] Susie Lake (Tahoe region), 1;[92] Ten Lakes, Yosemite Park, 3;[92] Tioga Road (near Mount Hoffman), Yosemite Park, 2;[92] Tuolumne Meadows, Yosemite Park, 24;[95] Tuolumne River (6,400 to 7,300 feet altitude), 3;[92] Upper Lost Creek (Shasta County), 1; Upper McClure Fork, Yosemite Park, 3;[92] Walker Lake, Mono County, 6;[92] White Cascade, Tuolumne River (8,000 feet altitude), 2;[92] Walker River, Mono County, 1;[90] Wright Lake, El Dorado County, 2;[92] Woodfords, Alpine County, 3; Yosemite Creek, 1;[92] Yosemite Falls, 1;[92] Yosemite Point, 2.[92]

Nevada: Edgewood, Douglas County, 2;[85] Genoa, Douglas County, 1;[90] Glenbrook, 1.

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[84] Mus. Vert. Zool.
[85] Amer. Mus. Nat. Hist.
[86] Amer. Mus. Nat. Hist., 1; Colo. Agr. College, 1.
[87] Mus. Vert. Zool., 41.
[88] Mus. Comp. Zool., 7; Amer. Mus. Nat. Hist., 1; Mus. Vert. Zool., 1.
[89] Mus. Comp. Zool., 1; Fish Camp is probably the same as Happy Camp, about 5 miles from the Mariposa Grove.
[90] Mus. Comp Zool.
[91] Mus. Vert Zool., 3.
[92] Mus. Vert. Zool.
[93] Mus. Vert. Zool., 4; Acad. Nat. Sci. Philadelphia, 1.
[94] Acad. Nat. Sci. Philadelphia.
[95] Mus. Vert. Zool., 18.

EUTAMIAS QUADRIVITTATUS SEQUOIENSIS Howell

Sequoia Chipmunk

(Pls. 4, h; 8, h)

Eutamias speciosus sequoiensis Howell, Journ. Mamm. 3: 180, August 4, 1922.

Type.—Collected at Mineral King, east fork of Kaweah River, Calif. (altitude, 7,300 feet), September 12, 1891, by Vernon Bailey; ♀ adult, skin and skull; No. $\frac{30899}{42799}$, United States National Museum (Biological Survey collection); original number, 3259.

Geographic distribution.—Upper slopes of the southern Sierra Nevada, Calif., from San Joaquin River south to Tule River; east to Mount Whitney and Olancha Peak. *Zonal range:* Canadian and Transition; 5,000 to 11,000 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias quadrivittatus frater* but upper parts averaging slightly darker, the median pair of dorsal stripes less whitish and more mixed with cinnamon; tail and ears averaging slightly longer, the tail much darker beneath, edged with a paler shade of buff and with more black at the tip. Compared with *speciosus:* Upper parts more brownish and less grayish in general tone, especially in summer pelage; median pair of dorsal stripes more mixed with cinnamon; rump and hind feet more buffy (less grayish); tail decidedly longer. Compared with *callipeplus:* Upper parts and sides more extensively tawny, the median pair of dorsal stripes less whitish; shoulders darker; tail with much more black at the tip; hind feet, ears, and tail longer.

Color.—*Summer pelage* (August and September): Crown and occiput mixed smoke gray and cinnamon, becoming fuscous on the nose; sides of crown bordered with a stripe of fuscous black, shaded with sayal brown; sides of nose washed with cinnamon buff; ocular stripe black, washed posteriorly with mikado brown; submalar stripe fuscous black, mixed with mikado brown; light facial stripes white; dark dorsal stripes mikado brown or pale russet, shaded with fuscous black, the median one blackish in the center;[96] median pair of light dorsal stripes smoke gray, strongly mixed with mikado brown or sayal brown; outer pair white; sides tawny, shading to russet next to the dorsal stripes; shoulders washed with cinnamon or ochraceous tawny; rump and thighs mixed cinnamon buff and smoke gray; feet pinkish buff; tail above mixed tawny and blackish, becoming clear black toward the tip, and edged on the sides with pinkish buff; tail beneath tawny, bordered with black and edged with pinkish buff, the black tip about 25 millimeters long; underparts grayish white, washed with pale pinkish buff. *Worn winter pelage* (May): Similar to the summer pelage, but colors less intense, the sides about sayal brown; tail edgings tilleul buff.

Molt.—A breeding female specimen from Mount Whitney, Calif. (head of Big Cottonwood), August 5, is in worn winter pelage, the new summer pelage appearing on the head; another female from the same locality shows the new pelage on the head and on the middle of the back.

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

Measurements.—Average of 12 adults from east fork Kaweah River and Sequoia National Park: Total length, 224.5 (214–241); tail vertebræ, 97.7 (92–114); hind foot, 34.5 (33–36); ear from notch, 16.2 (15–18). *Skull:* Average of 10 adults from same localities: Greatest length, 36 (35.3–36.8); zygomatic breadth, 19.4 (18.7–19.8); cranial breadth, 15 (14.4–16.6); interorbital breadth, 8.2 (7.9–8.7); length of nasals, 11.7 (10.7–12.5).

Remarks.—The Sequoia chipmunk is the most richly colored race in the species; it is related to both *frater* and *speciosus*, but differs from both in its more tawny upper parts, especially in summer pelage. Merriam (1897, p. 200, 202), referred the series from "the eastern crest of the High Sierra from Olancha Peak and Mount Whitney northward" to *speciosus* and the series from "the western slope of the Sierra from the headwaters of Tule River northward nearly to the

[96] In a small proportion of the specimens examined all the dark dorsal stripes are chiefly black, but becoming brownish anteriorly.

Yosemite Valley" to *callipeplus*. With a much larger series than was then available, the present reviser can detect no constant differences between these two colonies, but as a whole they show marked differences from all the other races, as pointed out above.

Specimens examined.—Total number, 300, as follows:

California: Alta Peak, Sequoia National Park, 4; Atwell Mill (Sequoia National Park), 6; Bubbs Creek, Fresno County (9,500 feet altitude), 2;[97] Cannell Meadow, Tulare County, 18;[97] Cottonwood Lakes, 2;[97] Giant Forest, Sequoia National Park, 10; Horse Corral Meadows, Fresno County, 28;[97] Hume, Fresno County, 19;[97] Jackass Meadows, Tulare County, 21;[97] Jordan Hot Springs, Tulare County, 3;[97] Kaweah River (east fork, 6,200 to 8,900 feet altitude), 6; Kings River (5,000 to 5,800 feet altitude), 8;[98] Little Cottonwood Creek, Inyo County (9,500 feet altitude), 4;[97] Manter Meadows, Tulare County, 1;[97] Monache Meadows, Tulare County, 15;[99] Middle Tule River (headwaters), 6; Mineral King (east fork Kaweah River) 5; Mount Whitney, 25; Mulkey Meadows (15 miles south of Mount Whitney), 3; North Tule River (headwaters), 5; Olancha Peak, 4; Ramshaw Meadows, Tulare County, 4;[97] Redwood Mountain, Tulare County (near northwest corner of Sequoia National Park), 10; Round Valley, Inyo County (12 miles south of Mount Whitney), 1; Sequoia National Park, 30;[1] Siretta Meadow, Tulare County, 11;[97] Summit Meadow (at head of Kern River, near Olancha Peak), 2; Taylor Meadows (Tulare County), 18;[97] Twin Lakes, Tulare County, 2;[97] Whitney Creek, Tulare County (10,650 to 11,000 feet altitude), 9;[97] Whitney Meadows, Tulare County, 18.[97]

EUTAMIAS QUADRIVITTATUS SPECIOSUS (MERRIAM)

SAN BERNARDINO CHIPMUNK

(PLS. 4, J; 8, J)

Tamias speciosus Merriam, *in* Allen, Bul. Amer. Mus. Nat. Hist. 3: 86, June, 1890.

Eutamias speciosus Merriam, Proc. Biol. Soc. Washington 11: 194, 202, July 1, 1897.

Type.—Collected at head of Whitewater Creek, San Bernardino Mountains, Calif. (altitude, 7,500 feet), June 22, 1885, by F. Stephens; ♂ adult, skin and skull; No. 186462, United States National Museum (No. $\frac{1148}{1804}$, Merriam collection).

Geographic distribution.—Upper slopes of the San Jacinto, San Bernardino, and Piute Mountains, Calif. *Zonal range:* Canadian and Transition; 7,000 to 10,000 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias quadrivittatus inyoensis*, but somewhat darker, the median pair of light dorsal stripes narrower and more mixed with cinnamon or tawny, the outer pair very broad and conspicuous and slightly more creamy in tone; sides a darker shade of brown, but more washed on shoulders with buff and smoke gray; dark facial stripes darker, more strongly contrasted with the alternating white stripes; tail shorter and darker both above and below and with more black on terminal portion; ear longer and more pointed.

Color.—*Summer pelage* (August): Sides of nose cinnamon buff; top of head smoke gray, faintly shaded with cinnamon, bordered on each side with a stripe of fuscous black; ocular stripe broad, fuscous black, shaded with mikado brown; submalar stripe mikado brown, shaded with fuscous black; ears fuscous or fuscous black, with a broad band of grayish white on posterior margin, and a

[97] Mus. Vert. Zool.
[98] Mus. Vert. Zool., 4.
[99] Mus. Vert. Zool., 12.
[1] Mus. Vert. Zool., 9.

tawny patch at anterior base; postauricular patches white—large and conspicuous; median dorsal stripe black, edged with mikado brown; outer dark stripes mikado brown, sometimes mixed with fuscous black; median pair of light stripes rather narrow, grayish white; outer pair broad, pure white; lateral stripes obsolete; sides ochraceous tawny, shading to russet next the white stripes; shoulders, rump, and thighs smoke gray, washed with pinkish buff; feet pale smoke gray sometimes faintly washed with pinkish buff; tail above, mixed black and tawny, becoming pure black for about 30 millimeters of terminal portion; tail beneath, cinnamon or tawny, bordered with black and edged with cinnamon buff or pinkish buff, the terminal portion for about 25 millimeters pure black or fuscous black; underparts white. *Winter pelage* (October): Similar to the summer pelage, but upper parts more washed with grayish, the dark dorsal stripes more brownish, the median stripe fuscous black heavily washed with mikado brown.

Molt.—A male specimen from San Bernardino Mountains, Calif., June 10, has the new summer pelage covering the head and most of the back; a female from San Jacinto Mountains (7,500 feet altitude), June 25, shows the summer molt just beginning in the middle of the back; another breeding female from an altitude of 10,200 feet on the same range is still in worn winter pelage, with no indications of molting; a breeding female from San Bernardino Mountains (9,000 feet altitude), August 21, has the new summer pelage covering the head and fore back, the rest of the body being in greatly worn winter pelage.

Skull.—Practically identical with that of *inyoensis;* the variation in size is considerable.

Measurements.—Average of 16 adults from type locality: Total length, 211.4 (202–220); tail vertebræ, 85.7 (80–91); hind foot, 33.4 (32–35); ear from notch, 15.7 (15–17.5). *Skull:* Average of 10 adults from type locality: Greatest length, 35.5 (34.6–36.7); zygomatic breadth, 19.3 (19–20); cranial breadth, 15 (14.3–15.4); interorbital breadth, 7.8 (7.5–8); length of nasals, 11.5 (10.4–12.3).

Remarks.—This handsome chipmunk has a discontinuous range, occurring on the upper slopes of the San Jacinto, San Bernardino, San Gabriel, and Piute Mountains. The Piute colony is intermediate in characters between *speciosus* and *sequoiensis*, and although separated from the southern colonies of *speciosus* by the wide expanse of the Mohave Desert, it is apparently nearer to that race than to *sequoiensis* of the High Sierra, with which its range must be nearly continuous. A considerable series in unworn winter pelage agree with *speciosus* in the grayness of the neck, shoulders, and rump, pale head, and short tail, but approach *sequoiensis* in having more buffy (less grayish) feet. The differences between these two races are comparatively slight in winter pelage, though well marked in summer pelage.

Specimens examined.—Total number, 407, as follows:

California: Converse Flats, 1; Piute Mountains, 27;[2] San Bernardino Mountains, 269 (including Alpine City, 1; Fawnskin Park, 1;[3] Bear Lake, 8;[4] Bear Valley, 7;[5] Bluff Lake, 66;[6] Dry Lake, 3;[4] Fish Creek, 3;[7] San Gorgonio Peak, 2;[4] Santa Ana River, 13;[4] Sugarloaf, 16;[4] San Bernardino Peak, 15; Little Bear Valley, 14[8]); San Gabriel Mountains, 12; San Jacinto Mountains, 98 (including Round Valley, 21;[9] Tahquitz Valley, 20[4]).

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[2] Mus. Comp. Zool., 19; Univ. Mich., 2.
[3] Acad. Nat. Sci. Philadelphia.
[4] E. R. Warren coll.
[5] Acad. Nat. Sci. Philadelphia, 3; E. R. Warren coll., 3; Colo. Agr. College, 1.
[6] Mus. Vert. Zool., 58; Mus. Comp. Zool., 2; Amer. Mus. Nat. Hist., 1; Colo. Agr. College, 2; Acad. Nat. Sci. Philadelphia, 1; E. R. Warren coll., 1.
[7] Mus. Vert. Zool., 2; Amer. Mus. Nat. Hist., 1.
[8] Mus. Comp. Zool., 10.
[9] Mus. Vert. Zool., 20; Amer. Mus. Nat. Hist., 1.

EUTAMIAS CALLIPEPLUS (MERRIAM)

MOUNT PIÑOS CHIPMUNK

(PLS. 4, K; 8, K)

Tamias callipeplus Merriam, Proc. Biol. Soc. Washington 8: 136, December 28, 1893.

Eutamias speciosus callipeplus Merriam, Proc. Biol. Soc. Washington 11: 194, 202, July 1, 1897.

Type.—Collected on Mount Piños, Calif., October 20, 1891, by E.W. Nelson; ♂ adult, skin and skull; No. $\frac{31299}{43164}$, United States National Museum (Biological Survey collection); original number, 1344.

Geographic distribution.—Mount Piños, Calif. *Zonal range:* Canadian and high Transition. (Fig. 6.)

Characters.—Similar to *Eutamias quadrivittatus speciosus*, but tawny of upper parts slightly paler; head more washed with cinnamon (less clear gray); sides of nose more extensively washed with cinnamon buff; sides of neck, also rump and thighs, more buffy (less grayish); light dorsal stripes and postauricular patches more creamy (less clear white) in tone; tail with less black, both above and below; feet more buffy (less whitish). Compared with *E. q. frater:* Tail darker beneath, and edged on sides with a lighter shade of buff; rump and thighs more buffy (less grayish); dark dorsal stripes averaging more blackish; outer pair of light stripes averaging more creamy in tone; hind feet paler (less buffy).

Color.—Summer pelage (July): Top of head pinkish cinnamon, mixed with pale smoke gray; ocular stripe black; other facial stripes fuscous mixed with mikado brown; ears fuscous anteriorly, buffy white posteriorly; postauricular patches large, creamy white; median dorsal stripe narrow, blackish, bordered with mikado brown; outer dark stripes mixed fuscous black and mikado brown; median pair of light stripes grayish white; outer pair broad, creamy white; sides sayal brown or cinnamon, shading above to mikado brown and on shoulders to pinkish buff; rump and thighs cinnamon buff mixed with smoke gray; feet grayish white, washed with pinkish buff; tail above, tawny, mixed with black or fuscous black and overlaid with warm buff; tail beneath, tawny bordered with fuscous black and edged with warm buff; underparts creamy white. *Winter pelage* (October 20): Similar to the summer pelage, but sides paler, shoulders and fore back washed with pale smoke gray; rump and hinder back more strongly cinnamon buff; dark dorsal stripes slightly more brownish (less blackish); and median light stripes slightly more grayish (less clear white).

Skull.—Practically identical with that of *E. quadrivittatus speciosus.*

Measurements.—Average of 12 adults from type locality: Total length, 213 (203–231); tail vertebræ, 90.6 (84–100); hind foot, 33.8 (33–35); ear from notch, 15.4 (14.5–16). *Skull:* Average of seven adults from type locality: Greatest length, 35.4 (34.6–36); zygomatic breadth, 19 (18.6–19.4); cranial breadth, 14.7 (14.4–15); interorbital breadth, 8.4 (8.2–8.9); length of nasals, 11.9 (11.6–12.3).

Remarks.—This chipmunk apparently is restricted to the slopes of Mount Piños, where it is completely isolated from its nearest relatives. The nearest point at which any other members of this group are known to occur is in the Piute Mountains lying about 60 miles to the northeastward. In general *callipeplus* is most like *E. quadrivittatus frater* of the northern Sierra Nevada, agreeing with that race in the small amount of black on the tip of the tail; it differs from it, however, in other characters (as pointed out above) and the ranges of the two forms are widely separated. Although the characters which separate this form from the races of *quadrivittatus* are relatively slight, they are constant, and there is no overlapping. Hence it seems best to give *callipeplus* the rank of a species.

Specimens examined.—Total number, 85, as follows:

California: "Cañon de las Uvas," 1;[10] Mount Piños, 84.[11]

[10] This specimen, collected many years ago by Xantus, probably came from the slopes of Mount Piños.
[11] Mus. Vert. Zool., 17; E. R. Warren coll., 2; Acad. Nat. Sci. Philadelphia, 1; Amer. Mus. Nat. Hist., 1.

EUTAMIAS PALMERI MERRIAM

PALMER'S CHIPMUNK

Eutamias palmeri Merriam, Proc. Biol. Soc. Washington 11: 208, July 1, 1897.

Type.—Collected on Charleston Peak, Nev. (altitude, 8,000 feet), February 13, 1891, by E. W. Nelson; ♂ adult, skin and skull; No. $\frac{26075}{33481}$, United States National Museum (Biological Survey collection); original number, 432.

Geographic distribution.—Known only from Charleston Peak, Nev. *Zonal range:* Canadian. (Fig. 6.)

Characters.—Similar in summer pelage to *Eutamias quadrivittatus inyoensis* but ocular stripe and dark dorsal stripes paler (more brownish) and tail more blackish above; in winter pelage more grayish above, the dorsal stripes much less distinct. Compared with *E. q. speciosus:* In summer pelage facial stripes paler and reduced in extent; dark dorsal stripes paler; median pair of light stripes broader and more grayish (less buffy); feet darker (more buffy); tail beneath with less black at tip; in winter pelage decidedly more grayish, the light dorsal stripes (4) of nearly equal width and less creamy or buffy; facial stripes paler and much reduced; tail averaging more blackish above but less extensively tipped with black below.

Color.—Summer pelage (July 1): Sides of nose light pinkish cinnamon; top of head smoke gray mixed with light pinkish cinnamon and bordered on sides of crown with fuscous; facial stripes sayal brown, shaded with fuscous, the median stripe with some fuscous black in front of and behind the eye; ears sayal brown on anterior portion, buffy white on posterior portion, clouded with fuscous in the middle portion; postauricular patches grayish white or creamy white; median dorsal stripe narrow, fuscous black, bordered with mikado brown, outer pair of dark stripes mikado brown, faintly shaded with fuscous; median pair of light stripes pale smoke gray; outer pair creamy white; no lateral stripes; sides tawny or cinnamon, shading to pale russet; rump and thighs cinnamon buff, shaded with fuscous and smoke gray; feet pinkish buff or pinkish cinnamon; tail above, fuscous black (the bases of the hairs cinnamon), edged with pinkish buff; tail beneath, ochraceous tawny, bordered with fuscous black and edged with pinkish buff; underparts creamy white. *Winter pelage* (February): Upper parts much more extensively grayish than in summer and the dark dorsal stripes less distinct; sides of nose clay color; dark dorsal stripes sayal brown, the median one fuscous black in the center; light dorsal stripes pale smoke gray; the outer pair slightly more whitish; nape and shoulders extensively washed with pale smoke gray; rump and thighs smoke gray, washed with cinnamon buff; sides sayal brown, shading to cinnamon buff on sides of neck; feet and tail as in summer.

Molt.—In a specimen (♂ adult) from Charleston Peak, July 1, the new summer pelage is appearing on the head and in irregular patches on the back.

Skull.—Practically identical with that of *inyoensis.*

Measurements.—Average of 10 adults from type locality: Total length, 219.5 (210–223); tail vertebræ, 94.6 (86.5–101); hind foot, 33.1 (32.5–34); ear from notch, 14.6 (13.5–15.5). *Skull:* Greatest length, 35.9 (34.9–36.5); zygomatic breadth, 19.6 (19.1–19.9); cranial breadth, 15.4 (15.1–15.8); interorbital breadth, 8.3 (8–8.8); length of nasals, 11.3 (10.7–12).

Remarks.—Palmer's chipmunk is most nearly related to *Eutamias quadrivittatus inyoensis,* which it much resembles in summer pelage; in winter pelage, however, it is very different and more nearly resembles *E. dorsalis utahensis* in the color of the dorsal area, although differing from the latter in its much darker tail. On account of its pronounced characters and isolated habitat, it seems best to treat it as a full species.

Specimens examined.—Total number, 22, as follows:

Nevada: Charleston Peak, 22.

EUTAMIAS ADSITUS Allen

Beaver Mountain Chipmunk

(Pls. 4, p; 8, p)

Eutamias adsitus Allen, Brooklyn Inst. Mus. Science Bul. 1: 118, March 31, 1905.

Type.—Collected at "Brigg's" [Britt's] Meadows, Beaver Mountains, Utah (altitude, 10,000 feet), August 20, 1904, by George P. Engelhardt; adult (not sexed) skin and skull; No. 28728, American Museum of Natural History (formerly No. 452, Museum of the Brooklyn Institute of Arts and Sciences).

Geographic distribution.—Beaver Mountains, Utah, and the Kaibab Plateau in northern Arizona. *Zonal range:* Canadian (8,000 to 11,000 feet altitude). (Fig. 6.)

Characters.—Similar to *Eutamias umbrinus*, but colors in summer pelage more contrasted, the dark dorsal stripes more blackish and the light stripes more whitish; in winter pelage sides and back more intensely tawny, and head more grayish; tail shorter, slenderer, more blackish and less tawny above and paler beneath, edged with a paler shade of buff or with smoke gray. Compared with *quadrivittatus* and *inyoensis:* Color of back and sides decidedly darker; outer dorsal stripes more blackish; tail more blackish (less tawny) above and paler beneath, edged with paler shade of buff or with gray; ears smaller. Compared with *hopiensis:* Colors above much darker, the dark stripes more blackish, the light stripes more whitish; tail shorter and slenderer, decidedly more blackish above and paler beneath. Compared with *cinereicollis:* In summer pelage sides darker brown; shoulders without a grayish collar; head more grayish (less tawny); light stripes more whitish (less grayish); dark stripes more blackish; tail more blackish above, the edgings paler and more grayish.

Color.—Summer pelage (August): Head grayish white mixed with cinnamon, bordered on the sides by a stripe of verona brown or bister; ocular stripes fuscous black, shaded with sayal brown; submalar stripe sayal brown—rather narrow; ears fuscous, broadly edged posteriorly with smoke gray or white, and washed on anterior margin with sayal brown; postauricular patches conspicuous, white; dark dorsal stripes black, the outer pair sometimes fuscous black, shaded with russet; lateral dark stripes obsolete or nearly so; median pair of light stripes rather narrow, grayish white, narrowly edged with mikado brown; outer pair broad, pure white; sides russet, shaded with ochraceous tawny or cinnamon; rump and thighs mixed smoke gray and cinnamon buff, sometimes shaded with fuscous black; front feet cinnamon buff or light pinkish cinnamon; hind feet cinnamon buff or pinkish buff; tail above, fuscous black mixed with cinnamon, and overlaid with tilleul buff or pinkish buff; tail beneath, sayal brown, cinnamon, or tawny; underparts white. Winter pelage not seen.

Molt.—A breeding female from Beaver Mountains, Utah, August 15, is in worn winter pelage, with the new summer pelage just beginning to appear in the stripes on the middle of the back. Another female taken August 26, has nearly completed the molt, the fresh pelage covering all but the rump and hinder back.

Skull.—Closely similar to that of *E. umbrinus* but averaging slightly larger; similar to that of *quadrivittatus* but averaging slightly smaller, with narrower rostrum and smaller brain case; similar to that of *cinereicollis* but smaller.

Measurements.—Average of 11 adults from type locality: Total length, 217.5 (209–229); tail vertebræ, 91.6 (86–99); hind foot, 32.3 (31–33); ear from notch, 13.2 (12–14). *Skull:* Average of nine adults from type locality: Greatest length, 35.2 (34.5–36.2); zygomatic breadth, 19.3 (18.7–20); cranial breadth, 15.3 (14.4–15.7); interorbital breadth, 8.2 (7.6–8.9); length of nasals, 11.2 (10.5–12.2).

Remarks.—This chipmunk is most nearly related to *E. umbrinus;* material now available indicates that it is a distinct species, but with the acquisition of more material from central Utah it may prove to intergrade with that species. It is very much darker than *E. quadrivittatus hopiensis* and intergradation with that race seems unlikely,

though their ranges must meet somewhere in southeastern Utah. Its distribution is peculiar in that it is found in two apparently isolated colonies—one on the Beaver Mountains, Utah, the other on the Kaibab Plateau, Ariz., whereas the chipmunks on the Parawan and Pine Valley Mountains are referable to *E. q. inyoensis*. The series from Kaibab Plateau are nearly typical, differing from the topotypes only in having more bushy tails with slightly darker edgings.

Specimens examined.—Total number, 35, as follows:

Arizona: Bright Angel Spring, Kaibab Plateau, 3; De Motte Park, Kaibab Plateau, 10.
Utah: Beaver Mountains, 22.[12]

EUTAMIAS UMBRINUS (ALLEN)

UINTA CHIPMUNK

(PLS. 4, o; 8, o)

Tamias umbrinus Allen, Bul. Amer. Mus. Nat. Hist. 3: 96, June, 1890.
Eutamias umbrinus Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 45, December 27, 1901.

Type.—Collected on Blacks Fork, Uinta Mountains, Utah (altitude about 9,500 feet), September 19, 1888, by Vernon Bailey; ♂ adult, skin and skull; No. 186463, United States National Museum (No. $\frac{4690}{5341}$, Merriam collection); original number, 228.

Geographic distribution.—Uinta and Wasatch Mountains in northeastern Utah and southwestern Wyoming; also mountains of western Wyoming (Salt River, Teton, Wind River, Absaroka and other ranges) and eastern Idaho (Big Hole Mountains); north to the Beartooth Mountains, Mont.; southern limits not definitely known. *Zonal range:* Canadian; 7,000 to 11,000 feet altitude.

Characters.—Similar to *Eutamias q. quadrivittatus* but dorsal area and sides darker; dark dorsal stripes less blackish (more brownish), light dorsal stripes duller (less clear white); head more drabby (less cinnamon); hind foot shorter; skull averaging smaller.

Color.—Summer pelage (July–September): Head pale smoke gray, shaded with fuscous and cinnamon and bordered on each side with a stripe of fuscous or bister; ocular stripe fuscous black; submalar stripe snuff brown or bister (often rather indistinct); ears fuscous or fuscous black, broadly margined posteriorly with grayish white; postauricular patches grayish white, rather faintly indicated; median dorsal stripe black, edged with sayal brown; outer pair fuscous black, much mixed with sayal brown; light dorsal stripes white, the median pair slightly narrower and often clouded with sayal brown; lateral stripes nearly or quite obsolete; sides sayal brown, shaded with clay color or cinnamon; rump and thighs sayal brown, shaded with smoke gray; feet cinnamon buff or pinkish buff; tail above, fuscous black mixed with tawny or sayal brown and overlaid with cinnamon buff or pinkish buff; tail beneath, tawny, ochraceous tawny, or sayal brown-bordered with fuscous black and edged with pinkish buff or cinnamon buff; underparts creamy white. *Winter pelage:* Not appreciably different from the summer pelage.

Molt.—A specimen (♀ adult) from Lake Fork, Wind River Mountains, Wyo., August 23, has nearly completed the summer molt, only the rump and hinder back retaining worn winter pelage; no specimens showing the fall molt have been seen, but an adult female from Uinta Mountains, Utah, September 19, apparently has acquired the full winter pelage.

Skull.—Similar to that of *E. q. quadrivittatus*, but averaging appreciably smaller.

[12] Amer. Mus. Nat. Hist., 1 (the type).

Measurements.—Average of 14 adults from Uinta and Wasatch Mountains, Utah: Total length, 225.9 (216–240); tail vertebræ, 101.1 (92–113); hind foot, 32.3 (31–33.5); ear from notch, 14.4 (13–15.2); *Skull:* Average of seven adults from Uinta Mountains (Utah and Wyoming): Greatest length, 34.7 (33.4–35.6); zygomatic breadth, 18.8 (18.3–19); cranial breadth, 15.1 (14.5–15.4); interorbital breadth, 8 (7.6–8.2): length of nasals, 10.8 (10.3–11.6).

Remarks.—The Uinta chipmunk is clearly a member of the *quadrivittatus* group and may yet be shown to intergrade with *hopiensis;* no specimens are available, however, from the eastern or southern slopes of the Uinta Mountains, where their ranges are most likely to meet. The difference in color between *umbrinus* and *hopiensis* is considerable, but between *umbrinus* and *quadrivittatus* is much less; however, the ranges of *umbrinus* and *quadrivittatus* are widely separated and there seems to be no possibility of physical intergradation between them.

Material is lacking, also, to determine the relationship of *umbrinus* with *adsitus*, but until intergrading specimens are secured, it seems best to consider them distinct species. The present form, as compared with its three relatives to the southward, *adsitus*, *hopiensis*, and *quadrivittatus*, is darker and duller colored, with less contrast between the light and dark dorsal stripes. In the Uinta and Wasatch Mountains, *E. umbrinus* occupies in part the same area as *E. minimus consobrinus* and in northwestern Wyoming occurs with both *consobrinus* and *E. amœnus luteiventris;* but it is readily distinguished from either of these species by its larger size and darker coloration and from *luteiventris* also by its white underparts.

Specimens examined.—Total number, 95, as follows:

Idaho: Big Hole Mountains (near Irwin), 1.

Montana: Beartooth Mountains, 2.

Utah: Barclay, 2; Park City, 1; Uinta Mountains (south of Fort Bridger, Wyo.), 14; Wasatch Mountains, near Ogden, 2; Wasatch Mountains, 16 miles east of Salt Lake City, 1.

Wyoming: Beartooth Lake, 1; Big Sandy, 3; Bull Lake, Wind River Mountains, 3; Clark Fork (near source), 1; Fremont Peak, 6; Gros Ventre Range (12 miles northwest of Kendall), 4; Henry Fork (5 miles west of Lonetree), 2; Jackeys Creek (4 miles southwest of Dubois), 3; La Barge Creek (Wyoming Range), 2; Lake Fork, Wind River Mountains, 9; Lonetree, 5; Merna, 1; Needle Mountain (Park County), 1; Pahaska (north fork Shoshone River), 7; Salt River Mountains, 4; Stanley (8 miles west), 4; Teton Mountains (south of Moose Creek), 4; Valley, Shoshone Mountains, 3; Whirlwind Peak (near Pahaska), 9.

EUTAMIAS RUFICAUDUS Howell

[Synonymy under subspecies]

Characters.—Size medium (about as in *quadrivittatus*); hind foot, 32–36; skull length, 33.9–36.2; skull similar to that of *quadrivittatus* but averaging slightly smaller, with narrower rostrum and interorbital region; in coloration similar to *Eutamias q. quadrivittatus* and *E. umbrinus* but upper parts and sides deeper tawny; head cinnamon or ochraceous tawny, mixed with fuscous; dark dorsal stripes black or fuscous black; light dorsal stripes grayish white, often mixed with ochraceous tawny; rump and thighs hair brown, drab, or cinnamon buff, mixed with fuscous; sides tawny or ochraceous tawny; under surface of tail ochraceous tawny to Sanford brown; hind feet pinkish cinnamon.

EUTAMIAS RUFICAUDUS RUFICAUDUS Howell

Rufous-tailed Chipmunk

(Pls. 4, m; 8, m)

Eutamias umbrinus felix Bailey, Wild Animals of Glacier National Park, p. 42, 1918 [=January 10, 1919] (not *Tamias quadrivittatus felix* Rhoads).
Eutamias ruficaudus Howell, Proc. Biol. Soc. Washington 33: 91, December 30, 1920.

Type.—Collected at Upper St. Marys Lake, Mont., May 30, 1895, by A. H. Howell; ♂ adult, skin and skull; No. 72294, United States National Museum (Biological Survey collection); original number, 27.

Geographic distribution.—Eastern slopes of the Rocky Mountain divide in western Montana, from the Canadian boundary south to Deer Lodge County.[13] *Zonal range:* Canadian; 4,000 to 8,000 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias umbrinus*, but coloration of upper parts and sides decidedly more tawny; head and face more ochraceous (less grayish); postauricular patches more buffy (less whitish); dark dorsal stripes more blackish (less brownish); light dorsal stripes less whitish and more mixed with ochraceous tawny; underside of tail deeper red. Skull averaging larger, the zygomata more abruptly expanded posteriorly.

Color.—Winter pelage (May and June):[14] Sides of nose pinkish cinnamon or cinnamon buff; top of head mixed cinnamon and fuscous, sprinkled with grayish white and bordered with an indistinct fuscous stripe; light facial stripes grayish white, shaded with buff; submalar stripe fuscous or bister mixed with tawny; ocular stripe fuscous black; ears fuscous black, the posterior margin with a broad band of buffy white or pinkish buff; inside of ears clothed with cinnamon hairs; postauricular patches buffy white, rather small and inconspicuous; dark dorsal stripes black or fuscous black; median pair of light stripes grayish white, mixed with cinnamon or tawny and shading anteriorly into the color of the crown; outer pair of light stripes creamy white; lateral stripes fuscous black, overlaid with tawny—often very indistinct; rump and thighs mouse gray, mixed with cinnamon; sides ochraceous tawny; feet pinkish cinnamon; tail above, fuscous black mixed with orange cinnamon; tail beneath, amber brown, bordered with fuscous black and edged with light pinkish cinnamon; underparts creamy white, faintly washed with pale pinkish buff.

Skull.—Similar to that of *E. umbrinus* but averaging larger, with the zygomatic portion of the squamosal heavier, the zygomata more widely expanded posteriorly.

Measurements.—Average of 12 adults from the type locality: Total length, 231.2 (223–244); tail vertebræ, 106.2 (101–118); hind foot, 35 (33.5–36); ear from notch, 14.4 (13–15.5). *Skull:* Greatest length, 35.3 (34.5–36.2); zygomatic breadth, 19.5 (19.1–20.1); cranial breadth, 15.1 (14.5–15.6); interorbital breadth, 7.8 (7.5–8.2); length of nasals, 11.1 (9.6–11.7).

Remarks.—The rufous-tailed chipmunk is an inhabitant of the heavy coniferous forests in the mountains of western Montana where its range overlaps in part the ranges of *E. amœnus luteiventris* on the lower slopes and of *E. minimus oreocetes* on the upper slopes near timber line. Its nearest relative is *E. umbrinus* and additional material from the region between the known ranges of these two species may show that they intergrade; at present, however, there is no evidence of such intergradation, and the rather pronounced character in the shape of the zygomata indicates specific distinction.

The species has been recognized by the author and other members of the Bureau of Biological Survey staff for many years, but until closely studied was referred to *E. amœnus felix*, which it resembles rather closely in superficial characters; it may be distinguished from

[13] Limits of range imperfectly known.
[14] Summer pelage not represented.

that form by its whiter belly, more reddish tail, more whitish dorsal stripes, and particularly by its larger skull, with longer rostrum.

Specimens examined.—Total number, 54, as follows:

Montana: Bass Creek, Bitterroot Mountains (northwest of Stevensville), 8; Bear Creek, Flathead County (near Marias Pass), 8; Belton, 1; Corvallis (in mountains, 15 miles east), 1; Deer Lodge County, 2;[15] Fish Creek, Glacier Park, 1; Florence (mountains west, 5,000 to 7,200 feet altitude), 5;[16] Glacial Lakes (Swift Current River), 1;[17] Lake McDonald, 1; Lolo Hot Springs, 2; Paola, Flathead County, 1; Summit, Teton County (Great Northern Railroad), 2; Upper Stillwater Lake, 3; Upper St. Marys Lake, 14; Willow Creek (10 miles east of Corvallis), 1.
Alberta: Waterton Lake Park, 3.[18]

EUTAMIAS RUFICAUDUS SIMULANS Howell

Cœur d'Alene Chipmunk

(Pls. 4, n; 8, n)

Eutamias ruficaudus simulans Howell, Journ. Mamm. 3: 179, August 4, 1922.

Type.—Collected at Cœur d'Alene, Idaho, June 1, 1891, by Clark P. Streator; ♀ adult, skin and skull; No. $\frac{28487}{40591}$, United States National Museum (Biological Survey collection); original number, 881.

Geographic distribution.—Mountains of northwestern Montana (west of the main divide), northern Idaho, northeastern Washington, and southeastern British Columbia. *Zonal range:* Transition and Canadian; 2,400 to 6,300 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias ruficaudus ruficaudus* but color of sides (at least in winter pelage), under surface of tail, and tail edgings paler; skull with relatively broad brain case and rostrum. Compared with *E. amœnus felix:* Size slightly larger; tail averaging longer; underparts clearer white; head more tawny; sides slightly paler. Compared with *E. a. ludibundus:* Size slightly larger; tail and ears longer; upper parts in summer more tawny, especially the head, shoulders, and rump.

Color.—*Summer pelage* (August): Top of head cinnamon or ochraceous tawny, mixed with fuscous and white, bordered on each side with a fuscous stripe; ocular stripe fuscous black, shaded posteriorly with ochraceous tawny; submalar stripe fuscous, washed with cinnamon or clay color; sides of nose and face washed with clay color; ears chætura drab, broadly margined posteriorly with pinkish buff; dark dorsal stripes black or fuscous black; median pair of light stripes grayish white, more or less mixed with ochraceous tawny; outer pair creamy white; lateral stripes fuscous or fuscous black; shoulders and sides ochraceous tawny (sometimes nearly tawny); rump and thighs mixed clay color and fuscous; hind feet pinkish cinnamon; front feet light pinkish cinnamon; tail above, fuscous black, overlaid with pinkish buff; tail beneath, ochraceous tawny, bordered with fuscous black and tipped with pinkish buff; underparts grayish white, washed with pale pinkish buff. *Winter pelage* (April): Similar to the summer pelage but upper parts paler and more grayish (much less tawny); sides cinnamon or pale ochraceous tawny; tail edged with tilleul buff or pale smoke gray.

Molt.—An adult male specimen from Thompson Pass, Idaho, August 5, has nearly completed the summer molt, the new pelage covering the anterior half of the body and nearly all of the sides to the flanks.

Skull.—Similar to that of *ruficaudus* but brain case and rostrum averaging broader; similar also to that of *E. amœnus felix* but averaging larger and relatively narrower with longer nasals; similar to that of *E. a. ludibundus*, but averaging slightly larger, with larger audital bullæ.

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[15] Kans. Univ. Mus. Nat. Hist.
[16] Mont. State College, 2.
[17] Amer. Mus. Nat. Hist.
[18] Nat. Mus. Canada.

Measurements.—Average of 10 adults from northern Idaho and northeastern Washington: Total length, 238.2 (224–248); tail vertebræ, 112.5 (103–121); hind foot, 33.6 (32–35); ear from notch, 13.9 (13–14.5). *Skull:* Average of 10 adults from northern Idaho: Greatest length, 34.7 (33.9–35.3); zygomatic breadth, 19.4 (18.7–20); cranial breadth, 15.3 (14.7–15.8); interorbital breadth, 7.5 (6.9–7.8); length of nasals, 11.1 (9.7–12.1).

Remarks.—This race, occupying the western slopes of the main Rocky Mountain divide in northern Montana and Idaho, may be distinguished from typical *ruficaudus* by the paler colors of body and tail. It bears a striking resemblance to *E. amœnus felix* of the coast region of British Columbia, but may be distinguished by its slightly larger skull, longer tail, and more tawny head. *E. a. felix* is a member of the *amœnus* group, intergrading with *ludibundus*, and its range does not touch that of *simulans;* moreover, *simulans* occurs in the region occupied by *luteiventris*, which is a member of the same group with *felix*. The resemblance between *simulans* and *felix*, therefore, is clearly accidental and does not indicate close relationship.

The range of *simulans* also meets and slightly overlaps the range of *E. amœnus canicaudus* in northeastern Washington; externally the two are readily separable by the more tawny coloration of *simulans*, especially of the underside of tail, but the skulls are in many cases difficult to separate; that of *simulans*, however, averages broader across the zygomata, rostrum, and brain case.

Specimens examined.—Total number, 120, as follows:

British Columbia: Salmon River, Kootenay district (near United States boundary), 1;[19] Nelson, 5;[20] Toad Mountain, 6 miles south of Nelson, 15.

Idaho: Bonners Ferry, 2; Cabinet Mountains, 1; Cœur d'Alene, 7; Kingston, 1; McKinnis, Shoshone County (7 miles east), 14;[21] Mission, Kootenai County, 2; Moscow, 1;[22] Mullan, 5; Murray, 2; Osburn, 2; Packer's Meadow (south of Lolo Hot Springs), 3; Priest Lake, 6; Thompson Pass, 9.

Montana: Silver [Saltese], 1; Thompson Pass, 4; Prospect Creek (near Thompson Falls), 5.

Washington: Calispell Lake, Pend Oreille County, 2; Calispell Peak (9 miles west of Locke), 2; Colville, 4; Loon Lake, Stevens County, 6; Marcus, 1; Metaline (9 miles north), 5; Sullivan Lake, Pend Oreille County, 14.

EUTAMIAS CINEREICOLLIS (ALLEN)

[Synonymy under subspecies]

Characters.—Size medium to large; hind foot, 32–36; skull length, 35.1–38.4; skull averaging longer than that of *quadrivittatus;* coloration similar to that of *quadrivittatus* but general tone more grayish (less tawny) especially on the shoulders; head cinnamon, cinnamon buff, or sayal brown, mixed with smoke gray or grayish white; shoulders with a more or less distinct wash of smoke gray; dark dorsal stripes black or fuscous black, shaded with mikado brown; median pair of light dorsal stripes smoke gray, sometimes sparingly sprinkled with cinnamon; outer pair grayish white; rump and thighs mixed smoke gray and cinnamon buff or pinkish buff; sides cinnamon buff, pinkish buff, cinnamon, sayal brown, or ochraceous tawny; hind feet smoke gray or pinkish buff; tail beneath, ochraceous tawny or sayal brown.

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[19] Nat. Mus. Canada.
[20] Acad. Nat. Sci. Philadelphia.
[21] D. R. Dickey coll.
[22] Amer. Mus. Nat. Hist.

EUTAMIAS CINEREICOLLIS CINEREICOLLIS (Allen)

Gray-collared Chipmunk

(Pls. 5, a; 9, a)

Tamias cinereicollis Allen, Bul. Amer. Mus. Nat. Hist. 3: 94, June, 1890.
Eutamias cinereicollis Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 40, December 27, 1901.

Type.—Collected on San Francisco Mountain, Ariz., August 2, 1889, by C. Hart Merriam and Vernon Bailey; ♀ adult, skin and skull; No. $\frac{17597}{24533}$, United States National Museum (Biological Survey collection); original number, 260.

Geographic distribution.—Mountain and plateau region of central Arizona from San Francisco Mountains southward across the Mogollon Plateau to the White Mountains and the Prieto Plateau; east to the San Francisco Range, N. Mex. *Zonal range:* Canadian; 6,500 to 11,500 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias q. quadrivittatus* but general tone of upper parts more grayish (less tawny), the nape and shoulders usually with a distinct wash of smoke gray; sides of nose more strongly washed with clay color; facial stripes averaging broader; sides slightly darker; hind feet paler buff and averaging slightly longer. Compared with *adsitus:* Tail longer; hind foot and ears larger; coloration paler and more grayish (less tawny), especially on shoulders; tail darker.

Color.—*Summer pelage* (August): Top of head sayal brown, mixed with grayish white, strongly shaded on top and sides of nose with clay color or cinnamon buff; crown bordered on each side with a stripe of fuscous or warm sepia; ocular stripe blackish, shaded with sayal brown; submalar stripe sayal brown, shaded with bister; ears fuscous or chætura drab, broadly margined posteriorly with grayish white and washed on anterior margin with sayal brown; inside surface washed with sayal brown; nape and shoulders with a more or less distinct wash of smoke gray, mixed on sides with pinkish buff or pinkish cinnamon; dorsal stripes black, bordered on each side with sayal brown; median pair of light stripes pale smoke gray; outer pair white; lateral stripes fuscous black, mixed with sayal brown or russet; rump and thighs smoke gray, mixed with cinnamon buff; sides sayal brown; feet pinkish buff or light pinkish cinnamon, shaded with clay color or sometimes with grayish white; tail above, fuscous black (the bases of the hairs cinnamon) overlaid with pinkish buff or cinnamon buff; tail beneath, tawny or ochraceous tawny (fading to clay color), bordered with fuscous black and edged with pinkish buff or cinnamon buff; underparts creamy white, often tinged with pinkish buff. *Winter pelage* (October): Similar to the summer pelage but sides paler (light sayal brown); tail edgings slightly paler, and upper parts usually more extensively washed with grayish.

Molt.—The spring molt takes place early in this species; three male specimens from Flagstaff, Ariz., May 15, 16, and 17, are in greatly worn winter pelage, with the new summer pelage appearing in irregular patches over the upper parts.

Skull.—Practically indistinguishable from that of *E. q. quadrivittatus.*

Measurements.—Average of 13 adults from type locality: Total length, 224.5 (212–242); tail vertebræ, 102 (95–109); hind foot, 35 (34–36); ear from notch, 15.3 (14.3–16). *Skull:* Average of eight from type locality: Greatest length, 35.9 (35.1–36.6); zygomatic breadth, 19.7 (19.4–20.2); cranial breadth, 14.9 (14–15.4); interorbital breadth, 8.1 (7.9–8.6); length of nasals, 11.2 (10.5–12.3).

Remarks.—This species is very closely related to *E. quadrivittatus* but may be distinguished by a number of constant, though slight, characters. Their ranges apparently are separated by a considerable area unsuited to their habitat, so there is no chance for physical intergradation. The present form is also quite distinct from *E. adsitus,* the range of which lies to the northward of the Grand Canyon in northwestern Arizona and southern Utah. Intergradation with subspecies *cinereus* occurs in western New Mexico. Over a portion

of its range (the White Mountains and Prieto Plateau) *cinereicollis* occurs with a smaller species, *E. minimus arizonensis*, which it resembles so closely in coloration that the two are easily confused; in fact, they have been confused ever since collections were first made in that region. The small species (*arizonensis*) may be distinguished by paler sides, smaller ears, and hind feet, and much smaller skull.

Specimens examined.—Total number, 175, as follows:

Arizona: Alpine, 3; Anderson Mesa, 2; Baker Butte, 6; Bill Williams Mountain, 2; Blue River, 1; Camp Apache, 1; Coleman Lake, 3;[23] Flagstaff, 46;[24] Horseshoe Cienega (White Mountains), 2; Little Spring, 2; Mayer, 1; Mount Agassiz, 1; Mount Thomas (White Mountains), 2; Prieto Plateau (south end of Blue Range), 10; Quaking Asp Settlement, 1;[25] San Francisco Mountain, 29; Springerville, 17; White Mountains, 42;[26] Williams, 4.

EUTAMIAS CINEREICOLLIS CINEREUS Bailey

Magdalena Chipmunk

(Pls. 5, b; 9, b)

Eutamias cinereicollis cinereus Bailey, Proc. Biol. Soc. Washington 26: 130, May 21, 1913.

Type.—Collected in Copper Canyon, Magdalena Mountains, N. Mex. (altitude, 8,200 feet), September 1, 1909, by E. A. Goldman; ♂ adult, skin and skull; No. 167029, United States National Museum (Biological Survey collection); original number, 20435.

Geographic distribution.—Mountains of southwestern New Mexico (Magdalena, San Mateo, Mimbres, and Mogollon Ranges). *Zonal range:* Transition and Canadian; 6,700 to 10,000 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias c. cinereicollis* but paler and more grayish, especially on nape, shoulders, and rump; gray wash on anterior sides more extensive and less mixed with buff; ears less tawny; sides slightly paler; tail slightly shorter.

Color.—*Summer pelage* (September): Top of head pale smoke gray, mixed with cinnamon, and bordered on each side with fuscous black; sides of nose faintly washed with light pinkish cinnamon; ocular stripe fuscous black, shaded with mikado brown; submalar stripe mikado brown, shaded with fuscous; ears chætura drab, broadly margined posteriorly with grayish white and washed anteriorly with mikado brown; postauricular patches large, grayish white; nape and shoulders extensively washed with smoke gray; varied on sides with pale pinkish buff; dark dorsal stripe black, margined with mikado brown, the outer pair sometimes mainly brownish; lateral stripes fuscous black shading to mikado brown; median pair of light stripes grayish white; outer pair white; rump and thighs smoke gray, sparingly mixed with pinkish buff; sides between sayal brown and pale clay color; feet pinkish buff or pinkish cinnamon, shaded with pale smoke gray; tail above, fuscous black (the bases of the hairs pinkish cinnamon) overlaid with pinkish buff; tail beneath, sayal brown, bordered with fuscous black and tipped with pinkish buff; underparts creamy white, faintly tinged with pale buff. *Winter pelage* (October 25): Closely similar to the summer pelage.

Skull.—Practically identical with that of *cinereicollis*.

Measurements.—Average of 10 adults from San Mateo and Magdalena Mountains, N. Mex.: Total length, 221.5 (208–231); tail vertebræ, 94.8 (90–101); hind foot, 34.5 (33–36); ear from notch, 14.8 (14–15.3). *Skull:* Average of six (adult and subadult) from same localities: Greatest length, 36.1 (35.5–36.7); zygomatic breadth, 19.6 (19.4–19.8); cranial breadth, 15.3 (14.8–15.6); interorbital breadth, 7.9 (7.8–8); length of nasals, 11.2 (10.5–11.6).

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[23] D. R. Dickey coll., 2.
[24] D. R. Dickey coll., 2; Univ. Mich., 3.
[25] Mus. Comp. Zool.
[26] Amer. Mus. Nat. Hist., 17; Field Mus. Nat. Hist., 22; Mus. Comp. Zool., 2.

Remarks.—This subspecies is a pale gray form, nearest to *cinereicollis*, with which it intergrades in the Mimbres and Mogollon Mountains of southwestern New Mexico. It is markedly paler than *canipes*, from the Jicarilla and White Mountains to the eastward, and there is little evidence of intergradation with that form. It is also widely different from *E. quadrivittatus* of northern New Mexico, and their ranges apparently are not contiguous.

Specimens examined.—Total number, 31, as follows:

New Mexico: Datil Range (22 miles northwest of Fort Tularosa), 1; Kingston, 3; Magdalena Mountains, 5; Mimbres River (head), 1; Mimbres Mountains, 4; Mogollon Mountains, 5; Organ Mountains, 6;[27] San Mateo Mountains (Socorro County), 6.

EUTAMIAS CINEREICOLLIS CANIPES Bailey

Gray-footed Chipmunk

(Pls. 5, c; 9, c)

Eutamias cinereicollis canipes Bailey, Proc. Biol. Soc. Washington 15: 117, June 2, 1902.

Type.—Collected at head of Dog Canyon, Guadalupe Mountains, Tex. (altitude, 7,000 feet), August 24, 1901, by Vernon Bailey; ♀ adult, skin and skull; No. 109229, United States National Museum (Biological Survey collection); original number, 7827.

Geographic distribution.—Mountains of southeastern New Mexico and western Texas (Jicarilla, Capitan, White, and Guadalupe Mountains). *Zonal range:* Canadian and Transition; 7,000 to 12,000 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias c. cinereicollis*, but sides paler; outer pair of dorsal stripes more brownish (less blackish); sides of nose and face less heavily washed with buff; feet more grayish (less buffy); tail edgings paler and more grayish (less buffy); hind foot averaging shorter. Compared with *E. q. quadrivittatus:* General tone of upper parts more grayish (less tawny); shoulders with a rather indistinct grayish wash (the same region tawny in *quadrivittatus*); ocular stripe broader and more blackish; head darker and more grayish (less buffy); dark dorsal stripes averaging broader, the outer pairs more brownish (less blackish); feet more grayish (less buffy).

Color.—Summer pelage (August and September): Top of head mixed sayal brown and grayish white, bordered on each side with a stripe of fuscous black, shaded with sayal brown; ocular stripe black, edged with sayal brown; submalar stripe sayal brown, shaded with fuscous; ears chætura drab, broadly margined posteriorly with grayish white and washed on anterior margin with sayal brown; postauricular patches pale smoke gray; shoulders, rump, and thighs with a rather indistinct wash of smoke gray, sprinkled with pinkish buff; median dorsal stripe broad, black, bordered with sayal brown; outer pair of dark stripes fuscous black, sprinkled with mikado brown or sayal brown; lateral stripes distinct, mikado brown; sides sayal brown or pale clay color; median pair of light stripes grayish white or pale smoke gray; outer pair white; tail, above, fuscous black (the bases of the hairs pinkish cinnamon) overlaid with pinkish buff, tilleul buff or pale smoke gray; hind feet smoke gray, faintly shaded with pinkish buff; tail beneath, ochraceous tawny, bordered with fuscous black and edged with pinkish buff, tilleul buff or pale smoke gray; underparts creamy white. *Winter pelage* (May): Very similar to the summer pelage but averaging slightly more grayish above and paler on the sides.

Molt.—An adult male specimen from Mount Capitan, N. Mex., June 15, is in worn winter pelage, with the new summer pelage just beginning to appear in patches on the back.

Skull.—Similar to that of *cinereicollis* but averaging slightly larger; similar to that of *E. q. quadrivittatus* but averaging larger, with relatively longer and slenderer rostrum.

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[27] Mus. Comp. Zool., 5; State College N. Mex, 1.

Measurements.—Average of 10 adults from Guadalupe Mountains, Tex., and White Mountains, N. Mex.: Total length, 228.1 (210–250); tail vertebræ, 99.9 (92–115); hind foot, 33. 5 (32–35); ear from notch, 15.2 (14–17). *Skull:* Average of six adults from same localities: Greatest length, 36.9 (36.1–38.4); zygomatic breadth, 19.8 (19.3–21); cranial breadth, 15.5 (14.7–17.1); interorbital breadth, 8.2 (7.9–8.6); length of nasals, 12.1 (11.7–12.3).

Remarks.—This chipmunk is a strongly marked form and might almost be considered a distinct species. It is more different from *cinereus* (whose range approaches nearest to that of *canipes*) than from *cinereicollis*, and there is little evidence of intergradation with that race. The most constant character separating it from its near relatives is the paler and more grayish edging of the tail, but an occasional specimen of *canipes* has the tail edged with cinnamon buff, as in *cinereicollis*.

The present race shows approach toward *E. bulleri* in the broadening and blackening of the ocular stripe and in the large size of the skull; however, the hind foot is shorter and the dorsal stripes less blackish than in either *bulleri* or *cinereicollis*.

Two specimens in the series from the White Mountains, N. Mex., have larger skulls than the typical series from Guadalupe Mountains, Tex.; indeed, one skull from there is larger than the average of *bulleri*.

This race, although separated from the range of *Eutamias q. quadrivittatus* by a comparatively narrow gap, shows no evidence of intergradation with the latter; indeed it is more different from *quadrivittatus* than is *E. c. cinereicollis* of Arizona. It may be distinguished from *quadrivittatus* by a number of constant characters (as pointed out above), particularly the more grayish (less tawny) shoulders, hind feet, and tail edgings. The skulls average distinctly longer, but some specimens are scarcely distinguishable from those of *quadrivittatus*.

Specimens examined.—Total number, 82, as follows:

New Mexico: Capitan Mountains, 46; Cloudcroft, 13; Jicarilla Mountains, 10; Mescalero, 2;[28] Ruidoso, 5;[29] White Mountains (12,000 feet altitude), 1.

Texas: Guadalupe Mountains (head of Dog Canyon), 5.

EUTAMIAS BULLERI (ALLEN)

[Synonymy under subspecies]

Characters.—Size large; hind foot, 34–38; skull length, 35.7–39.6; skull similar to that of *cinereicollis* but averaging larger; coloration similar to that of *cinereicollis* but facial markings broader and more blackish; grayish collar present in some forms, nearly obsolete in others; head fuscous, sayal brown, or bister, mixed with grayish white; dark dorsal stripes black, shaded with mikado brown; median pair of light dorsal stripes grayish white or cinnamon; outer pair creamy white, or shaded with buff; sides cinnamon, cinnamon buff, or sayal brown; rump and thighs cinnamon buff, mixed with smoke gray; hind feet pinkish buff or grayish white; under surface of tail pinkish buff, cinnamon, ochraceous tawny, or russet.

EUTAMIAS BULLERI BULLERI (ALLEN)

SIERRA MADRE CHIPMUNK

(PLS. 5, E; 9, E)

Tamias asiaticus bulleri Allen, Bul. Amer. Mus. Nat. Hist. 2: 173, October 21, 1889.

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[28] Acad. Nat. Sci. Philadelphia, 1; State College N. Mex., 1.
[29] Acad. Nat. Sci. Philadelphia.

Tamias bulleri Allen, Bul. Amer. Mus. Nat. Hist. 3: 92, June, 1890.
Eutamias bulleri Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 40, December 27, 1901.

Cotypes.—Collected in the Sierra de Valparaiso, Zacatecas, Mexico, August 2, 1889, by Audley Buller; adult females, skins and skulls; Nos. $\frac{1972}{1241}$, $\frac{1973}{1242}$, American Museum of Natural History.

Geographic distribution.—Southern end of the Sierra Madre, in the State of Zacatecas, Mexico. *Zonal range:* Transition; 8,000 to 8,700 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias cinereicollis canipes*, but sides paler; head darker; ocular stripe broader; submalar stripe and sides of nose darker; median dorsal stripe between ears broader and more blackish; outer pair of dark stripes darker (more blackish); feet averaging slightly more buffy; tail paler beneath; hind foot much larger; skull larger; ears averaging broader and less pointed. Compared with *cinereicollis:* Head darker; ocular stripe broader and more blackish; sides of body and underside of tail paler; hind feet slightly paler.

Color.—Summer pelage (July and August): Top of head fuscous or bister, sparingly mixed with grayish white; sides of crown bordered with fuscous black; ocular stripe broad, black, edged with mikado brown; submalar stripe mikado brown, mixed with fuscous black; ears chætura drab, broadly margined posteriorly with grayish or buffy white and edged on anterior margin with sayal brown; postauricular patches prominent, grayish white; grayish collar indistinct or obsolete; dorsal stripes black, margined with mikado brown; lateral stripes mikado brown, rather indistinct; median pair of light stripes grayish white, outer pair white; sides dull cinnamon buff, shaded with sayal brown, becoming pinkish buff on shoulders; rump and thighs mixed cinnamon buff and smoke gray; feet pinkish buff or clay color, shaded with grayish white; tail above, fuscous black, overlaid with pinkish buff; tail beneath varying from cinnamon buff to sayal brown or ochraceous tawny; underparts creamy white. *Winter pelage* (November and December): Similar to the summer pelage but dorsal stripes less contrasted in color; median pair of light stripes mixed with sayal brown, the outer pair creamy white; outer pair of dark stripes much mixed with mikado brown.

Skull.—Similar to that of *E. cinereicollis canipes* but averaging larger.

Measurements.—Average of 10 adults from type locality: Total length, 235.4 (222–247); tail vertebræ, 103.7 (93–113); hind foot, 36.8 (36–38); ear from notch, 14.4 (13.2–16.5). *Skull:* Average of nine adults from type locality: Greatest length, 38.3 (37.2–39.6); zygomatic breadth, 20.5 (20–21); cranial breadth, 15.9 (15.4–16.3); interorbital breadth, 8.4 (8–9.1); length of nasals, 12 (11.2–12.5).

Remarks.—The Sierra Madre chipmunk clearly belongs in the *quadrivittatus* group, having rather close relationship to both *cinereicollis* and *canipes*. So far as known, however, there is a considerable gap between the ranges of the subspecies of *bulleri* and of *cinereicollis; Eutamias bulleri durangæ* is not known from farther north than San Julian, in extreme southern Chihuahua, nor *E. cinereicollis canipes* from south of the Guadalupe Mountains, Tex.

Typical *bulleri* apparently has a rather restricted range, being known at present only from the State of Zacatecas, Mexico; a short distance to the northward in the mountains near Durango City, it gives place to the subspecies *durangæ*.

Specimens examined.—Total number, 36, as follows:

Zacatecas: Sierra Madre [southwest of Sombrerete], 9; Valparaiso Mountains, 25;[30] no definite locality, 2.[31]

[30] Amer. Mus. Nat. Hist., 5.
[31] Mus. Comp. Zool.

EUTAMIAS BULLERI DURANGÆ ALLEN

DURANGO CHIPMUNK

(PLS. 5, F; 9, F)

Eutamias durangæ Allen, Bul. Amer. Mus. Nat. Hist. 19: 594, November 12, 1903.
Tamias nexus Elliot, Proc. Biol. Soc. Washington 18: 233, December 9, 1905 (Coyotes, Durango).

Type.—Collected at Arroyo de Bucy, Sierra de Candella, Durango, Mexico (altitude, about 7,500 feet), May 29, 1903, by J. H. Batty; ♀ adult, skin and skull; No. 21410, American Museum of Natural History.

Geographic distribution.—Sierra Madre of Mexico from southern Durango north to southern Chihuahua. *Zonal range:* Transition; 6,500 to 8,500 feet altitude. (Fig. 6.)

Characters.—Similar to *Euiamias b. bulleri* but upper parts much more brownish, the dorsal stripes (except the median one) brownish instead of black, and light dorsal stripes duller white and much mixed with cinnamon; head paler, tail much darker beneath; ears averaging larger.

Color.—Summer pelage (El Salto specimens, July): Top of head mixed sayal brown and grayish white, bordered on each side with fuscous; ocular stripe black, mixed with verona brown between eye and ear; submalar stripe verona brown; ears fuscous anteriorly, the posterior third grayish or buffy white, this color forming a band about 4 millimeters broad; postauricular spots larger, grayish white; shoulders with a more or less distinct grayish wash; median dorsal stripe black, bordered with mikado brown, becoming paler and less distinct on nape and occiput; outer dorsal stripes broad, mikado brown, the lateral stripes of same color and width as the inner pair; light dorsal stripes dull buffy white, mixed with cinnamon; sides dull cinnamon or cinnamon buff, shaded on shoulders with smoke gray; rump and thighs cinnamon buff mixed with smoke gray; feet pinkish buff; tail above, fuscous (the bases of the hairs pinkish cinnamon) overlaid with pale pinkish buff; tail beneath, dark tawny or russet, bordered with fuscous and tipped with pale pinkish buff; underparts creamy white tinged with pale buff. *Worn winter pelage* (topotype series, May): Similar to the summer pelage, but upper parts less strongly suffused with brownish, the outer pair of dorsal stripes more blackish.

Skull.—Practically identical with that of *bulleri*.

Measurements.—Average of nine adults from El Salto, Durango: Total length, 237.4 (228–248); tail vertebræ, 102.7 (96–110); hind foot, 37.1 (36–38); ear from notch, 16.3 (15–17.5). *Skull:* Average of six adults from type locality: Greatest length, 38.5 (37.9–39); zygomatic breadth, 20.8 (20.3–21); cranial breadth, 16.2 (15.8–16.7); interorbital breadth, 9 (8.4–9.8); length of nasals, 12.1 (11.6–12.5).

Remarks.—Although there is apparently no barrier between the range of this race and that of *bulleri* there is a striking difference between the two forms in coloration. The characters are shown in both pelages but are most pronounced in summer, when the strong brownish suffusion on the back and the dark undersurface of the tail are in striking contrast with the blackish colors and pale tail of *bulleri*. The present form shows no approach toward *E. cinereicollis*.

The type series of *E. "nexus"* has been examined and found to agree perfectly with the series in summer pelage from El Salto, which is very close to the type locality of *durangæ*.[32]

Specimens examined.—Total number, 58, as follows:

Chihuahua: Sierra Madre, near Guadalupe y Calvo, 26.

Durango: Arroyo de Bucy (Sierra de Candella), 11;[33] Ciudad, 2;[34] Coyotes, 6;[35] El Salto, 13.

[32] The exact location of Coyotes, whence came the type of *nexus*, is not known to the writer.
[33] Amer. Mus. Nat. Hist.
[34] Field Mus. Nat. Hist.
[35] Field Mus. Nat. Hist., 5.

EUTAMIAS BULLERI SOLIVAGUS Howell

Coahuila Chipmunk

(Pls. 5, d; 9, d)

Eutamias bulleri solivagus Howell, Journ. Mamm. 3: 179, August 4, 1922.

Type.—Collected in the Sierra Guadalupe, Coahuila, Mexico, May 1, 1902, by E. W. Nelson and E. A. Goldman; ♀ adult, skin and skull; No. 116882, United States National Museum (Biological Survey collection); original number, 15169.

Geographic distribution.—Known only from the type locality. *Zonal range:* Transition; 8,500 to 9,500 feet altitude. (Fig. 6.)

Characters.—Similar to *Eutamias b. bulleri*, but sides and rump slightly darker; head slightly paler (more grayish); tail darker beneath and edged with a darker shade of buff; hind foot shorter; skull smaller. Compared with *E. cinereicollis canipes:* Outer pair of dorsal stripes more blackish; sides and rump darker; postauricular patches less distinct; feet more buffy (less grayish); tail darker beneath and edged with a darker shade of buff.

Color.—*Unworn summer* (?) *pelage* (May 1): Top of head fuscous, overlaid with grayish white, shaded on front of face with snuff brown and bordered on sides of crown with fuscous; sides of nose cinnamon buff; ocular stripe fuscous black, shaded posteriorly with verona brown; submalar stripe fuscous, mixed with verona brown; ears fuscous, margined posteriorly with grayish white and washed on anterior margin with mikado brown; postauricular patches small and indistinct, buffy white; shoulders faintly and indistinctly washed with smoke gray, mixed with dull cinnamon buff; dorsal stripes rather broad, black, margined with mikado brown; light dorsal stripes dull white, the median pair slightly more grayish; lateral stripes bister, broad, but not sharply defined; sides cinnamon and sayal brown, washed on shoulders with smoke gray and cinnamon buff; rump and thighs smoke gray, shaded with cinnamon buff; feet pinkish buff, shaded with grayish; tail above, fuscous (the bases of the hairs pinkish cinnamon), overlaid with pinkish buff; tail beneath, ochraceous tawny, bordered with fuscous and tipped with pinkish buff; underparts creamy white. *Worn winter pelage:* Similar to the fresh summer pelage, but dorsal stripes snuff brown faintly shaded with fuscous black, the median one often black on hinder back.

Skull.—Similar to that of *bulleri*, but smaller; very similar to that of *E. cinereicollis canipes.*

Measurements.—Average of 10 adults from type locality: Total length, 233.4 (225–239); tail vertebræ, 106.5 (100–112); hind foot, 35 (34–36); ear from notch, 15.4 (14.3–17). *Skull:* Greatest length, 36.3 (35.7–37.3); zygomatic breadth, 19.8 (19.4–20.7); cranial breadth, 15.7 (15.1–16.1); interorbital breadth, 8.2 (7.9–8.7); length of nasals, 11.7 (11.3–12.1).

Remarks.—This race apparently is confined to an isolated mountain range in southern Coahuila; it most resembles typical *bulleri* in color, but is readily distinguished by the darker color of the underside of the tail; in this character it resembles *durangæ*, but differs from that race in the absence of a buffy wash on the upper parts.

In the series of 15 specimens from the type locality, taken May 1–3, six are in a worn and faded winter pelage, while the remainder apparently are in a fresh summer pelage; the molt apparently begins on the hinder back and sides and spreads in both directions. Nelson and Goldman found this chipmunk common in the coniferous forest on top of the Sierra Guadalupe, above La Concordia.

Specimens examined.—Total number, 15, as follows:

Coahuila: Sierra Guadalupe, 15.

EUTAMIAS TOWNSENDII GROUP

EUTAMIAS TOWNSENDII (BACHMAN)

[Synonymy under subspecies]

Characters.—Size large; hind foot, 34–39; skull length, 36.8–40.8; skull similar in general to that of *Eutamias bulleri, E. speciosus,* and other members of the *quadrivittatus* group, but larger; zygomata more widely expanded at posterior end; audital bullæ relatively smaller; rostrum short and broad; coloration very variable, but tail edgings uniformly smoke gray or pale tilleul buff (never deep buff); general tone of sides and upper parts varying from tawny, antique brown or Saccardo's umber to tawny olive, sayal brown, orange cinnamon, or clay color; dark dorsal stripes black or fuscous black, more or less mixed with sayal brown, mikado brown, or russet; median pair of light dorsal stripes varying from grayish white or smoke gray to ochraceous tawny and tawny olive; outer pair of light dorsal stripes varying from grayish white or creamy white (*senex*) to ochraceous tawny (*townsendii*), in some races much obscured by cinnamon, tawny, or olivaceous tips; rump and thighs varying from smoke gray (*senex*) to ochraceous tawny (*townsendii*) or Saccardo's umber (*ochrogenys*); hind feet varying from cinnamon buff or clay color to sayal brown, cinnamon, or tawny olive; underparts grayish white, creamy white, pinkish buff, pinkish cinnamon, or light ochraceous buff; under surface of tail varying from clay color or sayal brown to mikado brown, tawny, and hazel.

EUTAMIAS TOWNSENDII TOWNSENDII (BACHMAN)

TOWNSEND'S CHIPMUNK

Tamias townsendii Bachman, Journ. Acad. Nat. Sci. Philadelphia 8: pt. 1, p. 68, 1839; Townsend, Narr. Journ. across Rocky Mts., etc., p. 321, 1839 (Columbia River).

Tamias hindei (typ. err. for *hindsii*) Gray, Ann. & Mag. Nat. Hist. 10: 264, December, 1842.

Tamias hindsii Gray, List Spec. Mamm. British Mus., p. 145, 1843 (not of Allen, Merriam, and other recent authors).[36]

Tamias quadrivittatus townsendii Allen, Proc. Boston Soc. Nat. Hist. 16: 290, 1874.

Tamias asiaticus var. *townsendi* Allen, Monog. North Amer. Rodentia: Report, U. S. Geol. Surv. Terr. 11: 794, 1877.

Eutamias townsendi Merriam, Proc. Biol. Soc. Washington 11: 194–195, 1897.

Tamias townsendi littoralis Elliot, Field Columbian Mus. Pub. Zool. 3: 153, April, 1903 (Marshfield, Oregon).

Type (lectotype).—Collected on the Lower Columbia River, near lower mouth of Willamette River, Oreg., in 1834, by J. K. Townsend (1839, p. 177); mounted skin (with skull inside); No. 241, collection of Academy of Natural Sciences of Philadelphia.

Geographic distribution.—Coast region of southern British Columbia, Washington, and part of Oregon, from the lower Fraser River, British Columbia, south to Coos County, Oreg. (Myrtle Point), east to Church Mountain ("Mount Baker Range"), British Columbia, Mount St. Helens, Wash., and western base of Cascade Range in northern Oregon. *Zonal range:* Transition and Lower Canadian; sea level to 6,000 feet altitude. (Fig. 7.)

Characters.—Size large (hind foot averaging 35 mm.); ears of moderate length, broadly rounded at tip; colors dark, the upper parts and sides rich tawny; postauricular patches indistinct, or often obsolete; dark dorsal stripes distinct, black or brownish black; light dorsal stripes strongly ochraceous—never clear white; underparts whitish; tail edged with grayish; skull similar in general shape to that of *ruficaudus,* but decidedly larger.

[36] For the identification of this name, see Howell, 1922, p. 181–182.

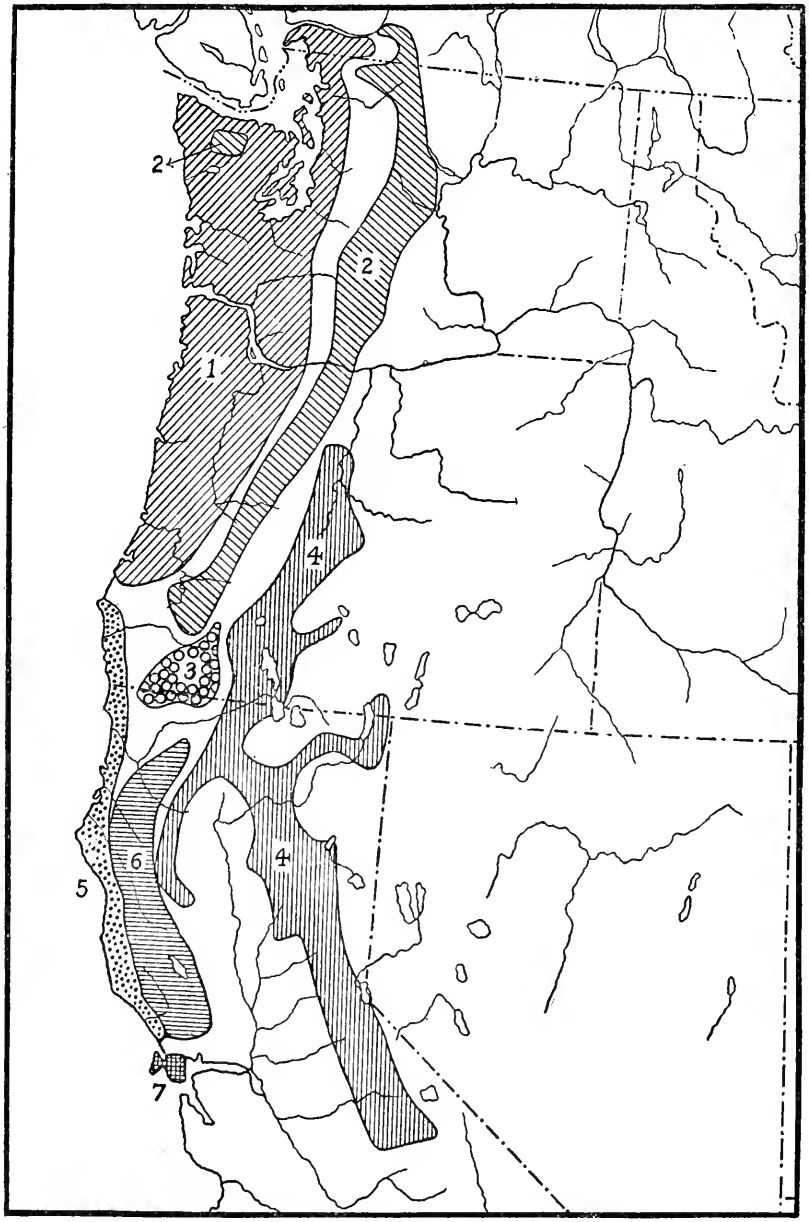

FIGURE 7.—Distribution of the subspecies of *Eutamias townsendii* and of *E. alleni*. 1, *E. townsendii townsendii*; 2, *E. townsendii cooperi*; 3, *E. townsendii siskiyou*; 4, *E. townsendii senex*; 5, *E. townsendii ochrogenys*; 6, *E. townsendii sonomæ*; 7, *E. alleni*

Color.—Tawny phase: [37] General tone of upper parts antique brown or ochraceous tawny; top of head sayal brown or cinnamon, heavily clouded with fuscous black, and bordered on each side with a fuscous black stripe; sides of nose cinnamon or sayal brown; stripe from eye to ear and submalar stripe fuscous black, often strongly shaded with sayal brown; eyelids bordered above and below with pinkish buff; light facial stripes rather indistinct, sometimes pinkish buff, but often much obscured with a wash of dull ochraceous buff; ears fuscous or fuscous black anteriorly, the posterior third or fourth pale smoke gray; dark dorsal stripes black or fuscous black, the median one extending from crown to rump, the others becoming obsolete anteriorly; lateral stripe fuscous, always narrow and often nearly obsolete; light dorsal stripes ochraceous tawny, moderately shaded with buffy white and in worn pelage fading to soiled whitish, the four stripes usually of uniform tone, but outer pair sometimes slightly more whitish; sides, rump, and thighs ochraceous tawny to antique brown, the thighs slightly paler and more olivaceous; hind feet sayal brown, the toes cinnamon buff; front feet cinnamon buff, washed with fuscous; tail above fuscous black, overlaid with pale smoke gray; tail beneath, tawny or ochraceous tawny, bordered with fuscous black and tipped with pale smoke gray; underparts creamy white, often faintly shaded with pale pinkish buff. *Olivaceous phase* (June and November, Portland, Oreg.): General tone of upper parts and sides between tawny olive and Saccardo's umber; top of head similar to sides, but sprinkled with whitish; sides of head practically without tawny or sayal brown, the light facial stripes dull whitish, faintly edged with cinnamon; dark dorsal stripes fuscous black, the median one usually darker; median pair of light stripes similar to sides; outer pair faintly washed with dull whitish; hind feet tawny olive, shaded with cinnamon buff; toes cinnamon buff, shaded with whitish; tail as in the ochraceous phase.

Molt.—Very few specimens are available showing the molt in this race; one from Sumas, British Columbia, June 23, and one from Tenino, Wash., June 30 (both males), have a fresh tawny pelage covering the anterior half of the body to the middle of the back, the hinder parts being much faded, with whitish dorsal stripes.

A specimen from Newport, Oreg., August 5, shows a new pelage investing the rump and thighs; this molt apparently corresponds to the fall molt in other species, but no other specimens showing this molt have been seen. A specimen, however, from Empire, Oreg., October 13, and one from Mapleton, Oreg., October 23, in the olivaceous phase are clearly in a fresh pelage. The winter pelage fades very decidedly in the spring, so that in many specimens taken in June or early July the tawny stripes of autumn have become buffy white in color.

Skull.—Size larger; rostrum broad and heavy; nasals broad, terminating on a line with posterior border of premaxillaries or slightly beyond.

Measurements.—Average of 10 adults from Portland, Oreg.: Total length, 249 (235–263); tail vertebræ, 109.6 (96–125); hind foot, 35.1 (34–36); ear from notch, 16.1 (15–17.5). *Skull:* Greatest length, 38.7 (38–39.5); zygomatic breadth, 21.6 (21.2–21.9); cranial breadth, 16.5 (16.2–17); interorbital breadth, 8.6 (8–9); length of nasals, 12.2 (11.6–12.6).

Remarks.—Townsend's chipmunk occupies the humid, heavily forested coast region of Washington, southern British Columbia, and Oregon south about to Cape Blanco; in this region it is the only chipmunk found. Along the western base of the Cascades it grades into the subspecies *cooperi* and in the vicinity of Myrtle Point, Oreg., into the subspecies *ochrogenys*. A series of eight from the latter place is clearly referable to *townsendii*, although one specimen shows approach to *ochrogenys* in having buffy underparts.

A large series from Marshfield, Oreg., comprising both winter and summer pelages shows no appreciable differences from typical *townsendii;* therefore the form described by Elliot from that locality as "*littoralis*" is placed in synonymy.

In the original description by Bachman, no type was designated and no mention is made of any particular specimen. Witmer Stone,

[37] It seems impossible to characterize summer and winter pelages of this race, since unworn specimens representing two phases of color but showing no pronounced seasonal differences are found throughout the year, and the very few specimens showing molt leave one in doubt as to the normal periods of pelage change.

of the Academy of Natural Sciences of Philadelphia, informs the writer that there is but one specimen of this species, collected by Townsend, entered in the Academy's catalogue, and this specimen (No. 241, mounted skin with skull inside) through the kindness of Doctor Stone is now before the present reviser. It agrees perfectly with recently collected specimens from the type region but does not correspond in all details with the original description. Although it is not possible definitely to fix this specimen as a "type," doubtless it served in part at least as the basis of Bachman's description and it is hereby designated as a lectotype. Another of Bachman's specimens came into the possession of the United States National Museum, where it was entered as No. 92, a mounted skin with skull inside. Many years later the specimen was dismounted and the skull removed; the skin has disappeared, but the skull was reentered under the number 38797, and is now in the collection (lacking the audital bullæ and part of the brain case).

Specimens examined.—Total number, 470, as follows:

British Columbia: Chilliwack, 6; Chilliwack Lake, 1;[38] Douglas, 3;[39] Esquimalt, 1; Huntingdon, 1;[40] Langley, 8; Mount Baker Range (Church Mountain), 2; Mount Lehman, 9;[41] Skagit, 2;[39] Sumas, 15;[42] Tami Hy Creek, 2;[39] Vedder Mountain (near Chilliwack), 1;[40] Westminster, 1.[43]

Oregon: Astoria, 10; Beaverton, 4;[44] Bissell, Clackamas County, 1; Blaine, 7;[45] Clackamas County, 4;[43] Columbia River, 2;[46] Drain, 2; East Portland, 2; Elk Head, 1; Empire, 4; Eugene, 2; Florence, 12; Forest Grove, 7; Gardiner, 4;[47] Grand Ronde, 4; Hood River, 1; Logan, 3;[43] Mapleton, 3; Marshfield, 27;[48] Myrtle Point, 8; Netarts, 1;[49] Newport, 9; Oakland, 1;[50] Oregon City, 2; Philomath, 5; Portland, 36;[51] Rainier, 1;[52] Salem, 19;[53] Seaside, 15; Seaton (Mapleton), 5; Scottsburg, 3; Sellwood, 2; Smith River (near Gardiner), 1; Tillamook, 27;[54] Tualatin, 1;[43] Wilson River, Tillamook County, 1; Yaquina Bay, 6.

Washington: Aberdeen, 2; Blyn, Clallam County, 1; Boulder Creek, Olympic Mountains, 6;[55] Boulder Lake, Olympic Mountains, 1;[56] Canyon Creek, Olympic Mountains, 1;[57] Cape Disappointment, 4;[58] Carson, 5; Cathlamet, 3; Cedarville, 2; Chehalis, 6; Chilliwack Creek, Whatcom County, 1;[57] Clinton, Whidbey Island, 3; Elwha River (at Boulder Creek, 560 feet altitude), 3; Elwha River (at Hays River, 2,000 feet altitude); Elwha P. O., 2; Everett, 5; Forks, Clallam County, 3; Fort Steilacoom, 1; Granville (Tahola), 2; Hamilton, 1; Happy Lake, Olympic Mountains, 9;[59] Ilwaco, 2; Kalama, 2;[43] Kirkland, 5; Lake Cushman, Olympic Mountains, 5; Lapush, 3; Mount Ellinor, Olympic Mountains (4,000 feet altitude), 3; Mount St. Helens, 3; Mount Vernon, 4; Neah Bay, 22; Nisqually, 2;[60] North Bend, 7; Oakville, 1; Olympia, 1;[52] Olympic Mountains, 2; Ozette Lake, Clallam County, 2; Pacific

[38] Mus. Comp. Zool.
[39] Nat. Mus. Canada.
[40] Kenneth Racey coll.
[41] Amer. Mus. Nat. Hist., 6; Field Mus. Nat. Hist., 2; Mus. Comp. Zool., 1.
[42] Mus. Comp. Zool., 8; Acad. Nat. Sci. Philadelphia, 2.
[43] Amer. Mus. Nat. Hist.
[44] Amer. Mus. Nat. Hist., 3; Mus. Comp. Zool., 1.
[45] D. R. Dickey coll., 6; Univ. Mich., 1.
[46] J. K. Townsend's specimens: U. S. Nat. Mus., 1; Acad. Nat. Sci. Philadelphia, 1.
[47] Field Mus. Nat. Hist., 3; Mus. Comp. Zool., 1.
[48] Field Mus. Nat. Hist., 8; Mus. Comp. Zool., 1.
[49] D. R. Dickey coll.
[50] A. H. Helme coll.
[51] Amer. Mus. Nat. Hist., 11; Mus. Comp. Zool., 1; E. R. Warren coll., 2.
[52] Univ. Michigan.
[53] Amer. Mus. Nat. Hist., 6; A. H. Helme coll., 11.
[54] Amer. Mus. Nat. Hist., 12; D. R. Dickey coll., 5.
[55] Field Mus. Nat. Hist., 5; Amer. Mus. Nat. Hist., 1.
[56] Field Mus. Nat. Hist.
[57] State College Wash.
[58] Amer. Mus. Nat. Hist., 3; Mus. Comp. Zool., 1.
[59] Field Mus. Nat. Hist., 8; Amer. Mus. Nat. Hist., 1.
[60] Acad. Nat. Sci. Philadelphia.

County, 2; [43] Port Townsend, 1; Potlatch, Mason County, 1; [40] Puyallup, 1; [38] Quinault Lake, 7; Rochester, 2; Roy, 1; Seattle, 1; [61] Shelton, 5; Shoalwater Bay, 2; Silver Lake, 7 miles east of Castle Rock, 3; Skamania, 1; Soleduck Hot Springs, Clallam County, 1; Steilacoom, 5; Stevenson, Skamania County, 2; Taholah, Chehalis County, 1; Tenino, 3; Tokeland, 2; Toledo, 3; Vancouver, 1.

EUTAMIAS TOWNSENDII COOPERI (BAIRD)

COOPER'S CHIPMUNK

(PLS. 3, G; 7, G)

Tamias cooperi Baird, Proc. Acad. Nat. Sci. Philadelphia 7: 334, 1855; Mamm. North Amer.: Expl. and Surv. R. R. Pac., p. 301 (footnote), 1857.
Tamias townsendii var. *cooperi* Baird, Mamm. North Amer., pl. 5, fig. 2, 1857.
Eutamias cooperi Lyon, Smiths. Misc. Coll. 50: 89, 1907.

Cotypes.—Collected at Klickitat Pass, Cascade Mountains, Skamania County, Wash. (altitude, 4,500 feet)[62], July, 1853, by J. G. Cooper; No. $\frac{2\,1\,1\,2}{1\,1\,8\,3}$, United States National Museum; adult (unsexed), skin and portion of skull; No. 4754, Museum Comparative Zoology, Harvard University (formerly No. $\frac{2\,1\,1\,1}{1\,1\,8\,2}$, United States National Museum); adult, skin only.

Geographic distribution.—Cascade Range (both slopes) in Washington and Oregon and higher parts of the Olympic Mountains, Wash.; north to southwestern British Columbia (near Hope); south in the Cascades to Three Sisters, Oreg., and in western Oregon to southern Douglas County (Glendale); east to Lake Chelan and Wenatchee, Wash., west to Reston, Oreg. *Zonal range:* Canadian; 1,100 feet (Lake Chelan) to 6,500 feet altitude. (Fig. 7.)

Characters.—Similar to *Eutamias t. townsendii* but decidedly paler and less tawny; light dorsal stripes distinctly whitish; sides of face paler buff; feet paler (less ochraceous); tail paler beneath; skull slightly smaller.

Color.—*Summer pelage* (August): Top of nose fuscous black; top of head mixed pinkish buff, smoke gray, and fuscous, bordered on each side with an indistinct line of fuscous; light facial stripes cream white; dark facial stripes cinnamon buff, shaded with fuscous; ears fuscous anteriorly, smoke gray posteriorly; dark dorsal stripes black or fuscous black, the outer pair usually paler, becoming indistinct anteriorly, all moderately sprinkled with cinnamon buff; light dorsal stripes grayish white, the median pair washed with cinnamon buff; sides pale cinnamon buff; rump and thighs similar but more drab in tone; hind feet pinkish buff, clouded with fuscous; front feet similar but paler; tail above, fuscous black, sprinkled with grayish white; tail beneath, clay color, bordered with fuscous black and tipped with grayish white; underparts grayish white, tinged with cream color. *Winter pelage* (April 1, Mount Hood, Oreg.): Similar to the summer pelage, but slightly darker, the dorsal surface more washed with ochraceous tawny and the dorsal stripes less clear white.

Molt.—A specimen (♀ adult) from Entiat River, Wash., July 9, and one (♂ adult) from Glendale, Oreg., June 12, show the summer pelage just beginning to appear on the head and fore back. In a specimen from Anchor, Oreg., August 7, the fresh summer pelage covers the anterior half of the back and most of the sides.

Skull.—Similar to that of *E. t. townsendii* but averaging smaller, with narrower rostrum.

Measurements.—Average of 10 adults from Cascades of southern Washington (Mount Adams, Signal Peak, and McAllister Meadows, Tieton River): Total

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[38] Mus. Comp. Zool.
[40] D. R. Dickey coll.
[43] Amer. Mus. Nat. Hist.
[61] Kans. Univ. Mus.
[62] Cf. Cooper, Amer. Nat. 2: 531, 1869.

length, 250.3 (238–263); tail vertebræ, 112.2 (102–120); hind foot, 35.7 (34–38); ear from notch, 16.8 (15–18). *Skull:* Greatest length, 37.9 (36.8–38.7); zygomatic breadth, 21.3 (20.6–22); cranial breadth, 16.2 (15.7–16.5); interorbital breadth, 8.3 (8–8.7); length of nasals, 11.9 (11.4–12.4).

Remarks.—Cooper's chipmunk in its typical form is a well-marked, paler race of *townsendii*, as is usually the case with the forms occupying the Cascades, in contrast to the richly colored forms living in the humid coast region.

Intergradation with *townsendii* takes place all along the west base of the Cascades; intermediate specimens have been examined from Roab's Ranch, near Hope, British Columbia; from the vicinity of McKenzie Bridge, Oreg.; and from many other localities in Oregon and Washington.

The series from Mount Rainier and the Olympic Mountains, Wash., are somewhat darker than typical *cooperi*, but are best referred to that form; on the north slopes of the Olympics, this race descends to very low altitudes, specimens from 4 miles southwest of Port Angeles at an altitude of 800 feet, being much nearer to *cooperi* than to *townsendii*.

A large series in winter pelage from Glendale, Oreg., is intermediate between *cooperi* and *townsendii*, but apparently nearer to the former; although this series might be expected to show approach to *siskiyou*, which occurs on the slopes of the Siskiyou Range, less than 30 miles southwest of Glendale, such is not the case, and apparently the two races do not intergrade at this point.

Specimens examined.—Total number, 333, as follows:

British Columbia: Chilliwack Lake, 6; [63] Chilliwack Valley, 2; [63] Cultus Lake 1; [63] Hope, 18; [64] Huntingdon, 11; [63] Lihumption Park, 1.[63]

Oregon: Anchor, 7; Bald Mountain, head of Clackamas River, 1; Blue River, 2; Cascade Mountains (east base, southeast of Mount Hood), 2; Detroit, 7; Glendale, 33; McKenzie Bridge (including O'Leary Mountain, 10 miles south), 16; Mount Hood, 9; Parkdale, 3; Permelia Lake, west base of Mount Jefferson, 11; Reston, 2; Vida, 3; Wapinitia, 1.

Washington: American Lake, Pierce County, 1; [65] Barron (5,000 feet altitude), 3; Beaver Creek, Whatcom County (2,500 feet altitude), 3; Beaver Pass, Whatcom County, 1; Blewett Pass, Kittitas County, 1; Buck Creek Pass (head of Suiattle River, Snohomish County, 1; Bumping Lake, Yakima County, 5; Canyon Creek, Clallam County, 2; Cascade Mountains, Skamania County (60 miles east of Toledo), 1; Cascade Tunnel, Chelan County, 2; Chilliwack Creek, Whatcom County (30 miles east of Glacier), 5; Dosewallips River, Jefferson County (headwaters, 4,500 feet altitude), 3; Easton, 6; Elwha, Olympic Mountains, 1; [66] Elwha River, Jefferson County (2,750 feet altitude), 4; Entiat River (20 miles from mouth), 11; Fort Simcoe (9 miles southwest), 1; Glacier, Whatcom County, 1; Goose Prairie, Bumping River, 1; [66] Hoh River, Clallam County (5,000 feet altitude), 1; Husam, 2; Index, 1; [66] Index Peak (2,700 feet altitude), 5; Keechelus Lake, 11; Klickitat Pass, Skamania County, 2; [67] Lake Chelan (head), 10; Longmire, 1; [66] Martin, Kittitas County, 3; [65] McAllister Meadows, Tieton River, 5; Mount Adams (Gotchen Creek, 3,500 feet altitude), 6; Mount Aix (head Hindoo Creek, 6,500 feet altitude), 2; Mount Angeles (6,000 feet altitude), 4; Mount Rainier (2,000 to 6,000 feet altitude), 39; Mount Stuart, 1; [66] Nooksak River (14 miles east of Glacier), 2; Port Angeles (4 miles southwest, on Frazier Creek), 3; Quinault River (head of north fork, 4,000 feet altitude), 4; Ruby Creek, Whatcom County, 3; Scenic, King County, 3; Seven Lakes Basin, Clallam County, 1; Snoqualmie Pass, King

[63] Nat. Mus. Canada.
[64] Mus. Comp. Zool., 13; Nat. Mus. Canada, 5.
[65] Acad. Nat. Sci. Philadelphia.
[66] State College Wash.
[67] Mus. Comp. Zool., 1.

County, 1; Stehekin, 12; Stevens Pass (King and Chelan Counties), 4; Swamp Creek, Nooksak River, 1;[66] Teanaway River (north fork, 6 miles south of Mount Stuart), 4; Trout Lake, Klickitat County, 3; Twin Sister Lakes (near Cowlitz Pass, Yakima County), 1; Wenatchee (mountains near), 5; Wenatchee Lake, 1; White Salmon, 1; Winchester Mountain, Whatcom County (5,200 feet altitude), 1; Signal Peak, Yakima Indian Reservation, 2.

EUTAMIAS TOWNSENDII OCHROGENYS Merriam

Redwood Chipmunk

(Pls. 3, h; 7, h)

Eutamias townsendi ochrogenys Merriam, Proc. Biol. Soc. Washington 11: 195, 206, July 1, 1897.

Tamias townsendi ochrogenys Elliot, Field Columbian Mus. Pub. Zool. 3: 182, 1903.

Type.—Collected at Mendocino, Calif., July 17, 1894, by J. E. McLellan; ♀ adult, skin and skull; No. 67182, United States National Museum (Biological Survey collection); original number, 1015.

Geographic distribution.—Coast region of southern Oregon and northern California, from Port Orford, Oreg., south to Freestone, Sonoma County, Calif., east to Gasquet and Willits, Calif. *Zonal range:* Transition; sea level to 2,700 feet altitude. (Fig. 7.)

Characters.—Similar to *Eutamias t. townsendii*, but larger; general tone of upper parts and sides in winter pelage less tawny and more olivaceous; light dorsal stripes more whitish; postauricular patches larger; underparts strongly washed with pinkish buff.

Color.—Winter pelage (November): General tone of upper parts dark tawny olive; sides of nose and cheeks deep cinnamon buff or pale ochraceous tawny; dark facial stripes fuscous, not sharply defined; light stripes grayish, washed with pinkish cinnamon; ears fuscous, broadly margined posteriorly with pale smoke gray; postauricular patches pale smoke gray; dark dorsal stripes fuscous black, scarcely reaching to the rump, the outer pair becoming indistinct anteriorly; median pair of light stripes tawny olive, often washed with grayish; outer pair grayish white, sometimes clouded with ochraceous tawny; sides tawny olive; rump and thighs Saccardo's umber; hind feet pinkish cinnamon or clay color, more or less shaded with tawny olive; front feet similar but paler; tail above, fuscous black, sprinkled with smoke gray; tail beneath, mikado brown or sayal brown, bordered with fuscous black and edged with smoke gray; underparts grayish white, strongly washed with pinkish buff or light pinkish cinnamon. *Summer pelage* (July–September): General tone of upper parts more tawny than in winter; median pair of light dorsal stripes usually whitish, like the outer pair; sides of nose and cheeks between cinnamon and tawny; sides of body tawny; underparts cinnamon buff.

Molt.—The beginning of the summer molt is shown by a specimen (♂ adult) from Cazadero, Calif., July 4, 1894, in which the new pelage has appeared on the head and in an irregular shaped patch on the nape and fore back. In a specimen (the type, ♂ adult) from Mendocino City, Calif., July 17, 1894, the new pelage covers the anterior portion of the body to the middle of the back, except for a patch on the right shoulder, where an area of old pelage still persists. On the underparts the new pelage extends a little farther back than on the upper parts, and an isolated patch of new hair shows on the right groin. The fall molt is well shown by a specimen from Mendocino City, November 7, in which the winter pelage is coming in thickly on the rump and hinder back.

Skull.—Similar to that of *E. t. townsendii* but averaging larger, with slenderer rostrum.

Measurements.—Average of 12 adults from type locality: Total length, 265.2 (252–277); tail vertebræ, 116.2 (107–126); hind foot, 37.7 (37–39); ear from notch, 17 (15–18). *Skull:* Average of seven adults from type locality: Greatest length, 40.1 (39–40.8); zygomatic breadth, 22.1 (21.7–22.4); cranial breadth, 16.8 (16.4–17.2); interorbital breadth, 8.8 (8.4–9.6); length of nasals, 12.6 (11.9–13.7).

[66] State College Wash.

Remarks.—The Redwood chipmunk is the largest and darkest member of the genus, occupying a narrow strip of humid forest along the coast of southern Oregon and northern California. A short distance back from the coast, it passes into the subspecies *siskiyou*. Specimens intermediate between these two races have been examined from Gasquet [68] and Dyerville, Calif. The present form apparently does not intergrade, however, with either *alleni* or *sonomæ*.

Specimens examined.—Total number, 319, as follows:

California: Arcata, 1; [69] Alton Junction, Humboldt County, 2; Bayside, Humboldt County, 1; [69] Cahto, 2; Camp Meeker, 9; Carlotta, Humboldt County, 2; [70] Carson Camp, Humboldt Bay, 20; Cazadero, 17; [71] Crescent City, 26; Cuddeback, Humboldt County, 5; [69] Dyerville, 3; Eureka, 7; [69] Fair Oaks, Humboldt County, 17; [69] Freestone, 11; [69] Freshwater, Humboldt County, 2; [69] Gasquet, Del Norte County (at junction of Smith River and Stony Creek), 11; Gualala, 34; [72] Hardy, Mendocino County, 2; [73] Humboldt Bay, 4; Lake Leonard, Mendocino County, 1; [69] Laytonville (6 miles southwest), 2; [69] Mad River, Humboldt County, 1; [69] Mendocino, 72; [74] Orick, Humboldt County, 5; Philo, 2; [75] Rio Dell, 3; Sherwood, 33; [72] Smith River, Del Norte County, 3; Trinidad, 4; [69] Upper Mattole (20 miles southeast), 1; Willits, 1.[69]

Oregon: Goldbeach, 11; [75a] Port Orford, 3; Rogue River Mountains, 1.

EUTAMIAS TOWNSENDII SISKIYOU Howell

Siskiyou Chipmunk

(Pls. 3, j; 7, j)

Eutamias townsendii siskiyou Howell, Journ. Mamm. 3: 180, August 4, 1922.

Type.—Collected near summit of White Mountain, Siskiyou Mountains, Calif. (altitude, 6,000 feet), September 16, 1909, by Ned Hollister; ♀ adult, skin and skull; No. 161033, United States National Museum (Biological Survey collection); original number, 3432.

Geographic distribution.—Siskiyou Mountain region of northern California and southern Oregon; north to southern Douglas County (east of Drew), Oreg.; south to Van Dusen River, Humboldt County, Calif. *Zonal range:* Canadian. (Fig. 7.)

Characters.—Nearest to *Eutamias townsendii senex*, from which it differs in darker coloration of the upper parts and sides, the rump and thighs especially being much more brownish (less grayish). Compared with *ochrogenys:* Coloration much more grayish (less brownish); light dorsal stripes grayish white instead of tawny olive; sides of head and face much less ochraceous; underparts more whitish, only faintly washed with pinkish buff; tail paler beneath. Compared with *sonomæ:* Coloration in winter pelage paler and more grayish (less tawny); in summer pelage general tone of upper parts more brownish, lacking the bright cinnamon wash on back and sides of *sonomæ;* ears with distinct whitish patches on posterior border.

Color.—*Winter pelage* (October): Top of head fuscous sprinkled with pinkish cinnamon and grayish white; sides of nose pinkish cinnamon; dark facial stripes sayal brown, shaded with fuscous; light facial stripes buffy whitish; ears fuscous black, the posterior half grayish white; postauricular patches pale smoke gray; median dorsal stripes black; outer pair fuscous black, overlaid with sayal brown; light dorsal stripes grayish white, the outer pair usually purer white; sides sayal

[68] Gasquet is on Smith River at the mouth of Stony Creek, and about 5 miles east of the eastern limit of the redwood forest; these intermediate specimens, therefore, were taken very close to the edge of this forest.
[69] Mus. Vert. Zool.
[70] D. R. Dickey coll., Pasadena, Calif.
[71] Mus. Vert. Zool., 12.
[72] Mus. Vert. Zool., 23.
[73] Mus. Vert. Zool., 1; D. R. Dickey coll., 1.
[74] Mus. Vert. Zool., 22.
[75] Amer. Mus. Nat. Hist., 1; Mus. Comp. Zool., 1.
[75a] Field Mus. Nat. Hist., 9.

brown or clay color; rump and thighs mixed sayal brown and smoke gray; hind feet tawny olive or clay color, the toes cinnamon buff; front feet similar, but paler; tail above, fuscous black, overlaid with pale smoke gray; tail beneath, ochraceous tawny, bordered with fuscous black and edged with pale smoke gray; underparts grayish white, faintly washed with pinkish buff. *Summer pelage* (Siskiyou, Oreg., October): General tone of upper parts more tawny (less grayish) than in winter pelage; outer pair of light dorsal stripes clear grayish white; inner pair much clouded with cinnamon; sides ochraceous tawny; otherwise, as in winter pelage.

Molt.—The fall molt is well shown by a male specimen from Siskiyou, Oreg., September 29, and a female from Shelley Creek, Siskiyou Mountains, Calif., October 18, in each of which the rump and hinder back are covered with the fresh winter pelage.

Skull.—Similar to that of *ochrogenys* but averaging smaller.

Measurements.—Average of 10 adults from Siskiyou Mountains (Preston Peak), Calif.: Total length, 255.3 (250–268); tail vertebræ, 110.8 (98–117); hind foot, 36.5 (35–38); ear from notch, 16.6 (15–18). *Skull:* Average of 10 adults from Siskiyou Mountains: Greatest length, 38.9 (38.1–39.5); zygomatic breadth, 21.5 (20.7–21.9); cranial breadth, 16.2 (16–16.5); interorbital breadth, 8.4 (8.1–8.7); length of nasals, 12.9 (12.1–13.6).

Remarks.—The Siskiyou chipmunk is a connecting link between *ochrogenys* and *senex*, intergrading with the former along the west base of the mountains near the coast and with the latter on the west slopes of the Cascades of southern Oregon. Although, of course, it is intermediate in characters between the two races, it nevertheless has well-defined characters distinguishing it from either and occupies an area of considerable breadth. It apparently intergrades also with *sonomæ*, as indicated by a series of specimens from Hoopa Valley, Calif. (See under *sonomæ*, p. 118.)

Three specimens from Van Dusen River, Humboldt County, Calif., are apparently typical *siskiyou*, but material is lacking to show just how this form reaches this point from its main range in the Siskiyou Mountains.

Specimens examined.—Total number, 174, as follows:

California: Salmon Mountains (west of Etna Mills), 9; Salmon Mountains (west of forks of Salmon), 3; Siskiyou Mountains, 92 (Preston Peak, 35; Shelley Creek, 24; White Mountain, 33); Van Dusen River, Humboldt County (12 miles east of Bridgeville), 3.

Oregon: Agness, 1;[76] Ashland Peak (Mount Wagner, south of Ashland), 13; Drew ("halfway between Drew and Crater Lake"), 4; Farren Ranger Station (on Briggs Creek, 18 miles southwest of Galice), 8; Siskiyou, 40; Three Sisters (west base, 5,000 feet altitude), 1.

EUTAMIAS TOWNSENDII SENEX (Allen)

Large Mountain Chipmunk

(Pls. 3, 1; 7, 1)

Tamias senex Allen, Bul. Amer. Mus. Nat. Hist. 3: 83, June, 1890.
Eutamias senex Merriam, Proc. Biol. Soc. Washington 11: 194, 196, July 1, 1897.

Type.—Collected at Summit of Donner Pass, Placer County, Calif., July 1, 1885, by L. Belding; adult, skin and skull; No. 186461, United States National Museum (formerly No. 1133, Merriam collection).

Geographic distribution.—Higher parts of the Sierra-Cascade system, from the Warm Springs Indian Reservation, Oreg., south to the headwaters of the Merced River, Yosemite National Park, Calif.;

[76] Field Mus. Nat. Hist.

east to the Big Valley Mountains, Lassen County, and the Warner Mountains, Modoc County, Calif.; west to the Salmon Mountains, on the line between Siskiyou and Trinity Counties, Calif.; and south in the interior coast range to southern Tehama County (head of Grindstone Creek). *Zonal range*· Canadian; 3,300 [77] to 9,000 [78] feet altitude. (Fig. 7.)

Characters.—Similar to *Eutamias townsendii siskiyou* but paler and more grayish, especially on the rump and thighs. Compared with *cooperi:* General tone of upper parts much more grayish (less ochraceous); sides brighter (more tawny) especially in summer pelage; light dorsal stripes clearer white; dark dorsal stripes more mixed with tawny.

Color.—Winter pelage (October to May): Top of head mixed pinkish cinnamon and fuscous, sprinkled with grayish white, bordered on each side with a stripe of fuscous; sides of nose cinnamon; dark facial stripes sayal brown, shaded with fuscous, with a blackish patch behind the eye; light facial stripes grayish white, tinged with buff; ears fuscous or fuscous black, bordered posteriorly with grayish white; postauricular patches grayish white; shoulders usually washed with smoke gray; dark dorsal stripes fuscous black, more or less mixed with mikado brown, the median stripe usually darkest; light dorsal stripes grayish white, the median pair sometimes faintly clouded with cinnamon; lateral stripes mikado brown; sides clay color; rump and thighs dark smoke gray or mouse gray; hind feet clay color or pale ochraceous tawny; the toes cinnamon buff; front feet cinnamon buff; tail above, fuscous black, overlaid with pale smoke gray; tail beneath, sayal brown or pale ochraceous tawny, bordered with fuscous black and edged with pale smoke gray; underparts creamy white. *Summer pelage* (July–September): Similar to the winter pelage, but sides darker (about sayal brown) and general tone of upper parts more ochraceous, lacking the grayish wash on shoulders and rump; median pair of light dorsal stripes often strongly mixed with pinkish buff.

Molt.—The summer molt may occur at any time during July or August, and exceptionally in September. An adult male from Sierra Buttes, Calif., June 27, and another from Mount Shasta, July 16, have the new pelage covering about two-thirds of the anterior portion of the body. A male from Summit [Donner], Calif., August 4, and a female from the same locality, August 12, have a little more than half the body covered by the new pelage. A breeding female from Wildwood, Trinity County, Calif., August 26, has the anterior half of the body covered by new pelage, the posterior half in much worn winter pelage. Another breeding female from Bear Creek, near Fort Crook, Calif., September 19, 1893, is apparently molting into summer pelage, although this is about the date to expect the fall molt into winter pelage. Specimens from Beswick, Calif., September 17 and 22, show the winter pelage beginning to invest the rump.

Skull.—Closely similar to that of *siskiyou* but averaging slightly smaller; practically identical with that of *townsendii;* larger than that of *cooperi* with broader rostrum.

Measurements.—Average of 10 adults from type region (Donner, Prattville, and Lake Tahoe): Total length, 243.3 (229–258); tail vertebræ, 102.9 (95–112); hind foot, 36.3 (35–38); ear from notch, 17.2 (15–19). *Skull:* Average of 11 adults from type locality: Greatest length, 38.4 (37.3–39.8); zygomatic breadth, 21.4 (20.5–22.2); cranial breadth, 16.3 (15.6–16.8); interorbital breadth, 8.4 (7.8–9); length of nasals, 12.3 (11.6–12.7). *Weight:* Average of 31 specimens, 89.6 grams (70.3–123.2).

Remarks.—The large mountain chipmunk is the palest and grayest of the races of *townsendii.* It has an extensive range in California and Oregon and shows comparatively little variation over its entire range in the Sierra-Cascade system. In northwestern California and southwestern Oregon it grades into the dark form recently described as *siskiyou;* large series of specimens in both pelages from the Trinity and Salmon Mountains are variously intermediate between these two forms, but nearer on the whole to *senex;* the darkest specimens are

[77] Specimens from Greenville, Plumas County.
[78] Specimens from south fork American River (head) and from Cloud's Rest Trail, Yosemite Park.

from Wildcat Peak and Jackson Lake, near the north end of Salmon Mountains, some individuals from these places being almost as dark as *siskiyou*, while others are nearer *senex;* in all of those from the Trinity region the underside of the tail is darker than in typical *senex*. The series from South Yolla Bolly Mountain is nearest to *senex* but several specimens apparently show approach to *sonomæ* in having more ochraceous mixed in the dorsal stripes and the hind feet paler.

Specimens examined.—Total number, 720, as follows:

California: South fork American River (near head), 2; Aspen Valley, Yosemite National Park, 1;[79] Baird, 1; Battle Creek Meadows, Tehama County (10 miles south of Lassen Peak), 1; Bear Creek, Shasta County, 4; Bear Creek (near head), Trinity County (Mount Eddy), 25;[79] Beswick, 21; Big Valley Mountains, Lassen County, 15; Buck Ranch, Plumas County (5 miles north of Mount Ararat), 5; Burney (12 miles west), 1; Campbell Hot Springs (near Sierraville), 1;[79] Canby (20 miles northwest), Modoc County, 1;[79] Canby (10 miles north), 1; Canyon Creek, Trinity County, 6; Carberry Ranch, Shasta County (12 miles west of Burney), 44; Cascade Creek, Yosemite National Park, 1;[79] Castle Lake, Siskiyou County, 35;[79] Chaparral, Butte County (about 23 miles southwest of Prattville), 21;[80] Cisco, Placer County, 32;[79] Cloud's Rest Trail, Yosemite National Park, 1;[79] Coffee Creek (north fork) Trinity County, 8;[79] Crane Flat, Mariposa County, 1;[79] Donner, 22; Donner Pass, 1;[79] Echo, Eldorado County, 2;[81] Echo Creek Basin, Yosemite National Park, 1;[79] Eagle Lake, Lassen County, 1;[79] Emerald Bay, Lake Tahoe, 11; Fallen Leaf Lake, 3;[79] Fall River Mills, Shasta County, 1; Fall River Valley, 1; Fort Bidwell, Modoc County, 8;[82] Fort Crook, Shasta County, 25; Glen Alpine Springs, Eldorado County, 1;[79] Glenn Aulin, Tuolumne River, Yosemite National Park, 2;[79] Goose Nest Mountain, Siskiyou County, 3; Greenville, 11; Grizzly Creek, Trinity County, 4;[79] Grizzly Mountains, Plumas County, 4; Grindstone Creek, Tehama County (6,500 feet altitude), 3; Hermit Valley, Calaveras County, 2;[82] Hat Creek Valley, Shasta County, 2; Hot Springs Valley, Plumas County, 1; Independence Lake, Nevada County, 6;[79] Indian Canyon, Mariposa County, 10;[79] Jackson Lake, Siskiyou County (Salmon Mountains), 14;[79] Johnson Pass, Placer County, 1;[79] Johnsville, Plumas County, 2;[79] Kangaroo Creek, Siskiyou County, 1;[79] Lake Tahoe, 6;[83] Lassen Creek, Modoc County, 1; Little Yosemite, 1; Lyonsville, Tehama County, 4; Markleeville, 2; McCloud, 6; McCloud River (near Bartle), 5; McKinney, Lake Tahoe, 5; Merced Lake, Yosemite National Park, 11;[79] Merced River (near head), 5; Mohawk, Plumas County, 3; Mono Meadows, Yosemite National Park, 10; Mount Shasta, 61; Mount Tallac, 24;[84] Parker Creek, Warner Mountains, 1;[79] Picard 1; Prattville, 5; Plumas County, 1;[85] Porcupine Flat, Yosemite National Park, 1;[79] Pyramid Peak, Eldorado County, 6;[86] Quincy, 28; Rush Creek, Siskiyou County (Salmon Mountains), 3;[79] Salmon River, Siskiyou County (south fork, at 5,000 feet altitude), 2;[79] Shasta County, 1; Shasta Valley, 1; Shingletown, Shasta County, 1; Sierra Buttes, Sierra County, 2; Sierra City, 1; Sierra Valley, Plumas County, 1; Silver Creek, Alpine County, 1; Silver Lake, Amador County, 5;[82] Sisson, 13; Slippery Ford, Eldorado County, 1;[81] South Yolla Bolly Mountain, 10;[79] Squaw Creek Valley, Shasta County, 6; Stanislaus River, Calaveras County (north fork, at 6,700 feet altitude), 1; Sugar Hill, Modoc County, 6;[79] Susanville, 4;[79] Tallac, Eldorado County, 2; Tamarack Flat, Mariposa County, 1;[79] Tuolumne River, Yosemite National Park, 2;[79] Warner Creek, Shasta County (southeast base of Mount Lassen), 1; Washburn Lake, Merced River, Yosemite National Park, 2;[79] Wildcat Peak, Siskiyou County (Salmon Mountains,) 3;[79] Wildwood, Trinity County, 1; Chinquapin, Yosemite National Park, 5;

[79] Mus. Vert. Zool.
[80] Amer. Mus. Nat. Hist., 19; Colorado Agr. College, 2.
[81] Mus. Comp. Zool.
[82] Amer. Mus. Nat. Hist.
[83] Kans. Univ. Mus.
[84] Acad. Nat. Sci. Philadelphia, 7; Mus. Comp. Zool., 7; Amer. Mus. Nat. Hist., 1.
[85] Carnegie Mus.
[86] Amer. Mus. Nat. Hist., 5; Mus. Comp. Zool., 1.

Yosemite Valley, 1;[79] Yosemite Creek, Yosemite National Park, 1;[79] Yosemite Falls, 1;[79] Yosemite Point, 7;[79] Willow Creek Valley, 1;[82] Woodfords, Alpine County, 2.

Nevada: Glenbrook, 2.

Oregon: Arnold Ice Cave, 2; Bend, 3; Crater Lake, 15; Fort Klamath, 18; Klamath Falls, 2;[85] Klamath Marsh, 1; Lakeview, 1; Mount Mazama (Anna Creek), 2; Naylox, 2; Paulina Lake, 3; Prospect, 12; Silverlake (west Silver Creek, 4,650 feet altitude), 1; Warm Springs (20 miles west, on Mill Creek), 7; Yamsay Mountains, 2.

EUTAMIAS TOWNSENDII SONOMÆ GRINNELL

SONOMA CHIPMUNK

(PLS. 3, L; 7, L)

Eutamias sonomæ Grinnell, Univ. California Pub. Zool. 12: 321, January 20, 1915.
Eutamias townsendii sonomæ Howell, Journ. Mamm. 3: 184, August 4, 1922.

Type.—Collected at Guerneville, Sonoma County, Calif., July 12, 1913, by Joseph and Hilda W. Grinnell; ♀ adult, skin and skull; No. 20825, Mus. Vert. Zool., Univ. of California; original number, 2250.

Geographic distribution.—"Inner coast ranges and intervening valleys [of northern California] lying between the narrow coastal Redwood fauna on the west and the Sacramento fauna on the east" (Grinnell, 1915, p. 324); north to the Scott Mountains, Siskiyou County; south to Freestone and Vacaville; east to eastern slopes of the Coast Range; west to Briceland, Willits, and Guerneville. *Zonal range:* Transition; 900 to 4,500 feet altitude. (Fig. 7.)

Characters.—Similar to *Eutamias townsendii siskiyou*, but coloration in summer pelage brighter tawny; median pair of light dorsal stripes heavily mixed with pinkish cinnamon; head paler (more grayish); sides of nose paler buff; facial stripes clearer white; hind feet paler; in winter pelage head and upper parts more brownish (less grayish); sides darker tawny; tail darker both above and below. Compared with *ochrogenys:* Size smaller; upper parts in winter pelage decidedly more tawny (less olivaceous); sides of face less extensively washed with buff; light dorsal stripes more whitish; underparts whitish instead of buff; tail darker beneath; in summer pelage, upper parts and sides much paler tawny; sides of head and face without ochraceous wash; the facial stripes white instead of buff; top of head much paler; hind feet paler; underparts whitish instead of buff. Compared with *senex:* Upper parts much darker and more tawny (less grayish), especially in winter pelage; head darker in winter, but more grayish (less buffy) in summer; hind feet less buffy (more grayish) especially in summer; tail longer, the under surface darker, especially in winter.

Color.—*Summer pelage* (July–September): Top of head pale smoke gray, mixed with sayal brown and bordered with fuscous; light facial stripes grayish white; postocular streak fuscous, shaded with sayal brown; submalar stripe similar but paler, and shading anteriorly to cinnamon; ears sayal brown anteriorly, mouse gray posteriorly; postauricular patches creamy white; shoulders and fore back between pinkish cinnamon and cinnamon buff, shaded with fuscous; median dorsal stripe blackish, bordered with cinnamon; outer pair of dark dorsal stripes black or fuscous black, more or less overlaid with ochraceous tawny; median pair of light stripes smoke gray, sprinkled with cinnamon and largely overlaid with a wash of that color on anterior back; outer pair of light stripes clear creamy white; lateral stripes nearly obsolete; sides ochraceous tawny; rump and thighs mouse gray, mixed with cinnamon buff; hind feet cinnamon buff, shading on inside of legs to light pinkish cinnamon; tail above, fuscous black, sprinkled with pale buff; tail beneath, between tawny and ochraceous tawny, bordered with fuscous black and edged with tilleul buff; underparts creamy white, sometimes faintly tinged with pale pinkish cinnamon. *Winter pelage* (Christine, Calif., November 18): Similar to the summer pelage but darker; head vandyke

[79] Mus. Vert. Zool. [82] Amer. Mus. Nat. Hist. [85] Carnegie Mus.

brown, sprinkled with grayish white; dark facial stripes vandyke brown, shaded with blackish; ears fuscous anteriorly, smoke gray posteriorly; median dorsal stripe blackish, edged with russet; outer dorsal stripes russet, shaded with blackish; sides dull tawny sprinkled with fuscous and shading above to russet; light dorsal stripes pale smoke gray, the median pair faintly washed with tawny; thighs hair brown, sprinkled with grayish white; hind feet cinnamon buff, shaded with fuscous; tail above, sayal brown, overlaid with blackish and sprinkled with grayish white; tail beneath, hazel bordered with blackish and edged with grayish white; underparts creamy white.

Molt.—The change from summer to winter pelage is shown by several specimens from Lower Lake, Calif., October 24 to 27, in which the new pelage covers the posterior half of the body.

Skull.—Similar to that of *siskiyou* but averaging narrower across zygomata, and nasals averaging shorter; decidedly smaller than that of *ochrogenys*.

Measurements.—Average of 10 adults from Sonoma and Mendocino Counties: Total length, 250.1 (220–264); tail vertebræ, 116.3 (100–126); hind foot, 37 (35.5–39); ear from notch, 17.2 (15.5–19). *Skull:* Average of 10 adults from Sonoma and Lake Counties: Greatest length, 38.7 (38–39.7); zygomatic breadth, 20.8 (19.4–21.3); cranial breadth, 16.1 (15.4–16.5); interorbital breadth, 8.9 (8.4–9.2); length of nasals, 11.9 (11.3–12.7).

Remarks.—The Sonoma chipmunk is one of the brightest and handsomest forms in the *townsendii* group. Its subspecific relationship to the *townsendii* group is proved by a series from Hoopa Valley, which shows intergradation with *siskiyou* in having darker feet than typical *sonomæ*, less of an ochraceous wash on the upper parts, and whitish patches on the ears. More than half of this series show intermediate characters; three agree closely with *sonomæ*, and one with *siskiyou*.

In the Salmon Mountains, west of Etna Mills, however, the ranges of *sonomæ* and *siskiyou* meet and the two forms remain distinct. In the series of 20 from this locality, 11 taken in the valley are clearly referable to *sonomæ*, while 9 taken near the summit of the mountains at about 6,000 feet altitude, are just as certainly *siskiyou*. On the west slope of the same range, at an altitude of 3,300 feet, 1 specimen of *sonomæ* and 3 of *siskiyou* were taken at the same or near-by points.

Intergradation with *senex* is suggested (if not proved) by the series from South Yolla Bolly Mountain. Farther east, however, *sonomæ* seems to intrude into the range of *senex*, notably at Dana and Fort Crook, Shasta County, from which localities 13 practically typical specimens have been examined; whereas a large series from Fort Crook and from Big Valley Mountains, east of Dana, are clearly referable to *senex*.

Specimens in winter pelage from Christine and Eel River (Mendocino County) are somewhat darker on the upper parts of body and on underside of tail, perhaps indicating gradation toward *ochrogenys*. A specimen in winter pelage from Philo, Mendocino County, Calif., agrees closely in color with typical *sonomæ;* its skull, however, is slightly larger than that of *sonomæ*. Two specimens of typical *ochrogenys* also have been examined from this locality. At Freestone and at a point 7 miles west of Cazadero, both *sonomæ* and *ochrogenys* occur in their typical forms, and Grinnell states (1915, p. 324) that the two races were taken in the same line of traps.

Specimens examined.—Total number, 240, as follows.

California: Berger Creek (near Sherwood), 1; Bricelland, Humboldt County, 1; Cahto, 8; Calpella, 1; Castle Peak, Mendocino County, 1;[87] Cazadero (7 miles west), 15;[87] Christine, Mendocino County, 1;

[87] Mus. Vert. Zool.

Cloverdale, 6; Coast Range, Tehama County (17 miles west of Paskenta) 1; Cold Creek (between Ukiah and Blue Lakes), 2; Covelo, 9;[87] Dana, 11; Eel River, southwest of South Yolla Bolly Mountain, 1; Eel River (ridge between Eel River and Berger Creek), 1; Etna Mills, 3; Fort Crook, Shasta County, 2; Freestone, Sonoma County, 2;[87] Guerneville, 6;[87] Harris (20 miles south), 1; Hermitage, 1; Hoopa, 2; Hoopa Valley 8; Kunz, Trinity County, 1;[87] Lakeport, 8;[88] Laytonville, 5; Lierley's Ranch, Sanhedrin Mountain, Mendocino County, 1; Long Valley, Mendocino County (near Sherwood), 1; Lower Lake, 30;[89] Mad River, Trinity County, 1; Mount St. Helena, 18; Mount Veeder (6 miles north of Sonoma), 4; Philo, 1; Post Creek, Trinity County, 1; Redding, 3;[90] Rumsey, Yolo County, 3;[87] St. Helena, 1;[90] Salmon Mountains, Siskiyou County (near Etna Mills), 11; Sanhedrin Mountain, Mendocino County (4,500 feet altitude), 24;[87] Scott River, Siskiyou County (near Callahan), 10;[87] Scott Mountains (west of Gazelle), 1; Scott Valley (4 miles south of Fort Jones), 1; Sheetiron Mountain, Glenn County, 2; Sherwood, 10; Snow Mountain, Colusa County, 5;[91] Vacaville, 5;[87] Weaverville, 2; Willits, Mendocino County, 7.

EUTAMIAS ALLENI Howell

Marin Chipmunk

(Pls. 3, k; 7, k)

Tamias townsendii hindsii Allen, Bul. Amer. Mus. Nat. Hist. 3: 75, June, 1890 (not *Tamias hindsii* Gray).

Eutamias hindsi Merriam, Proc. Biol. Soc. Washington 11: 196, July 1, 1897, and of recent authors generally (not *Tamias hindsii* Gray).

Eutamias townsendii alleni Howell, Journ. Mamm. 3: 181, August 4, 1922.

Type.—Collected at Inverness, Marin County, Calif., November 16, 1904, by N. Hollister; ♂ adult, skin and skull; No. 135177, United States National Museum (Biological Survey collection), original number, 1378.

Geographic distribution.—Coast region of Marin County, Calif., from Point Reyes east to Mount Tamalpais (Grinnell, 1915, p. 324). *Zonal range:* Transition. (Fig. 7.)

Characters.—Similar to *Eutamias townsendii sonomæ* but slightly smaller; head and upper parts distinctly darker in both pelages; outer pair of light dorsal stripes usually strongly washed with buff; underparts averaging more buffy (less whitish); hind feet darker; tail averaging darker beneath; skull similar to that of *sonomæ* but averaging smaller. Compared with *E. t. ochrogenys:* Size much smaller; upper parts much brighter tawny (less olivaceous), especially in winter pelage; dorsal stripes more distinct, the dark stripes much more blackish, the light stripes more buffy; sides of face less extensively washed with ochraceous.

Color.—Summer pelage (July 30–September 5): Top of head fuscous sprinkled with smoke gray and cinnamon; dark facial stripes fuscous or fuscous black, shaded with cinnamon or tawny; light facial stripes grayish white, clouded with pinkish cinnamon; shoulders, foreback, and median pair of light dorsal stripes tawny or ochraceous tawny, the stripes mixed with whitish on posterior back; outer pair of light dorsal stripes dull whitish, washed with cinnamon buff; dark dorsal stripes black (rarely fuscous); lateral stripes fuscous black, often indistinct and obscured by color of sides; sides deep tawny; rump ochraceous tawny, more or less mixed with cinnamon; thighs mixed fuscous and cinnamon buff, sprinkled with grayish white; hind feet cinnamon or cinnamon buff, shaded with fuscous; front feet cinnamon buff; tail above, fuscous black, mixed with tawny; tail beneath, tawny, bordered with fuscous black and tipped with a small amount of pale tilleul buff; underparts grayish white moderately washed with light ochraceous buff or pinkish buff, shading around root of tail to cinnamon. *Winter pelage* (November–June): Similar to summer pelage but duller and more brownish (less tawny); dark dorsal stripes sometimes fuscous black; shoulders and sides ochraceous tawny, shaded with russet; median pair of light dorsal stripes grayish

[87] Mus. Vert. Zool.
[88] J. H. Fleming coll., 6.
[89] Mus. Comp. Zool., 9.
[90] Amer. Mus. Nat. Hist.
[91] Field Mus. Nat. Hist., 1; Mus. Comp. Zool., 4.

white, obscured on foreback with tawny; rump and thighs tawny olive, shaded with ochraceous tawny; underparts grayish white, faintly washed with tilleul buff or heavily washed with cinnamon buff.

Molt.—The beginning of the summer molt is shown by a specimen (♂ adult) from Olema, Calif., July 8, 1897, in which the new pelage covers about the anterior two-thirds of the dorsal surface and about one-third of the ventral surface. The fall molt is well shown by a specimen from Marin County, Calif., October 6, 1888, and one from Inverness, October 22, 1904, in both of which the new winter pelage has invested the rump and about half of the posterior back. In neither case is there a sharp line of demarcation between the pelages, but the color and character of the fur make the pelages easily recognizable.

Skull.—Similar to that of *sonomæ*, but averaging smaller.

Measurements.—Average of 10 adults from Marin County, Calif.: Total length, 239.5 (231–250); tail vertebræ, 106.8 (100–113); hind foot, 35.6 (34–37); ear from notch, 16.1 (15–18). *Skull:* Average of nine adults from Marin County: Greatest length, 37.9 (36.8–39.3); zygomatic breadth, 20.3 (19.2–20.9); cranial breadth, 15.5 (15–16.2); interorbital breadth, 8.5 (8.1–9); length of nasals, 11.9 (11.2–12.4).

Remarks.—This race has been recognized for many years under the name *Eutamias hindsii*. The writer has recently shown (Howell, 1922, p. 181) that the latter name is a synonym of *E. t. townsendii* and has renamed the present form.

The Marin chipmunk has a very restricted range, confined, according to Grinnell, to Marin County, and "separated from the ranges of both *ochrogenys* and *sonomæ* by a belt of country apparently unfit associationally for the existence of any one of this group of chipmunks" (Grinnell, 1915, p. 324). Like the other races occupying the humid coast belt, it is a dark and richly colored form, being, indeed, the reddest of them all. It differs widely from *ochrogenys*, its nearest neighbor on the coast to the northward, both in size and color, but is more like *sonomæ*, which occupies the interior valleys and foothills. These two forms, although evidently closely related, apparently do not intergrade, but occasional specimens in the two series are separated with difficulty. For example, a specimen of *alleni* from Lagunitas (United States National Museum, No. 177405, September 16) is closely matched by one of *sonomæ* from Laytonville (United States National Museum, No. 98542, September 11), the latter being slightly paler on the head and feet but almost identical in the color of the upper parts and the belly, which is creamy white. Similar close agreement is shown also by two specimens in winter pelage, one of *alleni* from Inverness (United States National Museum, No. 135177, November 16) and one of *sonomæ* from Philo (United States National Museum, No. 96168, November 23). Originally described as a subspecies of *townsendii*, it is now considered a distinct species.

Specimens examined.—Total number, 111, as follows:

California: [San] Geronimo, Marin County, 1[92]; Inverness, 17;[93] Lagunitas, 2; Mailliard, Marin County, 2;[94] Marin County, 3; Nicasio, 70;[95] Olema, 15; Point Reyes, 1.[94]

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[92] Mus. Comp. Zool.
[93] Mus. Vert. Zool., 12.
[94] Mus. Vert. Zool.
[95] Amer. Mus. Nat. Hist., 25; Mus. Comp. Zool., 8.

EUTAMIAS QUADRIMACULATUS (GRAY)

LONG-EARED CHIPMUNK

(PLS. 3, M; 7, M)

Tamias quadrimaculatus Gray, Ann. and Mag. Nat. Hist. 20 (ser. 3): 435, December, 1867.
Tamias macrorhabdotes Merriam, Proc. Biol. Soc. Washington 3: 25, January 27, 1886 (Blue Canyon, Placer County, Calif.).
Eutamias quadrimaculatus Merriam, Proc. Biol. Soc. Washington 11: 203, July 1, 1897.

Type.—Collected at Michigan Bluff, Placer County, Calif., November 1, 1862, by F. Gruber; skin, with skull inside; No. 64.7.19.8, British Museum; original number, 1024.

Geographic distribution.—Upper Transition Zone along west slope of the Sierra Nevada, Calif., from Mariposa County (Fish Camp, near Mariposa Big Trees) north to northern Plumas County (Greenville); east to Glenbrook, Nev. (one specimen). *Zonal range:* Transition and Lower Canadian; 3,200 [96] to 7,500 feet altitude. (Fig. 8.)

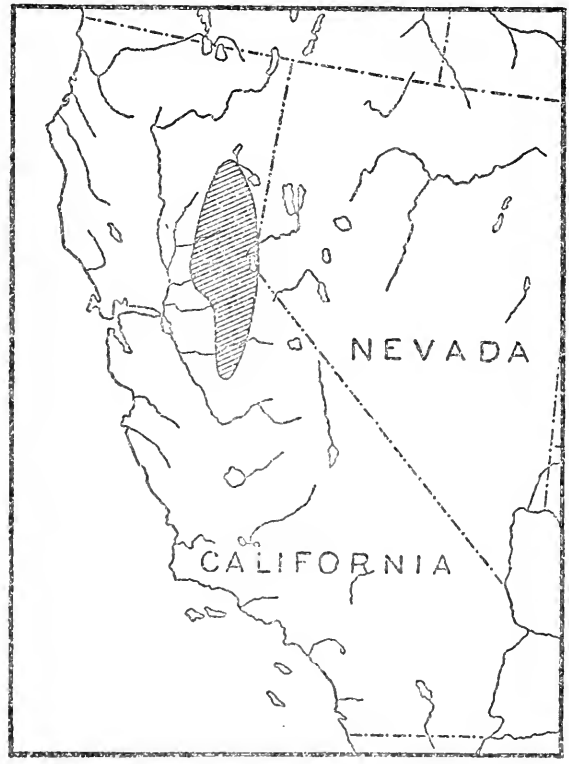

FIGURE 8.—Distribution of *Eutamias quadrimaculatus*

Characters.—Similar to *Eutamias townsendii sonomæ*, but ears and postauricular patches larger; general tone of head, upper parts, and sides in winter pelage paler; rump and thighs distinctly grayish (not brownish or ochraceous); light dorsal and facial stripes clearer white; tail paler, both above and below; hind feet brighter buff; in summer pelage upper parts very similar in tone, but dark stripes less blackish and rump distinctly grayish rather than ochraceous; tail similar beneath but more overlaid with grayish above; hind feet darker.

Compared with *E. townsendii senex:* Ears averaging slightly longer and narrower at tip; light facial stripes and postauricular patches clearer white and thus more conspicuous, strongly contrasting with the dark facial stripes, which are decidedly darker than in *senex;* whitish ear patches more extensive and more sharply defined; general tone of upper parts and sides in summer pelage darker tawny, the anterior portion of the median pair of grayish stripes more mixed with cinnamon or tawny; rump and thighs clearer gray (less ochraceous); tail darker beneath.

[96] Near Quincy, Plumas County.

Compared with *E. merriami merriami:* Ears much larger, with distinct whitish patches on posterior border; postauricular patches larger and much more distinct; dark facial stripes more blackish; upper parts in summer pelage more tawny (less grayish), the light dorsal stripes more creamy (less clear white), and median pair more mixed with tawny; rump darker and more grayish; hind feet darker cinnamon; tail slightly paler beneath, edged with gray instead of buff.

Color.—Winter pelage (topotypes, October 28–May 24): Top of head sayal brown mixed with grayish white and fuscous (the general tone near cinnamon drab), bordered on sides with fuscous; sides of nose clay color or sayal brown; dark facial stripes fuscous black, the submalar stripe shaded with mikado brown, very broad and reaching back beneath the ear to the postauricular patch; light facial stripes grayish white, the malar stripe extending beneath the ear and connecting with the large and prominent creamy white, postauricular patches; ears fuscous or fuscous black on anterior half, grayish white on posterior half; median dorsal stripe fuscous black; other dark stripes fuscous, all mixed with mikado brown; median pair of light stripes grayish white, frequently mixed with sayal brown; outer pair creamy white; sides sayal brown to snuff brown; rump and thighs neutral gray mixed with fuscous and sprinkled with grayish white; hind feet deep pinkish cinnamon or pinkish buff; front feet similar but paler; tail above fuscous black, overlaid with grayish white (the ochraceous bases of the hairs sometimes showing prominently); tail beneath, ochraceous tawny or mikado brown, bordered with fuscous black and edged with pale smoke gray; underparts grayish white. *Summer pelage* (August): Closely similar to the winter pelage, but upper parts more ochraceous (less grayish) in general tone, the foreback especially (including the median pair of light stripes) nearly always strongly washed with cinnamon; sides sayal brown to mikado brown; rump and thighs slightly more buffy (less grayish), with a faint wash of cinnamon buff.

Molt.—The summer molt apparently takes place rather late; an adult male specimen from Grizzly Mountain (Plumas County), Calif., August 12, and an adult female from Mohawk, Calif., August 10, have nearly completed this molt, the rump being the only part of the body showing the worn winter pelage. Two breeding females from Nevada City, Calif., taken August 8 and one from Fish Camp, Mariposa County, August 13, are still in worn winter pelage, with scarcely any indication of the beginning of the molt.

The fall molt occurs in October, as shown by a specimen from Nevada, Calif., No. 193222, United States National Museum, taken by E. W. Nelson in 1872 (exact date not recorded), in which the winter pelage has covered the tail and is investing the rump. A specimen (♀ adult) from Blue Canyon, Calif., October 9, 1885, is in full winter pelage.

Skull.—Similar to that of *E. townsendii senex* but averaging smaller, with narrower brain case, but slightly broader interorbitally; zygomata less widely expanded at posterior end; molars and incisive foramina smaller. Compared with *sonomæ:* Averaging smaller, but with relatively broader brain case and longer nasals. Compared with *E. merriami merriami:* Smaller and relatively broader, with shorter, broader rostrum.

Measurements.—Average of 12 adults from type locality: Total length, 238.7 (230–250); tail vertebræ, 104.3 (98–112); hind foot, 36 (35–37); ear from notch, 18.8 (17–20). *Skull.*—Average of nine adults from type locality: Greatest length, 37.4 (36.3–38.5); zygomatic breadth 20.3 (19.8–21.1); cranial breadth, 15.9 (15.5–16.6); interorbital breadth, 8.7 (8.3–9.5); length of nasals, 12.5 (11.3–13.4). *Weight:* Average of 22 specimens, 81.1 grams (73–105).

Remarks.—This handsome species clearly belongs in the *townsendii* group but apparently is not closely related to any of the species. Its closest affinity seems to be with *sonomæ*, as shown by the rather close resemblance in their skulls and by the general similarity in the color of the back in summer pelage; they are distinguished, however, as already shown, by many constant differences and in winter pelage are quite unlike. Their ranges, moreover, do not approach nearer than 65 miles. The range of *quadrimaculatus* overlaps that of *E. townsendii senex* at many places along the western slopes of the Sierra Nevada; and that of *E. merriami merriami* for a short distance in Mariposa County, but without any evidence of intergradation with those species.

Specimens examined.—Total number, 225, as follows:

California: South fork American River (at 5,000 feet altitude), 2; Aspen Valley, Yosemite National Park, 6;[97] Blue Canyon, Placer County, 77;[98] Camptonville, 1; Chinquapin, Yosemite National Park, 12;[97] Cisco, 8;[97] Damascus, Placer County, 1; Echo, Eldorado County, 7;[99] Emigrant Gap, Placer County, 3; Fish Camp, Mariposa County (near Mariposa Big Trees), 3; Forest Hill, Placer County, 1; Fyffe, Eldorado County, 6;[1] Greenville, 3; Grizzly Mountain, Plumas County, 7; Hodgdon Ranch, Tuolumne County, 1;[97] Hope Valley, Alpine County, 2;[97] Indian Canyon, Mariposa County, 1[97] Markleeville, 6; Merced Grove Big Trees, Mariposa County, 16;[97] Merrimac, Plumas County, 1; Michigan Bluff, 17;[2] Mohawk, Plumas County, 2; Nevada City, 10; Philipp's Station, Eldorado County, 1;[97] Placerville, 1;[99] Pyramid Peak, Eldorado County, 1;[3] Quincy, 10; Red Point, Placer County, 2;[4] Riverton, 2; Sequoia, Tuolumne County, 4; Slippery Ford, Eldorado County, 1;[99] North fork Stanislaus River, Calaveras County (6,500 feet altitude), 2; Gentry's, Yosemite National Park, 6;[97] Junction of Sunrise Trail and Cloud's Rest Trail, Yosemite National Park, 1.[97]

Nevada: Glenbrook, 1.

EUTAMIAS MERRIAMI (Allen)

[Synonymy under subspecies]

Characters.—Size medium to large; hind foot, 33–39 millimeters; skull length, 35.5–40.1; skull similar to that of *townsendii*, but rostrum narrower (laterally compressed at base); coloration similar in general to that of certain races of *townsendii* (*senex, siskiyou,* and *sonomæ*); ears more buffy (less grayish) and lacking the distinct grayish white border found in most of the races of *townsendii;* postauricular patches indistinct or obsolete; tail edgings more buffy (never distinctly grayish); top of head varying from pale smoke gray mixed with pinkish cinnamon to snuff brown or warm sepia; dark dorsal stripes snuff brown, mikado brown, sayal brown, russet, fuscous black, or black; light dorsal stripes grayish white or pale smoke gray, more or less shaded with cinnamon or brownish; rump and thighs varying from smoke gray or neutral gray to snuff brown; hind feet varying from pinkish buff to cinnamon or tawny olive; under surface of tail tawny, ochraceous tawny, or pale russet, edged with pinkish buff or tilleul buff; underparts creamy white, sometimes washed with pinkish buff.

EUTAMIAS MERRIAMI MERRIAMI (Allen)

Merriam's Chipmunk

(Pls. 3, n; 7, n)

Tamias asiaticus merriami Allen, Bul. Amer. Mus. Nat. Hist. 2: 176, October 21, 1889.

Tamias merriami Allen, Bul. Amer. Mus. Nat. Hist. 3: 84, June, 1890.

Eutamias merriami Merriam, Proc. Biol. Soc. Washington 11: 194–195, July 1, 1897.

Eutamias merriami mariposæ Grinnell and Storer, Univ. Calif. Pub. Zool. 17: no. 1, p. 4, August 23, 1916 (El Portal, 2,000 feet altitude, Mariposa County, Calif.).

Type.—Collected in the San Bernardino Mountains, Calif., due north of San Bernardino (altitude, 4,500 feet), June 13, 1887, by F. Stephens; ♀ adult, skin and skull; No. $\frac{11528}{7}$, American Museum of Natural History; original number, 482.

Geographic distribution.—Mountains of southern California, from Monterey and San Benito Counties south to the Mexican border in

[97] Mus. Vert. Zool.
[98] Amer. Mus. Nat. Hist., 18; Mus. Vert. Zool., 32; Mus. Comp. Zool., 8; Colo. Agr. College, 1; E. R. Warren coll., 2.
[99] Mus. Comp. Zool.
[1] Mus. Comp. Zool., 5; Mus. Vert. Zool., 1.
[2] Mus. Vert. Zool., 4.
[3] Amer. Mus. Nat. Hist.
[4] Amer. Mus. Nat. Hist., 1; Field Mus. Nat. Hist., 1.

San Diego County; also north through the Tehachapi and Piute Mountains and along the western foothills of the Sierra Nevada to Mariposa County (Coulterville and Yosemite Valley); east to Onion Valley, on the eastern slope of the Sierra Nevada. *Zonal range:* Upper Sonoran and Transition; sea level[5] to 9,000 feet altitude.[6] (Fig. 9.)

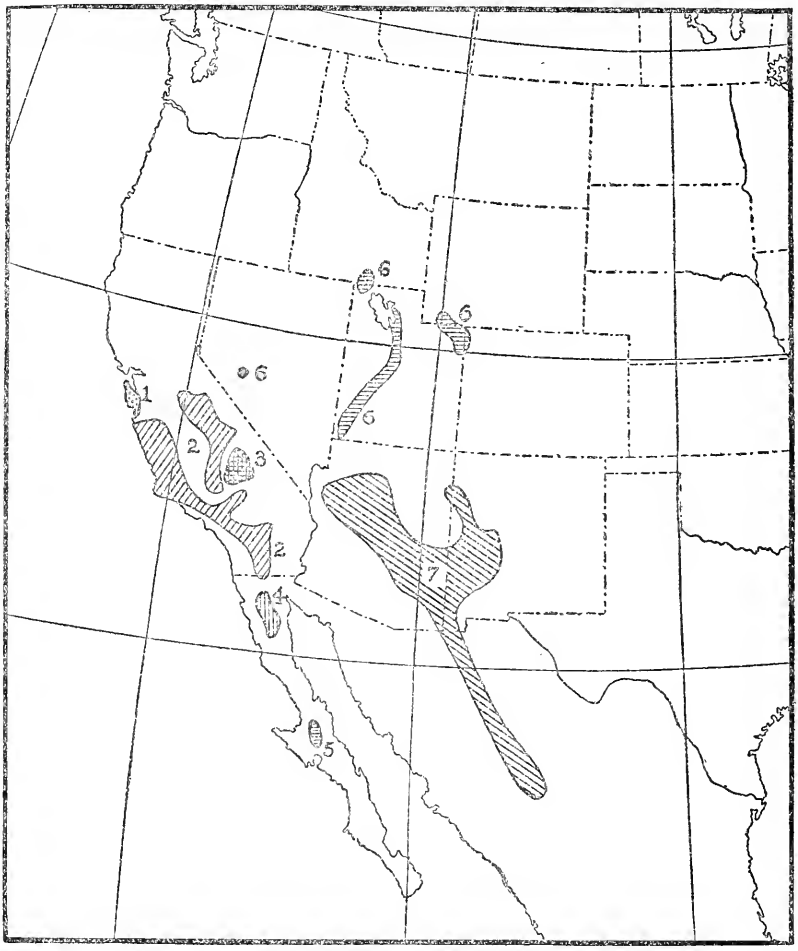

FIGURE 9.—Distribution of the subspecies of *Eutamias merriami* and of *E. dorsalis*. **1, *E. merriami*** *pricei;* 2, *E. merriami merriami;* 3, *E. merriami kernensis;* 4, *E. merriami obscurus;* 5, *E. merriami meridionalis;* 6, *E. dorsalis utahensis;* 7, *E. dorsalis dorsalis*

Characters.—Similar to *Eutamias townsendii senex*, but tail and hind foot averaging longer and skull longer and narrower; head and upper parts in summer pelage averaging paler and more grayish; sides of nose paler; sides of head grayish instead of buffy; facial stripes paler and narrower; postauricular patches smaller and less distinct; ears paler, usually without the contrasting grayish white and fuscous patches; hind feet paler (less tawny); tail darker beneath and edged with gray instead of buff. In winter pelage, there is less difference, but *merriami*

[5] Reported by A. Brazier Howell as occurring near Santa Barbara (Montecito) and at Pasadena, Calif.
[6] Specimens from Onion Valley, Sierra Nevada, and from Mount Piños at 8,500 feet altitude; from Round Valley, San Jacinto Mountains, at 9,000 feet.

differs in being more grayish on the sides of head and shoulders, more buffy (less grayish) on the rump and thighs, the dark dorsal stripes often much reduced in intensity and the light stripes less clear white; feet paler and tail darker.

Color.—Summer pelage (July to early October): Top of head cinnamon, sprinkled with grayish white, bordered on the sides with fuscous; sides of nose cinnamon buff; light facial stripes pale smoke gray or grayish white; dark facial stripes mikado brown, often blackish near the eye; ears mouse gray often more or less washed with pinkish buff and shading to grayish white at posterior base; postauricular patches pale smoke gray, small and indistinct; light dorsal stripes rather narrow, grayish white, the outer pair usually a little clearer white; dark dorsal stripes black or fuscous black, the median one darkest and all more or less shaded with sayal brown, the outer pair sometimes clear sayal brown; sides sayal brown, shaded with pinkish buff; shoulders washed with smoke gray and pinkish buff; rump and flanks mixed pinkish buff and smoke gray; hind feet pinkish buff; cinnamon buff or cinnamon; front feet pinkish buff; tail above, fuscous black overlaid with pinkish buff or cinnamon buff; tail beneath, tawny, ochraceous tawny, or pale russet, bordered with fuscous black and edged with pinkish buff or cinnamon buff; under parts creamy white, often washed on flanks with pinkish buff. *Winter pelage* (normal phase, November): Colors duller and less contrasted than in summer pelage; dark dorsal stripes fuscous or fuscous black, moderately shaded with sayal brown; light dorsal stripes dull grayish white, the median pair clouded with cinnamon or sayal brown; sides pale sayal brown; shoulders, rump, and thighs mixed sayal brown and smoke gray; otherwise as in summer. A gray phase occurs in winter, in which the upper parts are chiefly smoke gray, moderately sprinkled with sayal brown, the sides pinkish buff, washed with sayal brown, the hind feet tilleul buff.

Molt.—The spring molt takes place rather early in this species; a specimen (♂ adult) from Camp Badger, Calif., May 17, 1894, has the anterior portion of the back covered with fresh summer pelage, with an irregular patch of new hair on each flank. A female from Smith Mountain, Calif., June 24, 1892, shows the new pelage just starting in patches on the nape and the middle of the back. The fall molt is shown by a specimen (adult ♀) from Mount Piños, September 28, 1903, in which the winter pelage is coming in on the rump and hinder back.

Skull.—Similar to that of *E. townsendii senex* but averaging longer and narrower, with longer, slenderer rostrum, longer, narrower nasals, and narrower, less inflated brain case; incisive foramina smaller; molars slightly smaller.

Measurements.—Average of 12 adults from San Bernardino Mountains: Total length, 247.2 (234–261); tail vertebræ, 114.2 (106–130); hind foot, 37.1 (36–39); ear from notch, 17.4 (17–19). *Skull:* Average of 10 adults: Greatest length, 39 (38.3–40.1); zygomatic breadth, 20.7 (20–21.6); cranial breadth, 16 (15.5–16.2); interorbital breadth, 9 (8.5–9.4); length of nasals, 12.7 (11.4–14). *Weight:* Average of 45 specimens, 69.8 grams (53–88).

Remarks.—Merriam's chipmunk has an extensive range in California, occupying the greater part of the mountainous areas of the southern half of the State. It intergrades with *pricei* in Monterey County,[7] with *kernensis* in the Piute Mountains, and with *obscurus* in northern Lower California. The range of *merriami* meets or overlaps that of *senex* in the Yosemite Valley,[8] but there is no indication of intergradation between them. Specimens of these two forms in summer pelage often resemble one another rather closely in general appearance, but *merriami* may readily be distinguished by a number of characters, particularly its paler ears without white patches, smaller postauricular patches, and grayish instead of buffy edgings to the tail.

Comparison of a considerable series from the Yosemite region (described as subspecies "*mariposæ*") with typical *merriami* fails to reveal any appreciable constant difference between them.

A series from Kings River shows slight approach to *kernensis*, and one specimen from Badger in summer pelage is clearly referable to

[7] Specimens from Jolon are intermediate in color and length of tail between *merriami* and *pricei*.

[8] Specimens of *merriami* are at hand from the valley at altitudes of 4,000 to 5,000 feet; and of *senex* from 4,600 feet (near Lady Franklin Rock) to 7,000 feet or more.

that race, although a series from Camp Badger in worn spring pelage seem to be nearly typical *merriami*. A large series in winter pelage from Piute Mountains are somewhat intermediate between *merriami* and *kernensis;* the majority of them are nearly typical *merriami* but some are a little paler, and the hind-foot measurements agree with those of *kernensis*.

Specimens examined.—Total number, 613, as follows:

California: Bear Valley, head of Carmel River, Monterey County, 6; Big Pines, Los Angeles County (north of San Antonio), 1; [9] Big Pine Mountain, Santa Barbara County, 1; Camp Badger, Tulare County, 12; Cañada de las Uvas, Kern County, 6; Carrizo Plains (head of San Juan River), 1; Chalk Peak, Monterey County, 6; Cone Peak, Monterey County, 5; Cook P. O., Bear Valley, San Benito County, 4; [10] Coulterville, 8; Cuyamaca Mountains, San Diego County, 5; Dudley, Mariposa County, 6; [10] Dunlap, Fresno County, 1; [10] El Portal, Mariposa County, 3; [10] Fort Tejon, Kern County, 13; Frazier Mountain, Ventura County, 3; Fresno Flat, Madera County, 2; Gabilan Range, San Benito County (Laguna Ranch), 12; Glenville, 1; Idria Mines, San Benito County, 2; Jacumba, 1; Jamesburgh, 1; Jolon, 12; [10] Julian, San Diego County, 2; [10] Kaweah River (east fork, near Cain Flat), 3; Kings River, Fresno County (5,000 feet altitude), 19; [10] Laguna Mountains, San Diego County, 33; [11] Little Onion Valley (Inyo County), 2; [10] Mansfield, 4; Matilija, Ventura County, 15; [10] Milo, 5; Mountain Spring, San Diego County, 1; Mount Piños, 37; [12] Nachoguero Valley, San Diego County, 2; Onion Valley (Inyo County), 4; [10] Paso Robles, 2; Pine Flats, north fork San Gabriel River, Los Angeles County, 3; [10] Pine Valley, head of Carmel River, 7; Piute Mountains, 23; [13] Posts, 4; Priest Valley, Monterey County, 3; Raymond, 8; [10] Redwood Mountain (Tulare County), 2; Salt Springs, Fresno River (east of Raymond), 7; San Antonio Canyon, Los Angeles County, 2; [10] Avila's Ranch, San Antonio Creek, Monterey County, 3; [10] Upper San Antonio Creek, Monterey County, 2; [10] San Bernardino Mountains, 92 (including Bear Valley, 5; [14] Little Bear Valley, 29; Santa Ana River, 4; [10] Seven Oaks, 7; [10] Sugarloaf, 6; [10] Doble, 1; [10] Fish Creek, 7; [10] Saragossa Springs, 1; [10] Foreall Creek, 1; [10] and Converse Flats, 5); San Emigdio Canyon, Kern County, 4; San Gabriel Mountains (2,800 to 5,800 feet altitude), 13; Strawberry Peak, San Gabriel Mountains, 1; Wilson Peak, San Gabriel Mountains, 30; San Jacinto Mountains, 94 (including Fuller's Mill, 10; [10] Hemet Lake, 2; [10] Hidden Lake, 1; [10] Kenworthy, 9; [10] Oak Valley, 14; Poppet Flat, 2; [10] Round Valley, 1; [10] Schain's Ranch, 6; [10] Strawberry Valley, 20; [15] and Tahquitz Valley, 2 [10]); San Lorenzo Creek, Peachtree Valley, 1; [10] San Luis Obispo, 2; Little Pine Canyon, San Rafael Mountains, 2; San Simeon (mountains near), 2; Santa Lucia Peak, 20; [16] Santa Lucia Ranger Station (near Abbots, Monterey County), 1; [10] Santa Margarita, San Luis Obispo County, 3; [10] Santa Rosa Mountains, 7 (including Garnet Queen Mine, Santa Rosa Peak, and Toro Peak); [10] Santa Ysabel, 1; Sheep Creek, 2; [14] Smith Mountain, San Diego County, 7; [17] Soquel Mill, north fork San Joaquin River (altitude, 5,500 feet), 1; Tassajara Springs (Church Ranch), 1; Tehachapi Peak, 8; Tejon Canyon, 2; Topa Topa Lodge, Ventura County, 2; [9] Volcan Mountain, San Diego County, 2; [18] Warner Pass, San Diego County, 1; [10] Yosemite Valley (4,000 to 5,000 feet altitude), 9.[19]

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[9] D. R. Dickey coll.
[10] Mus. Vert. Zool.
[11] Amer. Mus. Nat. Hist., 8; Mus. Vert. Zool., 5.
[12] Mus. Vert. Zool., 22; Amer. Mus. Nat. Hist., 1; Acad. Nat. Sci. Philadelphia, 1; E. R. Warren coll., 2.
[13] Mus. Vert. Zool., 19; Univ. Mich., 2.
[14] Acad. Nat. Sci. Philadelphia.
[15] Mus. Vert. Zool., 6.
[16] Mus. Vert. Zool., 9.
[17] Amer. Mus. Nat. Hist., 4.
[18] Mus. Vert. Zool., 1.
[19] Mus. Vert. Zool., 4.

EUTAMIAS MERRIAMI PRICEI Allen

Santa Cruz Chipmunk

(Pls. 3, o; 7, o)

Tamias pricei Allen, Bul. Amer. Mus. Nat. Hist. 7: 333, November 8, 1895.
Eutamias pricei Miller and Rehn, Proc. Boston Soc. Nat. Hist. 30: 43, December 27, 1901.

Type.—Collected at Portola, San Mateo County, Calif., April 12, 1895, by J. Diefenbach; ♂ adult, skin and skull; No. $\frac{11288}{9552}$, American Museum of Natural History; original number, 511.

Geographic distribution.—Coast mountains of central California, from San Mateo County south to northern Monterey County. *Zonal range:* Transition and Upper Sonoran. (Fig. 9.)

Characters.—Similar to *Eutamias m. merriami* but tail averaging longer; coloration in both pelages darker and more tawny (less grayish); light dorsal stripes more mixed with tawny; ears and hind feet darker. Compared with *E. townsendii sonomæ:* Tail averaging longer and ears shorter; upper parts in summer pelage more grayish, lacking the heavy wash of cinnamon found in *sonomæ;* sides of body slightly darker, the shoulders washed with grayish (instead of bright cinnamon); head, hind feet, and tail darker, the tail edgings buffy rather than grayish; very similar in winter pelage to *sonomæ*, but dark dorsal stripes more blackish (less tawny); light dorsal stripes usually less whitish; rump and thighs more ochraceous (less grayish); tail edgings more buffy (less grayish); ears averaging more buffy (less grayish) on posterior border.

Color.—*Summer pelage* (September): Top of head sayal brown, sprinkled with grayish white, bordered on the sides with a rather indistinct streak of russet; facial stripes russet, the ocular stripe blackish around the eye; light facial stripes smoke gray; sides of nose clay color; ears mouse gray, shaded on posterior margin with dull buffy white and with a patch of russet at anterior base; postauricular patches rather indistinct, grayish or buffy white; median dorsal stripe black; outer pair of dark stripes fuscous black, mixed with mikado brown; light dorsal stripes grayish white, the median pair considerably clouded with brownish; sides sayal brown shading to tawny, washed on shoulders with cinnamon buff or ochraceous buff; rump and flanks mixed smoke gray and cinnamon buff; feet cinnamon buff or pinkish buff, more or less shaded with fuscous; tail above, fuscous black overlaid with pinkish buff; tail beneath, tawny or ochraceous tawny, bordered with fuscous black and edged with pinkish buff or tilleul buff; under parts creamy white, faintly washed on abdomen with pinkish buff or light pinkish cinnamon. *Winter pelage* (November): Similar to the summer pelage but darker, the rump and flanks about snuff brown in general tone; head snuff brown or warm sepia, sprinkled with whitish; dark dorsal stripes fuscous black shaded with russet; light dorsal stripes pale smoke gray; sides sayal brown, clouded with fuscous; hind feet tawny olive or cinnamon.

Molt.—No specimens are available showing the spring molt. The fall molt is shown by several specimens from Boulder Creek, Calif.; one taken October 12 has the new fall pelage investing the rump and flanks; another taken October 15 has about half of the hinder back and sides covered with new pelage; and one taken October 12 has the whole body covered with short, new pelage.

Skull.—Closely similar to that of *merriami* but averaging slightly smaller, with slightly broader rostrum; very similar, also, to that of *E. townsendii sonomæ*, but rostrum averaging narrower and nasals longer.

Measurements.—Average of 10 adults from type region (Stanford University, Santa Cruz Mountains, and Black Mountain): Total length, 257.8 (248–277); tail vertebræ, 125.2 (115–140); hind foot, 37.2 (37–38); ear from notch, 16.6 (15–18). *Skull:* Average of 11 adults from Portola, Boulder Creek, and Santa Cruz Mountains: Greatest length, 38.3 (37.1–39.3); zygomatic breadth, 20.5 (20.1–21); cranial breadth, 15.8 (15.3–16.7); interorbital breadth, 8.6 (8–9.4); length of nasals, 12.6 (11.9–13.7).

Remarks.—The Santa Cruz chipmunk is a well-marked race of *merriami* occupying the humid coast belt from San Francisco Bay to Monterey Bay. It is closely related to *E. townsendii sonomæ*, as

shown by the similarity in the skulls, but differs constantly from it in characters of the summer pelage, and the ranges of the two are separated by San Francisco Bay and a belt of territory around the bay not suited for occupation by any chipmunks.

Specimens examined.—Total number, 84, as follows:

California: Aptos, 1; Arroyo Quito, Santa Clara County, 1;[20] Bear Valley, San Benito County (29 miles southeast of Hollister), 1; Big Basin, Santa Cruz County, 6;[21] Black Mountain, Santa Clara County, 7;[22] Boulder Creek, 21; Corralitos, 1;[23] La Honda, 1;[24] Palo Alto, 1;[25] Palo Colorado Canyon, Monterey County, 7;[20] Pescadero Creek, San Mateo County, 3;[20] Portola, San Mateo County, 20;[26] Redwood [City], 1; Santa Cruz, 3;[27] Santa Cruz Mountains, 5; Sierra Morena, San Mateo County, 1;[28] Stanford University, 3; Stevens Creek, Santa Clara County, 1.[20]

EUTAMIAS MERRIAMI KERNENSIS Grinnell and Storer

Kern Basin Chipmunk

(Pls. 3, p; 7, p)

Eutamias merriami kernensis Grinnell and Storer, Univ. Calif. Pub. Zool. **17: 5,** August 23, 1916.

Type.—Collected at Fay Creek, 4,100 feet altitude, 6 miles north of Weldon, Kern County, Calif., July 13, 1911, by H. A. Carr and J. Grinnell; ♂ adult, skin and skull; No. 15022, Museum of Vertebrate Zoology; original number, 266.

Geographic distribution.—Kern Basin, Calif., from Havilah north to Kern Lakes; east to Walker Pass. *Zonal range:* Upper Sonoran and Transition; 2,400 to 7,000 feet altitude. (Fig. 9.)

Characters.—Similar to *Eutamias m. merriami*, but averaging slightly smaller, with shorter hind feet; coloration paler and more grayish (less tawny); median pair of light dorsal stripes averaging broader and more grayish; dark dorsal stripes (except the median one) paler and less distinct; hind feet averaging paler; tail paler, both above and below.

Color.—*Summer pelage* (July): Top of head mixed pinkish cinnamon and grayish white, bordered on each side with snuff brown; sides of nose pale cinnamon buff; light facial stripes creamy white, shading to smoke gray; dark facial stripes snuff brown or mikado brown, the ocular stripe fuscous black in front of and behind the eye; ears mouse gray, clouded with pinkish buff and shaded on anterior margin with sayal brown; median dorsal stripe black in middle of back, shading anteriorly to sayal brown; outer dorsal stripes sayal brown, becoming obsolete on the rump; light dorsal stripes pale smoke gray, the outer pair more whitish; sides clay color or pinkish buff, shaded with cinnamon; shoulders pale smoke gray shaded with pinkish buff; flanks and rump smoke gray washed with pinkish buff; feet pinkish buff; tail above, fuscous black, overlaid with pinkish buff; tail beneath, tawny or ochraceous tawny, bordered with fuscous black and edged with pinkish buff; underparts creamy white. Winter pelage not seen.

Molt.—An adult female from Walker Pass, Calif., July 2, 1891, is in greatly worn winter pelage, with irregular patches of new summer pelage appearing on the head and back; the fall molt is shown by a specimen from Havilah, Calif., October 10, in which the new winter pelage covers the rump, flanks, and hinder back.

Skull.—Very similar to that of *merriami*, but averaging slightly smaller.

Measurements.—Average of 11 adults from vicinity of type locality: Total length, 241.5 (233–264); tail vertebræ, 111.2 (102–119); hind foot, 35.4 (34–38);

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[20] Mus. Vert. Zool.
[21] Field Mus. Nat. Hist.
[22] Mus. Vert. Zool., 4; E. R. Warren coll., 2.
[23] Univ. Mich.
[24] Amer. Mus. Nat. Hist.
[25] Mus. Comp. Zool.
[26] Mus. Comp. Zool., 4; Amer. Mus. Nat. Hist., 11; Mus. Vert. Zool., 4; D. R. Dickey coll., 1.
[27] Kan. Univ. Mus., 2.
[28] E. R. Warren coll.

ear from notch, 17.7 (16–20). *Skull:* Average of 10 adults from type locality: Greatest length, 38 (36.7–39.7); zygomatic breadth, 20.3 (20–20.8); cranial breadth 15.5 (15–16.1); interorbital breadth, 9.1 (8.4–9.8); length of nasals, 12.3 (11.4–13.3).

Remarks.—This subspecies is a slightly differentiated form, restricted apparently to a rather small area in the Kern Basin, Calif. Intergradation with *merriami* occurs in the Piute Mountains and in the foothills of the southern Sierra Nevada.

Specimens examined.—Total number, 86, as follows:

California: Badger, 1; Bodfish, Kern County, 13;[29] Fay Creek, 6 miles north of Weldon, Kern County, 18;[29] Havilah, 5; Jordan Hot Springs, Tulare County, 3; Kiavah Mountain (near Walker Pass), 3;[29] Kern River Lakes, Tulare County, 1; south fork Kern River (near mouth), 1; Kernville, 12; Taylor Meadow, Tulare County [about 65 miles north of Weldon], 10;[29] Trout Creek, Tulare County, 7;[29] Walker Pass, 12.[30]

EUTAMIAS MERRIAMI OBSCURUS (ALLEN)

SAN PEDRO MARTIR CHIPMUNK

(PLS. 4, A; 8, A)

Tamias obscurus Allen [Townsend, MS.], Bul. Amer. Mus. Nat. Hist. 3: 70, June, 1890.

E.[utamias] obscurus Merriam, Proc. Biol. Soc. Washington 11: 194, July 1, 1897.

E.[utamias] m.[erriami] obscurus Nelson and Goldman, Proc. Biol. Soc. Washington 22: 23, March 10, 1909.

Type.—Collected in the San Pedro Martir Mountains (near Vallecitos),[31] Lower California, May 1, 1889, by C. H. Townsend; ♀ adult, skin and skull; No. $\frac{18050}{24954}$, United States National Museum; original number, 7.

Geographic distribution.—San Pedro Martir and Hanson Laguna Mountains, northern Lower California. *Zonal range:* Transition; 7,000 to 8,500 feet altitude. (Fig. 9.)

Characters.—Similar to *Eutamias m. merriami*, but averaging smaller, with distinctly shorter tail and hind feet, and smaller skull; dorsal stripes averaging more tawny (less fuscous) terminating more anteriorly, not extending onto the rump, and showing a tendency to become obsolete, especially in winter pelage; rump more grayish; tail slightly darker in winter pelage with darker (more ochraceous) edgings. Compared with *kernensis:* General tone of upper parts darker, the dorsal stripes deeper tawny and more distinct; head more grayish (less cinnamon); rump and hind feet darker; tail darker beneath, with darker (more ochraceous) edgings.

Color.—Summer pelage (July–September): Top of head pale smoke gray, shaded with pinkish cinnamon and bordered on the sides with a narrow stripe of bister or snuff brown; sides of nose clay color or cinnamon buff; dark facial stripes mikado brown, the ocular stripe fuscous black around the eye; light facial stripes pale smoke gray; ears mouse gray or chætura drab, indistinctly washed on posterior half with pale buff or soiled whitish; postauricular patches grayish white; dark dorsal stripes mikado brown or russet, the median one becoming blackish for the posterior half; median pair of light stripes smoke gray or pale smoke gray; outer pair grayish white; sides sayal brown; shoulders pale smoke gray, mixed with pinkish buff; rump and thighs grayish white mixed with clay color or cinnamon, giving a general tone near neutral gray; hind feet cinnamon buff or pinkish buff; front feet pinkish buff; tail above fuscous black, overlaid with pinkish buff; tail beneath, tawny, bordered with fuscous black and edged with pinkish buff; underparts creamy white. *Winter pelage* (November): Similar to the summer pelage, but general tone of upper parts darker and the dorsal

[29] Mus. Vert. Zool. [30] Mus. Vert. Zool., 5. [31] Information from C. H. Townsend.

stripes usually (?) much less distinct, often nearly obsolete; sides indistinctly washed with pale sayal brown or cinnamon buff.

Molt.—The winter pelage in this race is subject to much wear, so that late in spring or early in summer many specimens are extremely ragged and without any indication of stripes. The spring molt begins in June, as shown by a specimen (♂) from Hanson Laguna, Lower California, June 8, in which new summer pelage is appearing on the head and fore back. Another specimen (♀ adult) from Vallecitos, Lower California, July 14, is in similar worn condition on the hinder back, with the new pelage covering the anterior half of the body.

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

Measurements.—Average of 13 adults from vicinity of type locality: Total length, 227.9 (208–240); tail vertebræ, 105.7 (95–112); hind foot, 34.8 (33–37); ear from notch, 16.2 (15.5–17.5). *Skull:* Average of 10 adults: Greatest length, 37.1 (36.3–37.8); zygomatic breadth, 20 (19.4–20.7); cranial breadth, 15.4 (14.7–16.3); interorbital breadth, 8 (7.6–8.3); length of nasals, 11.9 (11.5–12.6).

Remarks.—The San Pedro Martir chipmunk is very closely related to *merriami;* in fact, many specimens, especially of those in summer pelage, are scarcely distinguishable, except by smaller size, from comparable specimens of *merriami*. In winter pelage the differences are somewhat more pronounced than in summer. The resemblance to *Eutamias dorsalis* suggested by the reduction of the dorsal stripes is accidental and not indicative of close relationship, as Doctor Allen was led to believe was the case when he described *obscurus*.

Specimens examined.—Total number, 131, as follows:

Lower California: Hanson Laguna Mountains, 11 (including El Rayo, 3; Hanson Laguna, 8); San Pedro Martir Mountains, 120[32] (including La Grulla, 9;[33] Rosarito Divide, 2;[33] Santa Eulalia, 13;[33] Santa Rosa, 2;[33] and Vallecitos, 1[33]).

EUTAMIAS MERRIAMI MERIDIONALIS Nelson and Goldman

Peninsula Chipmunk

(Pls. 4, b; 8, b)

Eutamias merriami meridionalis Nelson and Goldman, Proc. Biol. Soc. Washington 22: 23, March 10, 1909.

Type.—Collected at Aguaje de San Esteban, about 25 miles northwest of San Ignacio, Lower California, Mexico (altitude about 1,200 feet), October 5, 1905, by E. W. Nelson and E. A. Goldman; ♀ adult, skin and skull; No. 139597, United States National Museum (Biological Survey collection); original number, 18268.

Geographic distribution.—Known only from the type locality and from San Pablo, Lower California. *Zonal range:* Lower Sonoran [probably also Upper Sonoran]; 1,000 to 1,200 feet altitude. (Fig. 9.)

Characters.—Similar to *Eutamias merriami obscurus*, but paler on back, rump, and sides; tail paler, both above and below, bordered with a paler shade of buff; skull decidedly smaller and narrower.

Color.—Summer pelage (type, October 5)[34]: Top of head mixed pale smoke gray and cinnamon, bordered on sides with warm sepia; stripe from nose to eye pale cinnamon buff; from eye to ear warm sepia; submalar stripe sayal brown; light facial stripes grayish white; ears deep mouse gray, shading on posterior margin to dull smoke gray and with a patch of sayal brown at anterior base; postauricular patches small and indistinct grayish white; dark dorsal stripes pale snuff brown, the median one shading posteriorly to fuscous black, all the dorsal stripes scarcely reaching the rump; median pair of light stripes pale smoke gray; outer pair grayish white; sides pinkish buff; rump and thighs smoke gray, faintly

[32] Amer. Mus. Nat. Hist., 52.
[33] Field Mus. Nat. Hist.
[34] Winter pelage apparently covering rump and tail.

washed with pinkish buff; feet pinkish buff; tail above, fuscous black, overlaid with tilleul buff; tail beneath, tawny, bordered with fuscous black, and edged with tilleul buff; underparts creamy white.

Skull.—Similar to that of *obscurus* but smaller; brain case rather narrow, the zygomata appressed; rostrum shorter and relatively broader.

Measurements.—Type. (♀ adult): Total length, 237; tail vertebræ, 117; hind foot, 33; ear from notch, 14.5. *Skull:* Greatest length, 35.5; zygomatic breadth, 18.2; cranial breadth, 15.1; interorbital breadth, 8.4; length of nasals, 11.1.

Remarks.—This is the smallest and palest of the races of *merriami* and is the only one known to range in Lower Sonoran Zone; the few individuals seen were in giant-cactus country, but it seems probable that further exploration of the region where they were taken will show that their habitat includes some of the low mountain ranges in that vicinity. Apparently, however, there is a considerable gap between the range of this form and that of *obscurus*.

Specimens examined.—Total number 2, as follows:

Lower California: Aguaje de San Esteban, 1; San Pablo, 1.

EUTAMIAS DORSALIS (Baird)

[Synonymy under subspecies]

Characters.—Size medium to large; hind foot, 32–36 millimeters; skull length, 34.5–38.7 millimeters; skull similar to that of *merriami*, but brain case averaging shorter and deeper, and rostrum shorter and broader; general tone of upper parts smoke gray or neutral gray, the dorsal stripes (except the median one) usually (but not always) indistinct or obsolete; ears smoke gray or grayish white, margined anteriorly with cinnamon; sides varying from light pinkish cinnamon to sayal brown; rump like back; thighs shaded with cinnamon; hind feet varying from pinkish buff to cinnamon buff or clay color; under surface of tail from pinkish buff to cinnamon or tawny, edged with grayish white or tilleul buff; underparts creamy white, sometimes tinged with buff.

EUTAMIAS DORSALIS DORSALIS (Baird)

Cliff Chipmunk

(Pls. 4, c; 8, c)

Tamias dorsalis Baird, Proc. Acad. Nat. Sci. Philadelphia 7: 332, April, 1855.
[*Tamias quadrivitatus*] var. *dorsalis* Allen, Proc. Boston Soc. Nat. Hist. 16: 290, June, 1874.
Tamias asiaticus var. *dorsalis* Allen, Monog. North Amer. Rodentia, U. S. Geol. Surv. Terr. 11: 794, 1877.
Eutamias dorsalis Merriam, Proc. Biol. Soc. Washington 11: 211, July 1, 1897.
Eutamias canescens Allen, Bul. Amer. Mus. Nat. Hist. 20: 208, May 27, 1904 (Guanacevi, Durango, Mexico).

Cotypes.[35]—Collected at "Fort Webster, Coppermines of the Mimbres," near present site of Santa Rita, Grant County, N. Mex.,[36] in 1851, by J. H. Clark; No. 120, United States National Museum, mounted skin with skull inside; No. 4759, Museum Comparative Zoology (formerly No. $\frac{119}{3150}$, United States National Museum, skin and portion of mandible (skull missing).

Geographic distribution.—Plateau region of Arizona south of the Grand Canyon; western New Mexico; south in the Sierra Madre to northwestern Durango; east in New Mexico to the Rio Grande Valley; west in Arizona to Hualpai Mountains; north to the Grand

[35] Listed by Baird, in Mammals of North America, p. 300, 1857.
[36] Baird gives the location of Fort Webster as latitude 32° 47′ west, longitude 108° 4′ north (Baird, 1857b, p. 709).

Canyon and Fort Defiance, Ariz. *Zonal range:* Upper Sonoran; 2,500 feet (Ray, Ariz.) to 10,000 feet in Graham Mountains and Santa Catalina Mountains.[37] (Fig. 9.)

Characters.—Similar to *Eutamias merriami obscurus*, but upper parts decidedly more grayish (less tawny), the dorsal stripes (except the median one) usually much less distinct and never tawny; ears paler, with more whitish patches; tail paler beneath, overlaid above and on sides with smoke gray instead of buff.

Color.—Summer pelage (August and September): General tone of upper parts pale smoke gray or pallid neutral gray; top of head similar to back but mixed with cinnamon and bordered on each side with a stripe of snuff brown or bister; sides of nose cinnamon buff or clay color; ocular stripe fuscous black, shaded with sayal brown; malar stripe sayal brown, mixed with fuscous; ears pale smoke gray, or grayish white, margined anteriorly with cinnamon or sayal brown, and with a broad patch of the same on postero-internal surface; postauricular patches creamy white, prominent; median dorsal stripe well defined, fuscous black faintly sprinkled with sayal brown; other dark dorsal stripes when present, mikado brown, shaded with fuscous black but usually obsolete or very faintly indicated; light dorsal stripes grayish white, the outer pair creamy white, all of them usually indistinctly marked or obsolete; sides cinnamon or sayal brown; shoulders and rump smoke gray or pale smoke gray; thighs sayal brown or cinnamon; hind feet pinkish cinnamon, pinkish buff, or clay color; tail above, fuscous black, overlaid with grayish white or tilleul buff; tail beneath, tawny, ochraceous tawny, or cinnamon, bordered with fuscous black and tipped with grayish white or tilleul buff; underparts creamy white, sometimes faintly tinged with pinkish buff. *Winter pelage* (November–May): Much like that of summer but colors brighter and slightly deeper, the facial stripes and anterior portion of ears sometimes russet.

Molt.—The spring molt occurs in May or June; in a specimen (♂ adult) from Walnut, Ariz., May 12, 1893, the new summer pelage covers the anterior portion of the dorsum to beyond the middle of the back and appears as a large patch on the breast; an adult male from San Luis Mountains, N. Mex., June 24, 1892, is in much worn winter pelage, with a small patch of new hair appearing in the middle of the back. The fall molt is shown by a specimen (♀) from Gallup, N. Mex., September 28, 1908, in which new winter pelage covers the posterior half of the back; an adult female from Springerville, Ariz., October 24, 1890, is in complete winter pelage.

Skull.—Closely similar to that of *E. merriami obscurus* but rostrum averaging broader.

Measurements.—Average of 12 adults from Piños Altos Mountains, N. Mex.: Total length, 236.2 (222–242); tail vertebræ, 107.5 (98–114); hind foot, 35.4 34–36); ear from notch, 17 (16–18). *Skull:* Average of 10 adults from vicinity of type locality: Greatest length, 37.3 (36.5–38.7); zygomatic breadth, 20.4 (20–21.1); cranial breadth, 15.9 (15.1–16.4); interorbital breadth, 8.3 (7.6–8.7); length of nasals, 11.7 (11.2–12.8).

Remarks.—The cliff chipmunk, one of the handsomest and most strikingly marked members of the genus, was recognized many years ago as a distinct species. It is clearly a member of the *merriami* group and bears a rather close resemblance to *Eutamias merriami obscurus* as was pointed out by Doctor Allen when he described the latter form. It differs constantly from *obscurus*, however, in a number of details and the reduction of the dorsal stripes has proceeded even farther than in that race. The ranges of these two are separated, also, by the broad basin of the Lower Colorado River.

The present form has a wide range in Arizona and New Mexico and southward in Mexico to northwestern Durango. It presents a wide range of individual variation in the intensity of the dorsal stripes, but the writer is unable to distinguish any geographic variation of importance from that region. The series from Guanecevi, Durango, on which Allen based *Eutamias canescens*, together with a larger series from southern Chihuahua, has been carefully compared

[37] Steep, hot slopes carry the Upper Sonoran Zone unusually high in these ranges.

with typical *dorsalis* and found to agree very closely. In the Mexican examples the dorsal stripes average slightly more distinct and none of them show as complete reduction of the stripes as is shown by many of the Arizona specimens, but since many individuals from Mexico are absolutely matched by others from Arizona, it is not possible to recognize a Mexican race.

Specimens examined.—Total number, 424, as follows:

Arizona: Anderson Canyon, 30 miles southeast of Flagstaff, 1; Apache Maid Mountain, 2; Blue (6 miles north), 1; Blue River (Cosper Ranch, at 5,000 feet altitude), 2; Canyon Padre, Coconino County, 1;[38] Cherry Creek, Yavapai County, 1;[39] Chiricahua Mountains, 77;[40] Crown King, 1; Fish Creek, Tonto National Forest, 4; Fort Apache, 1; Fort Defiance, 2; Fort Grant, 2; Fort Verde, 3;[39] Fort Whipple, 11; Gila Mountains, 1; Graham Mountains, 13; Grand Canyon (southern side), 5; Hualpai Mountains, 25; Juniper Mountains, 20 miles northwest of Simmons, 4; Mayer, 6; McMillenville (8 miles north), 1; Mingus Mountains, 6 miles southeast of Jerome, 2; Montezuma Well, 9; Mount Turnbull, 3; Nantan Plateau, 25 miles northeast of Rice, 6; Oak Creek, 18 miles southwest of Flagstaff, 1; Oracle, 2; Payson, 1; Peach Springs, 1; Pinal County, 3;[41] Pine Creek, Tonto Basin, 1;[39] Pine Spring, Hualpai Indian Reservation, 3; Portal, 2; Prescott, 10;[42] Red Lake, 1; Rincon Mountains, 1; Roosevelt, 1; Salt River, 2 miles north of McMillenville, 1; Santa Catalina Mountains, 19; Sierra Ancha Mountains (Carr's Ranch), 11;[43] Springerville, 8; Stoneman Lake, Mogollon Mountains, 1;[39] Supai Village, Cataract Creek, 1;[39] Walnut (near Winona), 11; Weaver Mountains, 1; Whipple Barracks, 1;[39] Winona, 4.

Chihuahua: Colonia Garcia, 10; Minaca, 4;[44] Pacheco, 4;[45] San Luis Mountains, 1; Sierra Madre, near Guadalupe y Calvo, 24.

Durango: Guanacevi, 7.[39]

New Mexico: Animas Mountains, 6; Bear Spring Mountains, 5; Beaver Lake, Gila National Forest, 2; Bernalillo County, 1;[45] Burro Mountains, 2; Chloride (10 miles east), 2; Coppermines (near present site of Santa Rita), 2;[46] Datil, 1; Datil Mountains, 11; El Moro, 1;[45] Fairview, 2; Fort Wingate, 9; Gallina Mountains, Socorro County, 3; Gallup, 2; Guadalupe Canyon (Mexican Boundary), 1; Kingston, 1; Luna, Gila National Forest, 5; Magdalena Mountains, 4; Mimbres River (head), 8; Piños Altos Mountains (north of Silver City), 20; Redrock, Grant County, 1; San Luis Mountains, Grant County, 10; San Mateo Mountains, Socorro County, 3; Silver City, 1; Riley, 2.

EUTAMIAS DORSALIS UTAHENSIS Merriam

Utah Cliff Chipmunk

(Pls. 4, d; 8, d)

Eutamias dorsalis utahensis Merriam, Proc. Biol. Soc. Washington 11: 210, July 1, 1897.

Type.—Collected at Ogden, Utah, October 9, 1888, by Vernon Bailey; ♂ adult, skin and skull; No. 186457, United States National Museum (No. $\frac{4788}{5448}$, Merriam collection); original number, 289.

Geographic distribution.—Utah, northwestern Arizona, and southern Nevada; north to southern Idaho (Bridge), and southwestern Wyoming (Green River Valley); east to northwestern Colorado (Snake

[38] Univ. Mich.
[39] Amer. Mus. Nat. Hist.
[40] Amer. Mus. Nat. Hist., 42; Acad. Nat. Sci. Philadelphia, 5.
[41] Amer. Mus. Nat. Hist., 2; Mus. Comp. Zool., 1.
[42] Amer. Mus. Nat. Hist., 4; Mus. Comp. Zool., 2.
[43] Mus. Vert. Zool.
[44] Field Mus. Nat. Hist.
[45] Mus. Comp. Zool.
[46] Cotypes; Mus. Comp. Zool., 1; U. S. Nat. Mus., 1.

River Valley); south to the Grand Canyon, Arizona; west to central Nevada (Toquima Range). *Zonal range:* Upper Sonoran; 3,000 to 7,000 feet altitude. (Fig. 9.)

Characters.—Similar to *Eutamias d. dorsalis*, but smaller, and averaging paler; postauricular patches smaller and less clear white; facial stripes paler, especially the submalar stripe, which is also narrower and tends to become obsolete anteriorly; under side of tail paler; skull smaller.

Color.—*Summer pelage* (July and August): General tone of upper parts smoke gray or pale smoke gray; top of head similar to back but mixed with cinnamon, especially anteriorly, bordered on each side with a narrow line of fuscous; sides of nose clay color or cinnamon buff; facial stripes sayal brown shaded with fuscous or fuscous black; postauricular patches grayish white, poorly defined; median dorsal stripe fuscous to nearly black; outer dorsal stripes faintly indicated, often obsolete, pale fuscous, tinged with cinnamon; outer pair of light stripes faintly indicated, creamy white; sides pinkish cinnamon or light pinkish cinnamon; hind feet cinnamon buff; tail above, fuscous black, overlaid with tilleul buff; tail beneath, cinnamon buff or pinkish buff, bordered with fuscous black and edged with tilleul buff; underparts creamy white. *Winter pelage* (October and November): Very similar to the summer pelage but upper parts slightly darker, the cinnamon bases of the hairs more conspicuous, producing a general tone near light drab.

Molt.—A specimen (♂ adult) from Beaverdam Mountains, Utah, May 11, 1891, is in the midst of the spring molt, the new summer pelage covering about two-thirds of the dorsal area; a breeding female, however, from Ogden, Utah, taken July 20, 1893, is still in much worn winter pelage, with no sign of the molt beginning.

Skull.—Similar to that of *dorsalis* but smaller.

Measurements.—Average of 10 adults from Ogden and Provo, Utah: Total length, 222.3 (213–231); tail vertebræ, 101.4 (95–108); hind foot, 33 (32–35); ear from notch, 15.8 (15–17). *Skull:* Average of eight adults from type locality: Greatest length, 35.3 (34.5–36.2); zygomatic breadth, 19.7 (19.2–20.2); cranial breadth, 15.3 (15–15.7); interorbital breadth, 7.9 (7.5–8.2); length of nasals, 11.1 (10.4–11.8).

Remarks.—This race shows the most extreme condition of pallor and reduction of the dorsal stripes. Its range is rather sharply cut off from that of *dorsalis* by the Grand Canyon, specimens from Trumbull Mountains on the north side of the Canyon being nearly typical *utahensis*.

Specimens examined.—Total number, 85, as follows:

Arizona: Trumbull Mountains, 13.
Colorado: Douglas Spring, Routt County, 20;[47] Escalante Hills (20 miles southeast of Ladore), 15; Snake River (between Snake River Bridge and Lilly), 1.[48]
Idaho: Bridge, 9.
Nevada: Manhattan, 2.
Utah: Beaver Dam Mountains, 1; Clear Creek, Sevier County, 1; Hebron, 1; Manti, 1; Ogden, 12; Pine Valley, 1; Provo, 3.
Wyoming: Green River (4 miles northeast of Linwood, Utah), 5.

[47] Amer. Mus. Nat. Hist., 2; Colo. Agr. College, 2; Mus. Vert. Zool., 2; E. R. Warren coll., 13.
[48] E. R. Warren coll.

TABLE 2.—*Cranial measurements of typical adults of Eutamias*

Species and locality	No.	Sex	Greatest length	Zygomatic breadth	Cranial breadth [1]	Interorbital breadth	Length of nasals	Remarks
Eutamias alpinus:								
Mount Whitney, Calif.	41210	♀	30.3	17.6	14.1	7.8	9.5	
Do.	41211	♂	31.5	17.3	13.7	7.5	10	
Eutamias minimus minimus:								
Green River, Wyo.	55268	♂	28.7	16.1	13.3	6.8	8.1	
Do.	147946	♂	30.4	17.3	14.6	6.5	8.7	
Eutamias m. pictus:								
Kelton, Utah	186459	♂	29.4	16.6	13.1	6.4	9.5	Type.
Do.	193198	♀	30.6	16.6	13.4	6.5	9.9	
Eutamias m. caryi:								
Medano Ranch, Colo.	150740	♂	30	17.2	13.9	6	9.1	Do.
Do.	150741	♂	30.8	16.9	14.3	7	9	
Eutamias m. pallidus:								
Painted Robe Creek, Mont.	67581	♀	34.2	18.8	15.5	7.5	10.3	
Terry, Mont.	161343	♂	32	18.5	14.5	7.3	10.2	
Eutamias m. cacodemus:								
Cheyenne River, S. Dak.	61451	----	33.2	18.3	15 ·	6.7	10.3	
Corral Draw, S. Dak.	[2] 7562	♀	31.9	18.5	14.6	7.3	9.5	Old adult.
Eutamias m. confinis:								
Bighorn Mountains, Wyo.	168763	♂	32	18	15.6	7	10.5	
Do.	168764	♀	31.1	18.1	15.8	6.8	9.5	Do.
Eutamias m. consobrinus:								
Uinta Forest, Utah	226897	♂	31	17.5	14.5	6.8	9.1	
Park City, Utah	30067	♀	30	16.5	14.4	6.5	9.2	
Eutamias m. operarius:								
Gold Hill, Colo.	129808	♀	32	17.7	14.8	7.5	9.7	Type.
Estes Park, Colo.	74106	♀	32.7	18	16.2	8.3	9.3	
Eutamias m. atristriatus:								
Cloudcroft, N. Mex.	119028	♀	33.9	18.3	14.7	7	10.3	Do.
Do.	118823	♀	33.5	18.9	15.9	7.3	11.1	Old adult.
Eutamias m. arizonensis:								
Prieto Plateau, Ariz.	205869	♂	32.6	18	14.2	7.3	10.3	Type.
Do.	205872	♀	33.1	18.5	14.3	7.2	10.4	
Eutamias m. oreocetes:								
Summit, Mont.	72468	♀	32.1	18	14.8	6.7	10.6	Do.
Indian Pass, Mont.	244535	♀	32.3	18.9	16.4	7.8	10.1	
Eutamias m. borealis:								
Fort Smith, Mackenzie.	115766	♂	32.5	18	14.5	7	10.1	
Slave River, Alberta.	115762	♀	33.2	18.5	14.4	7	10.5	
Eutamias m. caniceps:								
Lake Lebarge, Yukon.	99200	♀	33.5	18.2	14.3	6.9	10.7	Do.
Do.	99204	♂	33	18.3	14.4	7	10.2	
Eutamias m. jacksoni:								
Crescent Lake, Wis.	227423	♂	32.9	18.1	14.5	7.2	9.8	Do.
Herbster, Wis.	232137	♂	33.2	18.1	14.3	7.3	10.7	Old adult
Eutamias amœnus amœnus:								
Fort Klamath, Oreg.	186400	♀	32	17.6	14.4	7.2	9.6	Type.
Do.	193121	♂	31.9	17.8	13.8	7.4	9.8	
Eutamias a. ochraceus:								
Siskiyou Mountains, Calif.	161049	♂	33.5	18.4	14.5	7.8	9.6	Do.
Siskiyou, Oreg.	65693	♀	33.2	18.4	14.5	7.8	10.5	
Eutamias a. monoensis:								
Leevining Creek, Calif.	[3] 23380	♂	32.2	17.8	15	7.5	10.1	Do.
Do.	[3] 23379	♀	33	17.9	14.5	8	10.2	
Eutamias a. luteiventris:								
St. Marys Lake, Mont.	72471	♂	34.4	19.2	15	7.6	10.5	
Do.	72456	♀	33.7	18.9	14.9	7.6	10.5	
Eutamias a. vallicola:								
Bitterroot Valley, Mont.	168027	♀	33.6	18.8	15	7.5	11.3	Do.
Do.	168028	♂	34.5	19.1	15.5	7.5	11.1	
Eutamias a. canicaudus:								
Spokane, Wash.	34428	♀	34.3	19	15.5	7.4	11	Do.
Do.	31373	♂	35.6	18.6	15	7.8	10.7	
Eutamias a. affinis:								
Ashcroft, British Columbia.	[4] 1500	♀	34.3	18.7	14.9	7.8	10.9	Do.
Do.	67017	♂	35.3	18.9	14.9	7	11.3	
Eutamias a. ludibundus:								
Yellowhead Lake, British Columbia.	174225	♀	33.6	19.3	15.1	7.4	11	Do.
Moose River, British Columbia.	174091	♂	34	18.6	15.2	7.4	11.5	
Eutamias a. felix:								
Mount Baker Range, British Columbia.	87966	♂	34.5	19.2	15.1	7.3	10.7	
Do.	87963	♀	34	19.5	14.8	7.1	10.5	

[1] Measured directly posterior to zygomata.
[2] Amer. Mus. Nat. Hist.
[3] Mus. Vert. Zool.
[4] Amer. Mus. Nat. Hist.

TABLE 2.—*Cranial measurements of typical adults of Eutamias*—Continued

Species and locality	No.	Sex	Greatest length	Zygomatic breadth	Cranial breadth[1]	Interorbital breadth	Length of nasals	Remarks
Eutamias a. caurinus:								
Olympic Mountains, Wash.	90636	♂	34.3	19.4	14.8	7.2	10.7	Type.
Do	[5] 232	♀	33.4	19.2	14.9	7.6	10.4	
Eutamias panamintinus:								
Panamint Mountains, Calif.	39702	♂	34.7	18.9	15	8	11.2	Do.
Do	40555	♀	34	18.7	15	7.7	10.4	
Eutamias quadrivittatus quadrivittatus:								
Canyon City, Colo	54140	♀	36.3	19.9	15.7	8.2	11.5	
Do	47904	♂	35.8	19.3	15.7	8.2	11.4	
Eutamias q. hopiensis:								
Keam Canyon, Ariz	67767	♂	36.1	19.7	15.2	8.2	11.5	
Do	66553	♀	35	19.3	15.1	7.8	10.4	
Eutamias q. inyoensis:								
White Mountains, Calif	[3] 27308	♂	35.3	19.4	15.2	8	11.2	
Do	[3] 27296	♀	36.5	20.2	15.9	8.2	11.9	
Eutamias q. frater:								
Donner, Calif	88662	♀	36.1	20	14.6	7.8	11.8	
Do	55773	♂	34.8	19.7	14.8	7.9	10.7	Old adult.
Eutamias q. sequoiensis:								
Mineral King, Calif	42799	♀	36.8	19.4	14.9	8.2	12.5	Type.
Sequoia National Park	42164	♂	35.4	19.3	15	8.2	11.8	
Eutamias q. speciosus:								
San Bernardino Mountains, Calif.	186462	♂	34.9	19.1	15	7.9	11.4	Do.
Do	90060	♀	36.7	20	15.1	7.6	12.3	
Eutamias callipeplus:								
Mount Piños, Calif	55967	♀	36	19.3	14.8	8.5	12.3	Old adult.
Do	55987	♂	35.4	19	14.6	8.3	11.9	
Eutamias palmeri:								
Charleston Peak, Nev	33481	♂	35.9	19.7	15.4	8.5	11	Type.
Do	208908	♀	36.3	19.9	15.4	8.2	10.7	
Eutamias adsitus:								
Beaver Mountains, Utah	158123	♀	35.9	19.6	15.3	8.8	11.5	
Do	158121	♂	34.5	19	15.7	8.3	10.5	
Eutamias umbrinus:								
Uinta Mountains, Utah	30032	♂	33.4	19	15.3	7.8	10.7	
Do	30033	♀	34.4	18.8	14.5	7.9	11.1	
Eutamias ruficaudus ruficaudus:								
St. Marys Lake, Mont	72294	♀	35.2	19.5	15.6	7.6	11.2	Do.
Do	72292	♂	36.2	20	14.7	8.2	11.3	
Eutamias r. simulans:								
Cœur d'Alene, Idaho	40591	♀	35	19.3	15.8	7.8	12.1	Do.
Do	40592	♂	34.3	19.4	15.3	7.4	11.2	
Eutamias cinereicollis cinereicollis:								
San Francisco Mountain, Ariz.	24533	♀	35.7	20.2	15	7.9	11.3	Do.
Do	24525	♂	36.3	20	15.2	8.6	10.9	
Eutamias c. cinereus:								
Magdalena Mountains, N. Mex.	167029	♂	35.8	19.5	15.3	7.8	10.5	Subadult (type).
Do	167031	♀	36.7	19.4	15.4	7.8	11.6	Do.
Eutamias c. canipes:								
Guadalupe Mountains, Tex.	109229	♀	36.5	19.4	15.4	8.1	11.9	Type.
Do	109228	----	36.8	19.3	14.9	7.9	12.3	Subadult.
Eutamias bulleri bulleri:								
Valparaiso Mountains, Zacatecas, Mexico.	91967	♂	38.6	20.7	15.9	8.6	12.5	
Do	91974	♀	37.9	20.4	16.1	8.4	12.5	
Eutamias b. durangæ:								
Arroyo de Bucy, Durango, Mexico.	[4] 21410	♀	38.7	21	16	9	12.5	Type.
Do	[4] 21403	----	38	20.6	16.3	8.4	12	
Eutamias b. solivagus:								
Sierra Guadalupe, Coahuila, Mexico.	116882	♀	36.6	19.5	15.8	8.3	12.1	Do.
Do	116887	----	37.3	20.7	16.1	8.7	11.9	
Eutamias townsendii townsendii:								
Portland, Oreg	142000	♀	39.5	21.8	17	9	12.4	Old adult.
Do	141998	♂	38	21.8	16.7	8.2	11.6	
Eutamias t. cooperi:								
Trout Lake, Wash	230527	♂	36.8	20.9	15.7	8.2	11.4	Do.
Do	230516	♀	38.7	21.4	16.4	8.6	12.1	Subadult.

[1] Measured directly posterior to zygomata.
[3] Mus. Vert. Zool.
[4] Amer. Mus. Nat. Hist.
[5] Field Mus. Nat. Hist.

TABLE 2.—*Cranial measurements of typical adults of Eutamias*—Continued

Species and locality	No.	Sex	Greatest length	Zygomatic breadth	Cranial breadth [1]	Interorbital breadth	Length of nasals	Remarks
Eutamias t. ochrogenys:								
Mendocino, Calif.	67174	♂	40.8	22.3	17.2	9	12.2	
Do	96111	♀	40	22.2	16.6	8.4	12.9	
Eutamias t. siskiyou:								
Siskiyou Mountains, Calif.	161033	♀	38.5	21.4	16.4	8.2	12.3	Type.
Do	91460	♀	39.2	21.4	16.3	8.4	12.8	
Eutamias t. senex:								
Donner, Calif.	186461	----	37.3	21.2	16.6	9	12.3	Old adult; type.
Do	55537	♀	39.1	22	16.4	8.7	12.7	Old adult.
Eutamias t. sonomæ:								
Guerneville, Calif.	[3] 20825	♀	38.3	21	15.4	-------	11.3	Type (old).
Cazadero, Calif.	[3] 20453	♀	39.6	21.3	16.5	9.2	12.7	Old adult.
Eutamias alleni:								
Nicasio, Calif.	68101	♀	36.8	20.2	15.4	8.5	12.2	
Do	68125	♀	39.3	20.6	15.7	9	12.3	Do
Eutamias quadrimaculatus:								
Michigan Bluff, Calif.	93764	♂	38.5	20	15.8	9.5	12.6	
Do	93760	♂	36.3	20.4	15.5	8.7	11.3	
Eutamias merriami merriami:								
San Bernardino Mountains, Calif.	56519	♀	40.1	21.6	16.1	9	14	
Do	127939	♂	38.3	20.6	15.8	9.4	12	
Eutamias m. pricei:								
Portola, Calif.	[4] 9552	♂	38.3	20.1	15.3	8.4	13.4	Type.
Santa Cruz, Calif.	63962	♀	39.3	20.3	15.9	8.1	13.7	
Eutamias m. kernensis:								
Fay Creek, Calif.	[3] 15022	♂	38.1	20.3	15.3	8.7	13.3	Do.
Do	[3] 15010	♀	38.9	20.6	16.1	9	12	Old adult.
Eutamias m. obscurus:								
San Pedro Martir Mountains, Lower California.	[5] 10585	♀	37.8	19.4	15	7.6	12.2	Do.
Do	[5] 10591	♀	36.4	19.9	15.5	7.8	12.1	
Eutamias m. meridionalis:								
Aguaje de San Esteban, Lower California.	139597	♀	35.5	18.2	15.1	8.4	11.1	Type; old adult.
Eutamias dorsalis dorsalis:								
Silver City, N. Mex.	66131	♀	36.5	20.1	15.1	8.6	11.5	
Pinos Altos Mountains, N. Mex.	51311	♀	38.7	21.1	16	8.7	12.8	Subadult.
Eutamias d. utahensis:								
Ogden, Utah	186457	♂	34.5	19.2	15.3	7.6	10.8	Type.
Do	55127	♀	36	20.2	15.7	8.2	10.4	Old adult.

[1] Measured directly posterior to zygomata.
[3] Mus. Vert. Zool.
[4] Amer. Mus. Nat. Hist.
[5] Field Mus. Nat. Hist.

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Following are the principal papers relating to American chipmunks; with these are included a number of faunal lists in which chipmunks are mentioned, preference being given to those treating of habits:

ABBOTT, C. C.

1884. A NATURALIST'S RAMBLES ABOUT HOME. p. 1–485.

Contains notes on hibernation of *Tamias striatus*.

ALLEN, J. A.

1874. ON GEOGRAPHICAL VARIATION IN COLOR AMONG NORTH AMERICAN SQUIRRELS; WITH A LIST OF THE SPECIES AND VARIETIES OF THE AMERICAN SCIURIDÆ OCCURRING NORTH OF MEXICO. Proc. Boston Soc. Nat. Hist. 16: 276–294, June.

Contains original description of *Tamias quadrivittatus* var. *pallidus* [*Eutamias minimus pallidus*].

1877. MONOGRAPHS OF NORTH AMERICAN RODENTIA. Rept. U. S. Geol. Surv. Terr. 11: 779–810.

Monographic revision of the American chipmunks, recognizing two species—*Tamias striatus* and *Tamias* [*Eutamias*] *asiaticus*—the latter with five varieties; complete synonymy and lists of specimens, but now entirely out of date with regard to species.

1889. NOTES ON A COLLECTION OF MAMMALS FROM SOUTHERN MEXICO, WITH DESCRIPTIONS OF NEW SPECIES OF THE GENERA SCIURUS, TAMIAS, AND SIGMODON. Bul. Amer. Mus. Nat. Hist. 2: 165–181, October 21.

Contains original descriptions of *Tamais asiaticus bulleri* [*Eutamias bulleri*] and *Tamias asiaticus merriami* [*Eutamias merriami*].

1890. A REVIEW OF SOME OF THE NORTH AMERICAN GROUND SQUIRRELS OF THE GENUS TAMIAS. Bul. Amer. Mus. Nat. Hist. 3: 45–116, June.

First revision of the genus *Eutamias* based on modern material; contains original descriptions of *Tamias* [*Eutamias*] *obscurus*, *T. senex*, *T. speciosus*, *T. frater*, *T. amœnus*, *T. cinereicollis*, *T. umbrinus*, *T. quadrivittatus gracilis*, *T. q. luteiventris*, *T. q. affinis*, *T. q. neglectus*, *T. minimus consobrinus*, and *T. m. pictus*.

1895. DESCRIPTIONS OF NEW AMERICAN MAMMALS. Bul. Amer. Mus. Nat. Hist. 7: 327–340, November 8.

Contains original description of *Tamias* [*Eutamias*] *pricei*.

1903. LIST OF MAMMALS COLLECTED BY MR. J. H. BATTY IN NEW MEXICO AND DURANGO, WITH DESCRIPTIONS OF NEW SPECIES AND SUBSPECIES. Bul. Amer. Mus. Nat. Hist. 19: 587–612, November 12.

Contains original description of *Eutamias durangæ*.

1904. FURTHER NOTES ON MAMMALS FROM NORTHWESTERN DURANGO. Bul. Amer. Mus. Nat. Hist. 20: 205–210, May 28.

Contains original description of *Eutamias canescens*.

1905. MAMMALS FROM BEAVER COUNTY, UTAH, COLLECTED BY THE MUSEUM EXPEDITION OF 1904. Brooklyn Inst. Mus. Science Bul. 1: 117–122, March 31.

Contains original descriptions of *Eutamias lectus* and *Eutamias adsitus*.

ALLISON, A.

1907. NOTES ON THE SPRING BIRDS OF TISHOMINGO COUNTY, MISSISSIPPI. The Auk 24: 12–25, January.

Contains mention of *Tamias striatus* and other mammals.

ANTHONY, A. W.

1924. HIBERNATING CHIPMUNKS. Journ. Mamm. 5: 76, February.

Account of finding several dormant individuals of *Eutamias townsendii* near Portland, Oreg.

ANTHONY, H. E.
1913. MAMMALS OF NORTHERN MALHEUR COUNTY, OREGON. Bul. Amer. Mus. Nat. Hist. 32: 1–27, March 7.
Contains original description of *Eutamias amœnus propinquus*.

AUDUBON, J. J., and J. BACHMAN.
1846–1854. THE VIVIPAROUS QUADRUPEDS OF NORTH AMERICA. 3 vols.: p. 1–384; 1–334; 1–348; pls. 1–155.
Contains (in vol. 1) extensive account of *Tamias striatus* [under the name *Tamias listeri*] and brief accounts of *Tamias* [*Eutamias*] *townsendii* and *Tamias quadrivittatus* [*Eutamias minimus* subsp.].

BACHMAN, J.
1839. DESCRIPTION OF SEVERAL NEW SPECIES OF AMERICAN QUADRUPEDS. Journ. Acad. Nat. Sci. Philadelphia 8: 57–74.
Contains original descriptions of *Tamias* [*Eutamias*] *townsendii* and *Tamias* [*Eutamias*] *minimus*, with a list of mammals collected by John K. Townsend on his transcontinental journey.

BAILEY, V.
1902. SEVEN NEW MAMMALS FROM WESTERN TEXAS. Proc. Biol. Soc. Washington 15: 117–120, June 2.
Contains original description of *Eutamias cinereicollis canipes*.

1905. BIOLOGICAL SURVEY OF TEXAS. North Amer. Fauna No. 25, p. 1–222, October 24.
Contains notes on habits of *Eutamias cinereicollis canipes*.

1913. TEN NEW MAMMALS FROM NEW MEXICO. Proc. Biol. Soc. Washington 26: 129–134, May 21.
Contains original descriptions of *Eutamias atristriatus* and *Eutamias cinereicollis cinereus*.

1918. A NEW SUBSPECIES OF CHIPMUNK FROM THE YELLOWSTONE NATIONAL PARK. Proc. Biol. Soc. Washington 31: 31–32, May 16.
Contains original description of *Eutamias consobrinus clarus*.

1919. WILD ANIMALS OF GLACIER NATIONAL PARK. The mammals, with notes on physiography and life zones. Publication (not numbered) of National Park Service, U. S. Dept. of Int., 1918, p. 25–102. (Dated 1918 but issued January 10, 1919.)
Contains accounts of habits of *Eutamias amœnus luteiventris*, *E. ruficaudus* (under the name *E. umbrinus felix*), and *E. oreocetes*.

1926. A BIOLOGICAL SURVEY OF NORTH DAKOTA. North Amer. Fauna No. 49, p. 1–226, December.
Contains accounts of habits of *Tamias striatus griseus*, *Eutamias minimus borealis* and *E. m. pallidus*.

BAIRD, S. F.
1855a. CHARACTERISTICS OF SOME NEW SPECIES OF MAMMALIA, COLLECTED BY THE U. S. AND MEXICAN BOUNDARY SURVEY, MAJOR W. H. EMORY U. S. A., COMMISSIONER. Proc. Acad. Nat. Sci. Philadelphia 7: 331–333, April.
Contains original description of *Tamias* [*Eutamias*] *dorsalis*.

1855b. CHARACTERISTICS OF SOME NEW SPECIES OF NORTH AMERICAN MAMMALIA, COLLECTED CHIEFLY IN CONNECTION WITH THE U. S. SURVEYS OF A RAILROAD ROUTE TO THE PACIFIC. Proc. Acad. Nat. Sci. Philadelphia 7: 333–336, April.
Contains original description of *Tamias cooperi* [*Eutamias townsendii cooperi*].

1857a. [REPORT OF THE ASSISTANT SECRETARY]. 11th Ann. Rept. Smithsonian Inst. for 1856, p. 47–68.
The Asiatic chipmunk shown to be distinct from the American and named *Tamias pallasii*.

1857b. [MAMMALS OF NORTH AMERICA]. Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean 8, pt. 1: i–xlviii; 1–757.
Contains monographic treatment of *Tamias striatus*, *T.* [*Eutamias*] *quadrivittatus*. *T.* [*Eutamias*] *townsendii*, and *T.* [*Eutamias*] *dorsalis*.

BAIRD, S. F.—Continued.
1859. MAMMALS OF THE BOUNDARY. U. S. and Mexican Boundary Survey 2, pt. 2: 1–62; pls. 1–27.
Contains full account of *Tamias* [*Eutamias*] *dorsalis*.

BANGS, O.
1896. SOME NEW MAMMALS FROM INDIAN TERRITORY AND MISSOURI. Proc. Biol. Soc. Washington 10: 135–138, December 28.
Contains original description of *Tamias striatus venustus*.

BROOKS, A.
1902. MAMMALS OF THE CHILLIWACK DISTRICT, B. C. Ottawa Naturalist 15: 239–244.
Brief account of *Eutamias townsendii* and *E. quadrivittatus* [*amœnus*] *felix*.

BROWN, C. E.
1913. A POCKET LIST OF THE MAMMALS OF EASTERN MASSACHUSETTS, WITH ESPECIAL REFERENCE TO ESSEX COUNTY. Peabody Acad. Sci. (Salem, Mass.), p. 1–48.
Contains brief notes on habits of *Tamias striatus*.

CARY, M.
1906. IDENTITY OF EUTAMIAS PALLIDUS (ALLEN), WITH A DESCRIPTION OF A RELATED FORM FROM THE SOUTH DAKOTA BAD LANDS. Proc. Biol. Soc. Washington 19: 87–90, June 4.
Eutamias pallidus revived; original description of *E. pallidus cacodemus*.

1911. A BIOLOGICAL SURVEY OF COLORADO. North Amer. Fauna No. 33, p. 1–256, August 17.
Contains full accounts (life histories and distribution) of *Eutamias quadrivittatus quadrivittatus, E. quadrivittatus hopiensis, E. minimus operarius, E. minimus minimus, E. minimus caryi, E. minimus consobrinus*, and *E. dorsalis utahensis*.

CATESBY, M.
1731, 1743. THE NATURAL HISTORY OF CAROLINA, FLORIDA, AND THE BAHAMA ISLANDS, ETC. 1: 1–100, 1731; 2: i–xliv, 1–20, 1–100, 1743.
Contains [vol. 2, p. 75] the first description and figure of the eastern chipmunk, under the name *Sciurus striatus*.

CORY, C. B.
1912. THE MAMMALS OF ILLINOIS AND WISCONSIN. Publ. Field Mus. Nat. Hist. (zool. ser.) 11: 1–505.
Contains extensive notes on habits and distribution of *Tamias striatus griseus* and *Eutamias borealis neglectus* [*E. minimus jacksoni*].

DEKAY, J. E.
1842. ZOOLOGY OF NEW YORK, OR THE NEW YORK FAUNA. Part 1, Mammalia, p. i–xiii, 1–146; pls. 1–33.
Contains account of the eastern chipmunk under the name *Sciurus striatus*.

ELLIOT, D. G.
1903. DESCRIPTIONS OF APPARENTLY NEW SPECIES AND SUBSPECIES OF MAMMALS FROM CALIFORNIA, OREGON, THE KENAI PENINSULA, ALASKA, AND LOWER CALIFORNIA, MEXICO. Field Columbian Mus. Publ. Zool. 3: 153–173, April.
Contains original description of *Tamias* [*Eutamias*] *t. littoralis*.

1905. DESCRIPTIONS OF APPARENTLY NEW SPECIES AND SUBSPECIES OF MAMMALS FROM MEXICO AND SAN DOMINGO. Proc. Biol. Soc. Washington 18: 233–236, December 9.
Contains original description of *Tamias nexus* [*Eutamias bulleri durangæ*].

EVERMANN, B. W., and H. W. CLARK.
1911. NOTES ON THE MAMMALS OF THE LAKE MAXINKUCKEE REGION [INDIANA]. Proc. Washington Acad. Sci. 13 (no. 1): 1–34, February 15.
Contains extended account of habits of *Tamias striatus*.

FORBUSH, E. H.
1904. SPECIAL REPORT ON THE DECREASE OF CERTAIN BIRDS, AND ITS CAUSES, WITH SUGGESTIONS FOR BIRD PROTECTION. Fifty-second Ann. Rept. Mass. State Board Agr., p. 429–543.
Contains mention of two instances of the eastern chipmunk attacking birds (p. 505–506).

GMELIN, J. F.
1788. SYSTEMA NATURAE 1: 1–500.
The eastern chipmunk named *Sciurus striatus americanus* (p. 130).

GRAY, J. E.
1842. DESCRIPTIONS OF SOME NEW GENERA AND FIFTY UNRECORDED SPECIES OF MAMMALIA. Ann. and Mag. Nat. Hist. 10: 255–267, December.
Contains original description of *Tamias hindei* (typographical error for *hindsii*) [=*Eutamias townsendii*].

1867. SYNOPSIS OF THE SPECIES OF BURROWING SQUIRRELS (TAMIAS) IN THE BRITISH MUSEUM. Ann. and Mag. Nat. Hist. (ser. 3) 20: 434–436, December.
Original description of *Tamias* [*Eutamias*] *quadrimaculatus;* six species of American chipmunks recognized: *Tamias* [*Eutamias*] *quadrivittatus, T. hindsii, T. townsendii, T. quadrimaculatus, T. americanus* [=*striatus*], and *T. dorsalis.*

GRINNELL, J.
1908. THE BIOTA OF THE SAN BERNARDINO MOUNTAINS. Univ. Calif. Publ. Zool. 5 (no. 1): 134–160, Mammals, December 31.
Contains notes on habits of *Eutamias speciosus* and *E. merriami.*

1915. EUTAMIAS SONOMAE, A NEW CHIPMUNK FROM THE INNER NORTHERN COAST BELT OF CALIFORNIA. Univ. Calif. Publ. Zool. 12 (no. 11): 321–325, January 20.

GRINNELL, J., and T. I. STORER.
1916. DIAGNOSES OF SEVEN NEW MAMMALS FROM EAST-CENTRAL CALIFORNIA. Univ. Calif. Publ. Zool. 17 (no. 1): 1–8, August 23.
Contains original descriptions of *Eutamias amœnus monoensis, E. merriami mariposæ* and *E. merriami kernensis.*

1924. ANIMAL LIFE IN THE YOSEMITE. An account of the mammals, birds, reptiles, and amphibians in a cross section of the Sierra Nevada, p. i–xviii, 1–752; pls. 1–62, Univ. Calif. Press.
Contains extended accounts of habits of *Eutamias speciosus frater, E. senex, E. merriami mariposæ, E. quadrimaculatus, E. alpinus, E. amœnus monoensis,* and *E. pictus.*

HAHN, W. L.
1909. THE MAMMALS OF INDIANA. 33d Ann. Rept. Dept. Geol. and Natural Resources of Indiana, p. 41–663.
Contains full account of habits of *Tamias striatus.*

HOLLISTER, N.
1911. FOUR NEW MAMMALS FROM THE CANADIAN ROCKIES. Smithsonian Misc. Coll. 56 (no. 26): 1–4, December 5.
Contains original description of *Eutamias ludibundus.*

HOWELL, A. B.
1924. THE MAMMALS OF MAMMOTH, MONO COUNTY, CALIFORNIA. Journ. Mamm. 5: 25–36, February.
Contains notes on zonal ranges of 7 subspecies of *Eutamias.*

HOWELL, A. H.
1920. DESCRIPTION OF A NEW CHIPMUNK FROM GLACIER NATIONAL PARK, MONTANA. Proc. Biol. Soc. Washington 33: 91–92, December 30.
Original description of *Eutamias ruficaudus.*

1921. A BIOLOGICAL SURVEY OF ALABAMA. North Amer. Fauna No. 45, p. 1–88, October 24.
Contains account of habits and distribution in Alabama of *Tamias striatus venustus.*

1922. DIAGNOSES OF SEVEN NEW CHIPMUNKS OF THE GENUS EUTAMIAS, WITH A LIST OF THE AMERICAN SPECIES. Journ. Mamm. 3: 178–185, August.
Original descriptions of *Eutamias minimus arizonensis, E. amœnus vallicola, E. ruficaudus simulans, E. bulleri solivagus, E. speciosus sequoiensis, E. townsendii siskiyou,* and *E. townsendii alleni* [=*E. alleni*].

1925. PRELIMINARY DESCRIPTIONS OF FIVE NEW CHIPMUNKS FROM NORTH AMERICA. Journ. Mamm. 6: 51–54, February 15.
Original descriptions of *Tamias striatus fisheri, Eutamias minimus grisescens, E. minimus confinis, E. minimus jacksoni,* and *E. amœnus ochraceus.*

ILLIGER, J. K. W.
1811. PRODROMUS SYST. MAM. ET AVIUM, p. i–xviii, 1–302.
First use of the generic name Tamias.

KENNICOTT, R.

1857. THE QUADRUPEDS OF ILLINOIS INJURIOUS AND BENEFICIAL TO THE FARMER. Rept. Commr. Patents for 1856, p. 52–110.

Contains an account of *Tamias striatus*, with notes on its food and general habits.

KLUGH, A. B.

1923. NOTES ON THE HABITS OF THE CHIPMUNK TAMIAS STRIATUS LYSTERI. Journ. Mamm. 4: 29–32, February.

LINNÆUS, C.

1754. MUS. ADOLPHI FRIDERICI REGIS.

Contains original description of the American chipmunk under the name *Sciurus striatus*.

1758. SYSTEMA NATURÆ 1: 1–824.

Contains description of *Sciurus striatus* [=*Tamias striatus*] (previously described by him in 1754.

LYON, M. W., JR.

1907. NOTES ON MAMMALS COLLECTED AT MT. RAINIER, WASHINGTON. Smithsonian Misc. Coll. 50: 89–92, June 27.

Eutamias cooperi (Baird) revived and type locality designated.

MEARNS, E. A.

1891. DESCRIPTION OF A NEW SUBSPECIES OF THE EASTERN CHIPMUNK, FROM THE UPPER MISSISSIPPI REGION, WEST OF THE GREAT LAKES. Bul. Amer. Mus. Nat. Hist. 3: 229–233, June 5.

Contains original description of *Tamias s. griseus*.

1898. A STUDY OF THE VERTEBRATE FAUNA OF THE HUDSON HIGHLANDS, WITH OBSERVATIONS ON THE MOLLUSCA, CRUSTACEA, LEPIDOPTERA, AND THE FLORA OF THE REGION. Bul. Amer. Mus. Nat. Hist. 10: 303–352, September 9.

Contains brief account of habits of *Tamias striatus*.

1907. MAMMALS OF THE MEXICAN BOUNDARY OF THE UNITED STATES. Bul. 56, U. S. Nat. Mus., p. 1–530.

Contains extended life histories and technical descriptions of *Eutamias cinereicollis*, *E. dorsalis*, and *E. merriami*.

MERRIAM, C. H.

1883. CHIPMUNKS AND RED SQUIRRELS. Forest and Stream 21: 103, September 6.

Account of a migration of chipmunks in Lewis County, N. Y., from June 30-July 10, 1883.

1882, 1884. THE VERTEBRATES OF THE ADIRONDACK REGION, NORTHEASTERN NEW YORK. Trans. Linnæan Soc. New York 1: 1–106, 1882; 2: 1–214, 1884.

Contains extended account (v. 2, p. 135–141) of life history of *Tamias striatus*.

1886a. DESCRIPTION OF A NEW SPECIES OF CHIPMUNK FROM CALIFORNIA (TAMIAS MACRORHABDOTES SP. NOV.). Proc. Biol. Soc. Washington 3: 25–28, January 27.

Original description of *Tamias macrorhabdotes* [*Eutamias quadrimaculatus*].

1886b. DESCRIPTION OF A NEW SUBSPECIES OF CHIPMUNK (TAMIAS STRIATUS LYSTERI). Amer. Nat. 20 (no. 2): 236–242, February.

First division of the species *Tamias striatus* into two races; Richardson's name *lysteri* revived for the northern race.

1890. DESCRIPTIONS OF FIVE NEW GROUND SQUIRRELS OF THE GENUS TAMIAS. North Amer. Fauna No. 4, p. 17–22, October 8.

Contains original descrlption of *Tamias minimus melanurus* [*Eutamias m. pictus*].

1891. RESULTS OF A BIOLOGICAL RECONNOISSANCE OF SOUTH-CENTRAL IDAHO. North Amer. Fauna No. 5, p. 1–127, July 30.

Contains accounts and detailed measurements of *Tamias quadrivittatus amœnus* [*Eutamias amœnus amœnus*] and *Tamias* [*Eutamias*] *minimus pictus*.

1893. DESCRIPTIONS OF EIGHT NEW GROUND SQUIRRELS OF THE GENERA SPERMOPHILUS AND TAMIAS FROM CALIFORNIA, TEXAS, AND MEXICO. Proc. Biol. Soc. Washington, 8: 129–138, December 28.

Contains original descriptions of *Tamias* [*Eutamias*] *panamintinus*, *T.* [*Eutamias*] *callipeplus*, and *T.* [*Eutamias*] *alpinus*.

MERRIAM, C. H.—Continued.

1897. NOTES ON THE CHIPMUNKS OF THE GENUS EUTAMIAS OCCURRING WEST OF THE EAST BASE OF THE CASCADE-SIERRA SYSTEM, WITH DESCRIPTIONS OF NEW FORMS. Proc. Biol. Soc. Washington 11: 189–212, July 1.

Distribution; seasonal changes in pelage; list of species and subspecies; remarks on the *townsendii* and *speciosus* groups, and on *Eutamias quadrimaculatus*. Original descriptions of *E. townsendii ochrogenys, E. oreocetes, E. speciosus inyoensis, E. palmeri*, and *E. dorsalis utahensis*.

1898. DESCRIPTIONS OF THREE NEW RODENTS FROM THE OLYMPIC MOUNTAINS, WASHINGTON. Proc. Acad. Nat. Sci. Philadelphia, 1898: 352–353, October 4.

Contains original description of *Eutamias caurinus*.

1899. RESULTS OF A BIOLOGICAL SURVEY OF MOUNT SHASTA, CALIFORNIA. North Amer. Fauna No. 16, p. 1–179, October 28.

Contains accounts of habits of *Eutamias amœnus* and *E. senex*.

1903. EIGHT NEW MAMMALS FROM THE UNITED STATES. Proc. Biol. Soc. Washington 16: 73–78, May 29.

Contains original description of *Eutamias canicaudus*.

1905. TWO NEW CHIPMUNKS FROM COLORADO AND ARIZONA. Proc. Biol. Soc. Washington 18: 163–166, June 29.

Contains original descriptions of *Eutamias hopiensis* and *E. amœnus operarius*. The name *Eutamias quadrivittatus* shown to apply to the larger of the two forms occurring in the mountains of eastern Colorado.

1906. IS MUTATION A FACTOR IN THE EVOLUTION OF THE HIGHER VERTEBRATES? Proc. Amer. Assoc. Adv. Science 55: 383–408.

Contains extended remarks on the distribution of chipmunks in California.

1908. THREE NEW RODENTS FROM COLORADO. Proc. Biol. Soc. Washington 21: 143–144, June 9.

Contains original description of *Eutamias minimus caryi*.

MILLER, G. S., JR.

1897. NOTES ON THE MAMMALS OF ONTARIO. Proc. Boston Soc. Nat. Hist. 28: 1–44, April.

Contains brief accounts of *Tamias striatus lysteri* and *T. striatus griseus;* and a fuller account of habits of *Tamias quadrivittatus neglectus* [*Eutamias minimus borealis*].

NELSON, E. W.

1918. SMALLER MAMMALS OF NORTH AMERICA. Natl. Geog. Mag. 33 (no. 5): 371–493, May.

Contains accounts, with illustrations, of *Tamias striatus, Eutamias townsendii*, and *Eutamias minimus pictus*.

NELSON, E. W., and E. A. GOLDMAN.

1909. ELEVEN NEW MAMMALS FROM LOWER CALIFORNIA. Proc. Biol. Soc. Washington 22: 23–28, March 10.

Contains original description of *Eutamias merriami meridionalis*.

OSGOOD, W. H.

1900. MAMMALS OF THE YUKON REGION. *In* North Amer. Fauna. No. 19, p. 21–100, October 6.

Contains original description of *Eutamias caniceps*.

PALLAS, P. S.

1778. NOVÆ SPECIES QUADRUPEDUM E GLIRIUM ORDINE, p. i–viii, 1–388.

Contains first description of the Asiatic chipmunk, under the name *Sciurus striatus*.

PREBLE, E. A.

1908. A BIOLOGICAL INVESTIGATION OF THE ATHABASKA-MACKENZIE REGION. North Amer. Fauna No. 27, p. 1–574, October 26.

Contains detailed notes on habits and distribution of *Eutamias borealis*.

REED, H. D., and A. H. WRIGHT.

1909. THE VERTEBRATES OF THE CAYUGA LAKE BASIN, NEW YORK. Proc. Amer. Philos. Soc. 48 (no. 193): 370–459.

Contains brief note on habits of *Tamias striatus*.

RHOADS, S. N.

1895. ADDITIONS TO THE MAMMAL FAUNA OF BRITISH COLUMBIA. Amer. Nat. 29: 940–942, October.

Contains original description of *Tamias quadrivittatus felix* [*Eutamias amœnus felix*].

RHOADS, S. N.—Continued.
1903. THE MAMMALS OF PENNSYLVANIA AND NEW JERSEY, p. 1–266, Philadelphia (privately published).
Contains extended notes on life history of *Tamias striatus*.

RICHARDSON, J.
1829. FAUNA BOREALI-AMERICANA. Part First. Quadrupeds, p. i–xlvi, 1–300, London.
Contains original description of *Sciurus (Tamias) lysteri*.

ROBINSON, W.
1923. WOODCHUCKS AND CHIPMUNKS. Journ. Mamm. 4 (no. 4): 256–257, November.
Account of a hibernating individual of *Tamias striatus*.

ROWLEY, J.
1902. THE MAMMALS OF WESTCHESTER COUNTY, NEW YORK. Abst. Proc. Linnæan Soc. New York, nos. 13–14, p. 31–60.
Contains notes on habits of *Tamias striatus*.

SAY, T. [*in* EDWIN JAMES].
1823. ACCOUNT OF AN EXPEDITION FROM PITTSBURGH TO THE ROCKY MOUNTAINS, PERFORMED IN THE YEARS 1819 AND 1820, UNDER THE COMMAND OF MAJOR STEPHEN H. LONG. FROM THE NOTES OF MAJOR LONG, MR. T. SAY, AND OTHER GENTLEMEN OF THE EXPLORING PARTY. Compiled by Edwin James. Vol. 1, p. 1–503; vol. 2, p. 1–442+ appendix i–xcviii.
Contains original description of *Sciurus [Eutamias] quadrivittatus* (vol. 2, p. 45).

SCHREBER, J. C. D.
1785. SÄUGTHIERE 4: 790–802.
Extended account of "*das schwarz gestreifte Erd-Eichhorn*" under the name *Sciurus striatus*; the American chipmunk first clearly separated from the Asiatic chipmunk.

SETON, E. T.
1909. LIFE HISTORIES OF NORTHERN ANIMALS. An account of the mammals of Manitoba. Vol. 1, Grass-eaters, p. i–xxx, 1–673, New York.
Contains extended life histories of *Tamias striatus griseus* and *Eutamias quadrivittatus neglectus* [=*E. minimus borealis*].

1925–1928. LIVES OF GAME ANIMALS. 4 vols.: p. 1–640; 1–746; 1–780; 1–949; illus. Garden City, N. Y.
Contains (v. 4, p. 170–215) extended life histories of *Eutamias minimus* and *Tamias striatus*.

SHERMAN, A. R.
1926. PERIODICITY IN THE CALLING OF A CHIPMUNK. Journ. Mamm. 7: p. 331–332, November.
Notes on voice and feeding habits of *Tamias striatus griseus*.

SHUFELDT, R. W.
1919. THE CHIPMUNK. Country Life 35 (no. 6): 98 and 102, April.
Notes on habits and partial hibernation of *Tamias striatus*.

SOPER, J. D.
1920. NOTES ON THE MAMMALS OF RIDOUT, DISTRICT OF SUDBURY, ONTARIO. Canadian Field-Naturalist 34 (no. 4): 61–69, April.
Contains notes on habits of *Eutamias quadrivittatus neglectus* [=*E. minimus borealis*] and *Tamias striatus lysteri*.

STEPHENS, F.
1906. CALIFORNIA MAMMALS, p. 1–351, San Diego.
Contains descriptions and ranges of *Eutamias alpinus, E. amœnus, E. pictus, E. panamintinus, E. speciosus speciosus, E. s. callipeplus, E. s. inyoensis, E. s. frater, E. quadrimaculatus, E. quadrimaculatus [townsendii] senex, E. hindsi [alleni], E. hindsi [merriami] pricei, E. merriami merriami*, and *E. townsendi ochrogenys*.

STONE, W.
1908.. THE MAMMALS OF NEW JERSEY. Ann. Rept. New Jersey State Mus., 1907, p. 33–110.
Contains account of habits of *Tamias striatus*.

STONE, W., and W. E. CRAM.
1902. AMERICAN ANIMALS, p. 1–318, New York.
Contains extensive account of habits of *Tamias striatus*.

SWARTH, H. S.
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Habits of *Eutamias merriami, E. quadrivittatus frater,* and *E. alpinus;* photographs of *E. alpinus, E. frater,* and *E. quadrimaculatus.*

1922. BIRDS AND MAMMALS OF THE STIKINE RIVER REGION OF NORTHERN BRITISH COLUMBIA AND SOUTHEASTERN ALASKA. Univ. Calif. Publ. Zool. 24: 125–314, June 17.

Habits of *Eutamias borealis* [*minimus*] *caniceps* as observed in the Telegraph Creek region, British Columbia.

1924. BIRDS AND MAMMALS OF THE SKEENA RIVER REGION OF NORTHERN BRITISH COLUMBIA. Univ. Calif. Publ. Zool. 24: 315–394, January 24.

Brief notes on habits of *Eutamias amœnus ludibundus* as observed at Hazelton, British Columbia.

TAYLOR, W. P.
1911. MAMMALS OF THE ALEXANDER NEVADA EXPEDITION OF 1909. Univ. Calif. Publ. Zool. 7 (no. 7): 205–307, June 24.

Contains account of habits and distribution of *Eutamias a. pictus.*[49]

TAYLOR, W. P., and W. T. SHAW.
1927. MAMMALS AND BIRDS OF MOUNT RAINIER NATIONAL PARK. Publication (not numbered) of National Park Service, U. S. Dept. of Int., p. 1–249.

Contains accounts of habits of *Eutamias townsendii cooperi* and *E. amœnus caurinus.*

TOWNSEND, J. K.
1839. NARRATIVE OF A JOURNEY ACROSS THE ROCKY MOUNTAINS, TO THE COLUMBIA RIVER, ETC., p. 1–352, Philadelphia.

Contains description (p. 321) and habits of *Tamias* [*Eutamias*] *townsendii.*

WALKER, A.
1923. A NOTE ON THE WINTER HABITS OF EUTAMIAS TOWNSENDII. Journ. Mamm. 4 (no. 4): 257, November.

Note on a hibernating individual.

WARREN, E. R.
1909. A NEW CHIPMUNK FROM COLORADO. Proc. Biol. Soc. Washington 22: 105–106, June 25.

Contains original description of *Eutamias quadrivittatus animosus.*

1910. THE MAMMALS OF COLORADO, p. 1–300, New York.

Contains accounts of *Eutamias dorsalis utahensis, E. quadrivittatus quadrivittatus, E. q. animosus, E. q. hopiensis, E. amœnus* [*minimus*] *operarius, E. minimus minimus. E. m. consobrinus,* and *E. m. caryi,* with illustrations and distribution map.

WOOD, F. E.
1910. A STUDY OF THE MAMMALS OF CHAMPAIGN COUNTY, ILLINOIS. Bul. Illinois State Laboratory of Natural History 8: 501–613.

Contains extended notes on habits of *Tamias striatus.*

[49] Part of the specimens recorded under this name are referable to *E. amœnus monoensis.*

PLATE 3

(Slightly less than natural size)

A. *Tamias striatus striatus*, ♂ ad., Roan Mountain, N. C. (No. 54742, U. S. Nat. Mus., Biological Survey collection).

B. *Tamias striatus lysteri*, ♂ ad., Emsdale, Ontario (No. 75860, U. S. Nat. Mus., Biological Survey collection).

C. *Tamias striatus griseus*, ♂ ad., Fort Snelling, Minn. (No. 122227, U. S. Nat. Mus.).

D. *Tamias striatus venustus*, ♀ ad., Stilwell, Okla. (No. 87264, U. S. Nat. Mus., Biological Survey collection).

E. *Tamias striatus fisheri*, ♂ ad., Ossining, N. Y. (No. 135551, U. S. Nat. Mus.).

F. *Eutamias townsendii townsendii*, ♀ ad., Portland, Oreg. (No. 142000, U. S. Nat. Mus.).

G. *Eutamias townsendii cooperi*, ♀ ad., Mount Adams, Wash. (No. 226735, U. S. Nat. Mus., Biological Survey collection).

H. *Eutamias townsendii ochrogenys*, ♀ ad., Mendocino, Calif. (No. 91604, U. S. Nat. Mus., Biological Survey collection).

I. *Eutamias townsendii senex*, ♀ ad., Donner, Calif. (No. 55203, U. S. Nat. Mus., Biological Survey collection).

J. *Eutamias townsendii siskiyou*, ♀ ad., Siskiyou Mountains, Calif. (No. 91460, U. S. Nat. Mus., Biological Survey collection).

K. *Eutamias alleni*, ♀ ad., Nicasio, Calif. (No. 68096, U. S. Nat. Mus., Biological Survey collection).

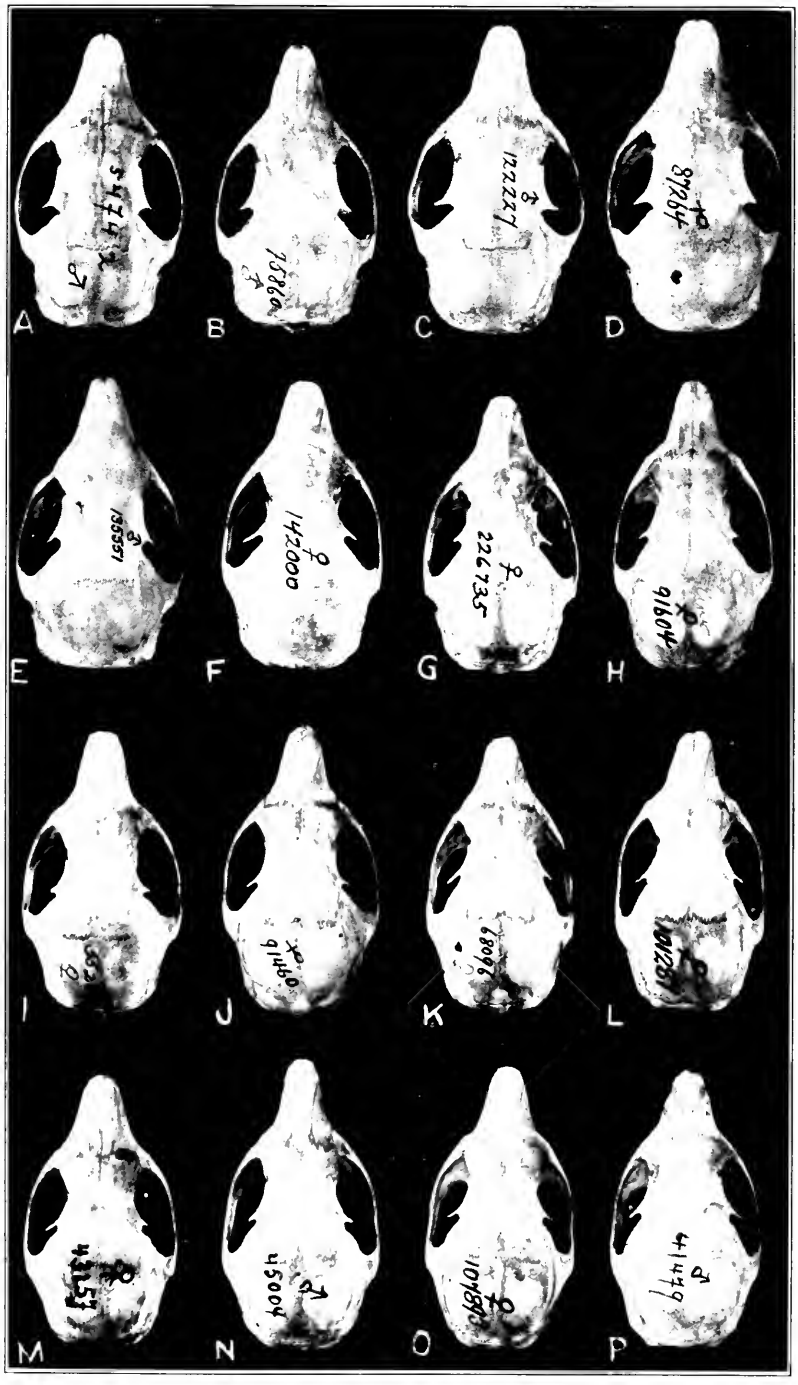
L. *Eutamias townsendii sonomae*, ♀ ad., Mount St. Helena, Calif. (No. 101287, U. S. Nat. Mus., Biological Survey collection).

M. *Eutamias quadrimaculatus*, ♀ ad., Michigan Bluff, Calif. (No. 43157, U. S. Nat. Mus., Biological Survey collection).

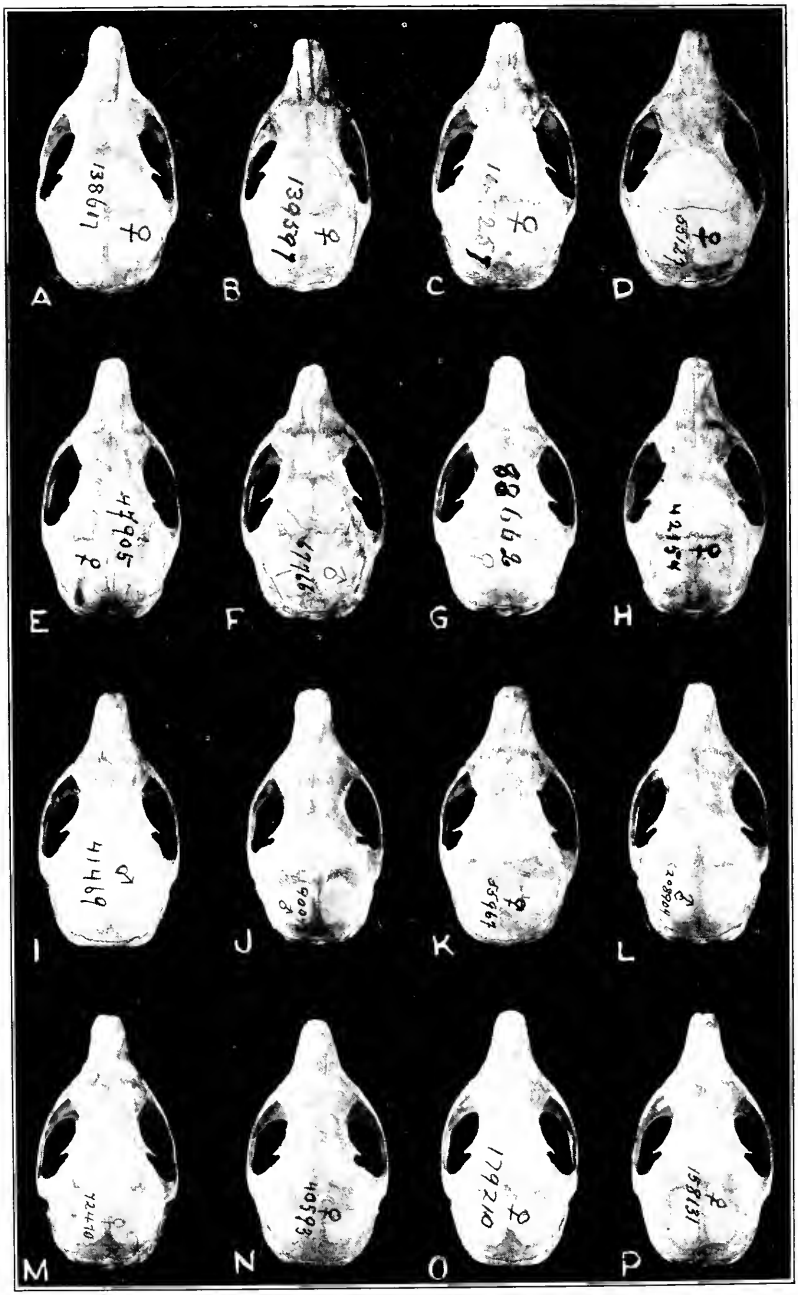
N. *Eutamias merriami merriami*, ♂ ad., San Bernardino Mountains, Calif. (No. 45004, U. S. Nat. Mus., Biological Survey collection).

O. *Eutamias merriami pricei*, ♀ ad., Santa Cruz Mountains, Calif. (No. 107893, U. S. Nat. Mus., Biological Survey collection).

P. *Eutamias merriami kernensis*, ♂ ad., Kernville, Calif. (No. 41479, U. S. Nat. Mus., Biological Survey collection).



SKULLS OF TAMIAS AND EUTAMIAS



SKULLS OF EUTAMIAS

PLATE 4

(Slightly less than natural size)

A. *Eutamias merriami obscurus*, ♀ ad., San Pedro Martir Mountains, Lower California, Mexico (No. 138617, U. S. Nat. Mus., Biological Survey collection).

B. *Eutamias merriami meridionalis*, ♀ ad. (type), Aguaje de San Esteban, Lower California, Mexico (No. 139597, U. S. Nat. Mus., Biological Survey collection).

C *Eutamias dorsalis dorsalis*, ♀ ad., Head of Mimbres River, N. Mex. (No. 147257, U. S. Nat. Mus., Biological Survey collection).

D. *Eutamias dorsalis utahensis*, ♀ ad., Ogden, Utah (No. 55127, U. S. Nat. Mus., Biological Survey collection).

E. *Eutamias quadrivittatus quadrivittatus*, ♀ ad., Canyon City, Colo. (No. 47905, U. S. Nat. Mus., Biological Survey collection).

F. *Eutamias quadrivittatus hopiensis*, ♂ ad., Keam Canyon, Ariz. (No. 67766, U. S. Nat. Mus., Biological Survey collection).

G. *Eutamias quadrivittatus frater*, ♂ ad., Donner, Calif. (No. 88662, U. S. Nat. Mus., Biological Survey collection).

H. *Eutamias quadrivittatus sequoiensis*, ♀ ad., Sequoia National Park, Calif. (No. 42154, U. S. Nat. Mus., Biological Survey collection).

I. *Eutamias quadrivittatus inyoensis*, ♂ ad., White Mountains, Calif. (No. 41469, U. S. Nat. Mus., Biological Survey collection).

J. *Eutamias quadrivittatus speciosus*, ♂ ad., San Bernardino Mountains, Calif. (No. 90042, U. S. Nat. Mus., Biological Survey collection).

K. *Eutamias callipeplus*, ♀ ad., Mount Piños, Calif. (No. 55967, U. S. Nat. Mus., Biological Survey collection).

L. *Eutamias palmeri*, ♂ ad., Charleston Peak, Nev. (No. 208904, U. S. Nat. Mus., Biological Survey collection).

M. *Eutamias ruficaudus ruficaudus*, ♀ ad., St. Mary Lake, Mont. (No. 72470, U. S. Nat. Mus., Biological Survey collection).

N. *Eutamias ruficaudus simulans*, ♀ ad., Coeur d'Alene, Idaho (No. 40593, U. S. Nat. Mus., Biological Survey collection).

O. *Eutamias umbrinus*, ♀ ad., Lone Tree, Wyo. (No. 179210, U. S. Nat. Mus., Biological Survey collection).

P. *Eutamias adsitus*, ♀ ad., Beaver Mountains, Utah (No. 158131, U. S. Nat. Mus., Biological Survey collection).

PLATE 5

(Slightly less than natural size)

A. *Eutamias cinereicollis cinereicollis*, ♀ ad., San Francisco Mountain, Ariz. (No. 24531, U. S. Nat. Mus., Biological Survey collection).

B. *Eutamias cinereicollis cinereus*, ♂ ad., Magdalena Mountains, N. Mex. (No. 167028, U. S. Nat. Mus., Biological Survey collection).

C. *Eutamias cinereicollis canipes*, ♂ ad., Guadalupe Mountains, Tex. (No. 109228, U. S. Nat. Mus., Biological Survey collection).

D. *Eutamias bulleri solivagus*, ♀ ad., Sierra Guadalupe, Coahuila, Mexico (No. 116881, U. S. Nat. Mus., Biological Survey collection).

E. *Eutamias bulleri bulleri*, ♂ ad., Valparaiso Mountains, Zacatecas, Mexico (No. 91967, U. S. Nat. Mus., Biological Survey collection).

F. *Eutamias bulleri durangae*, ♀ ad., Sierra Madre, near Guadalupe y Calvo, Chihuahua, Mexico (No. 95333, U. S. Nat. Mus., Biological Survey collection).

G. *Eutamias amoenus amoenus*, ♀ ad., Fort Klamath, Oreg. (No. 90122, U. S. Nat. Mus., Biological Survey collection).

H *Eutamias amoenus monoensis*, ♂ ad., Pine City, near Mammoth, Calif. (No. 42100, U. S. Nat. Mus., Biological Survey collection).

I. *Eutamias amoenus caurinus*, ♂ ad. (type), Olympic Mountains, Wash. (No. 90636, U. S. Nat. Mus., Biological Survey collection).

J. *Eutamias amoenus affinis*, ♀ ad., Ashcroft, British Columbia (No. 67015, U. S. Nat. Mus., Biological Survey collection).

K. *Eutamias amoenus ochraceus*, ♂ ad., Siskiyou Mountains, Calif. (No. 161049, U. S. Nat. Mus., Biological Survey collection).

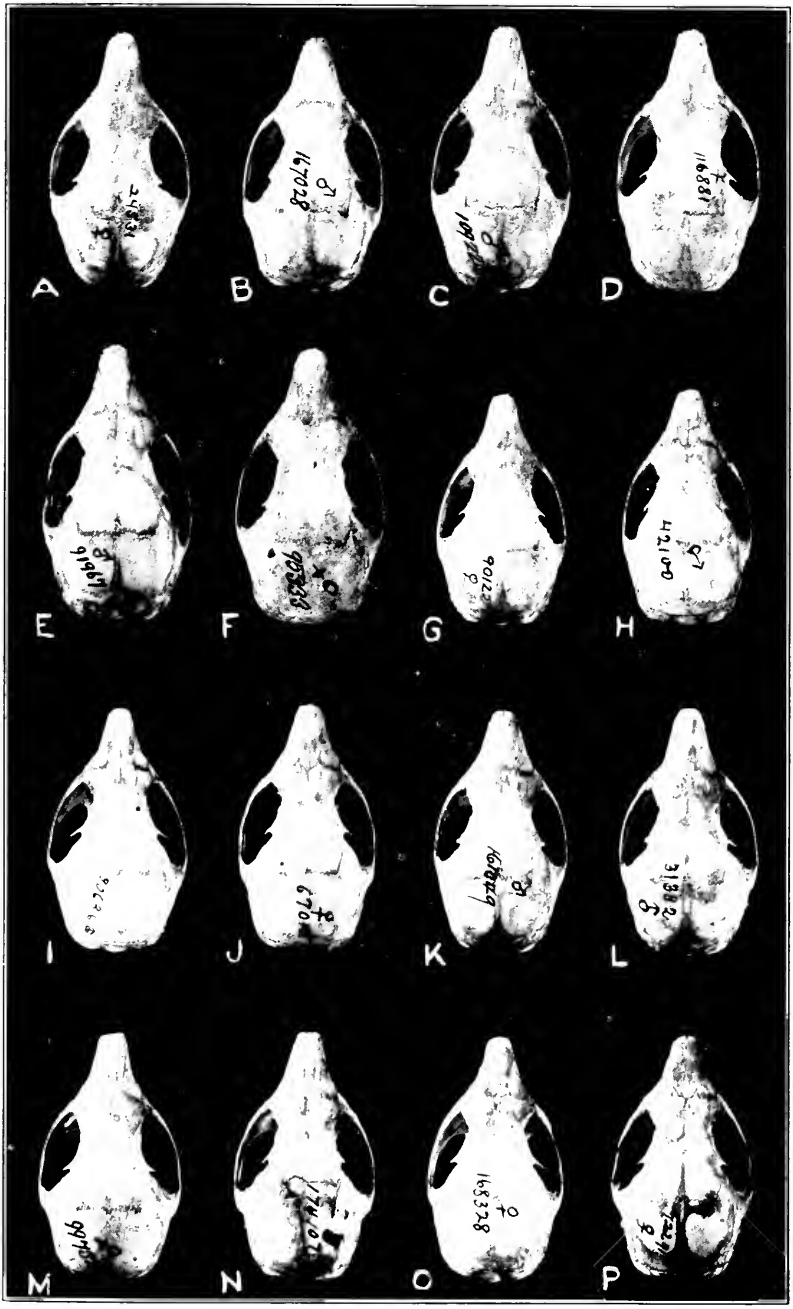
L. *Eutamias amoenus canicaudus*, ♂ ad., Spokane, Wash. (No. 31382, U. S. Nat. Mus., Biological Survey collection).

M. *Eutamias amoenus felix*, ♀ ad., Mount Baker Range, British Columbia (No. 99732, U. S. Nat. Mus., Biological Survey collection).

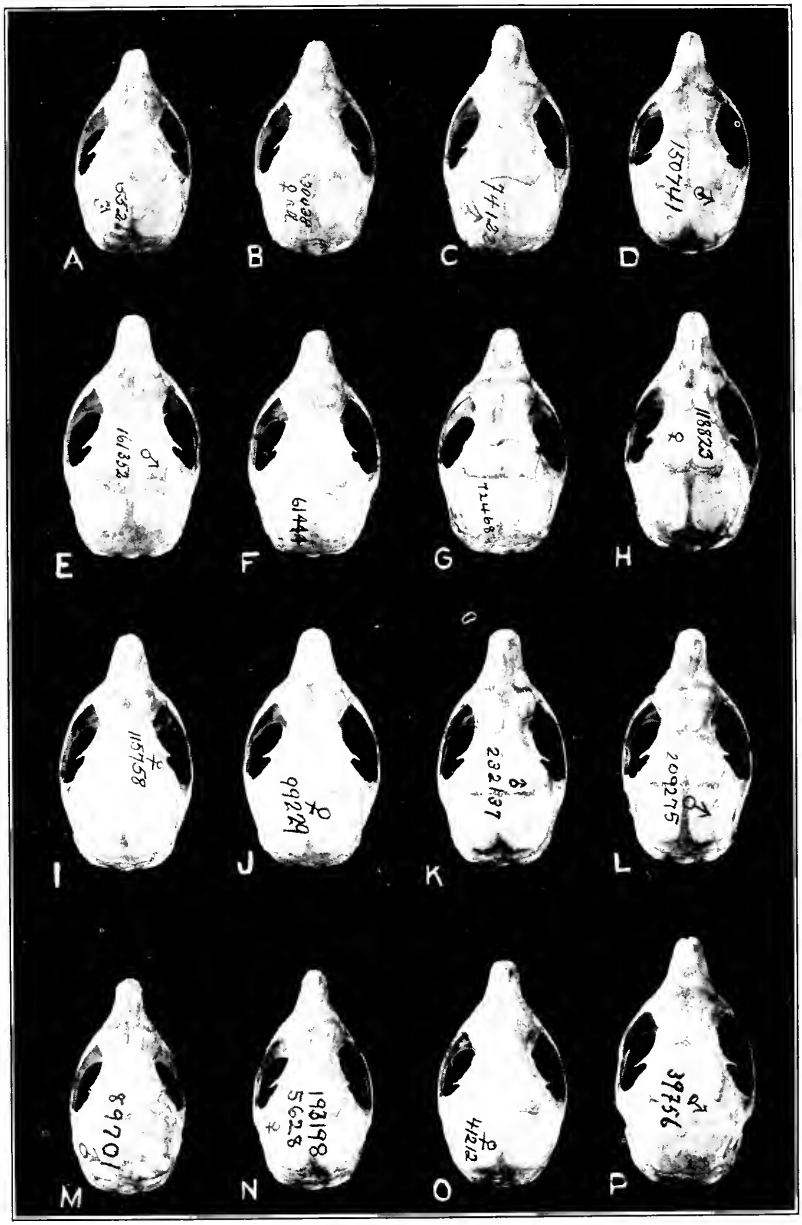
N *Eutamias amoenus ludibundus*, ♀ ad., Yellowhead Lake, British Columbia (No. 174107, U. S. Nat. Mus.).

O. *Eutamias amoenus vallicola*, ♀ ad., Bass Creek, Bitterroot Valley, Mont. (No. 168328, U. S. Nat. Mus., Biological Survey collection).

P. *Eutamias amoenus luteiventris*, ♀ ad., St. Mary Lake, Mont. (No. 72291, U. S. Nat. Mus., Biological Survey collection).



SKULLS OF EUTAMIAS



SKULLS OF EUTAMIAS

PLATE 6

(Slightly less than natural size)

A. *Eutamias minimus minimus*, ♂ ad., Green River, Wyo. (No. 55268, U. S. Nat. Mus., Biological Survey collection).

B. *Eutamias minimus consobrinus*, ♀ ad., Park City, Utah (No. 30038, U. S. Nat. Mus., Biological Survey collection).

C. *Eutamias minimus operarius*, ♂ ad., Estes Park, Colo. (No. 74122, U. S. Nat. Mus. Biological Survey collection).

D. *Eutamias minimus caryi*, ♂ ad., Medano Ranch, San Luis Valley, Colo. (No. 150741, U. S. Nat. Mus., Biological Survey collection).

E. *Eutamias minimus pallidus*, ♂ ad., Billings, Mont. (No. 161352, U. S. Nat. Mus., Biological Survey collection).

F. *Eutamias minimus cacodemus*, adult, Cheyenne River, S. Dak. (No. 61444, U. S. Nat. Mus.).

G. *Eutamias minimus oreocetes*, ♀ ad., Summit Station, Mont. (No. 72468, U. S. Nat. Mus., Biological Survey collection).

H. *Eutamias minimus atristriatus*, ♀ ad., Cloudcroft, N. Mex. (No. 118823, U. S. Nat. Mus., Biological Survey collection).

I. *Eutamias minimus borealis*, ♀ ad., Slave River, Alberta (No. 115758, U. S. Nat. Mus., Biological Survey collection).

J. *Eutamias minimus caniceps*, ♀ ad., Lake Marsh, Yukon (No. 99229, U. S. Nat. Mus., Biological Survey collection).

K. *Eutamias minimus jacksoni*, ♂ ad., Herbster, Wis. (No. 232137, U. S. Nat. Mus., Biological Survey collection).

L. *Eutamias minimus arizonensis*, ♂ ad., White Mountains, Ariz. (No. 209275, U. S. Nat. Mus., Biological Survey collection).

M. *Eutamias minimus grisescens*, ♂ subadult, (type), Farmer, Wash. (No. 89701, U. S. Nat. Mus., Biological Survey collection).

N. *Eutamias minimus pictus*, ♀ ad., Kelton, Utah (No. 193198, U. S. Nat. Mus., Biological Survey collection).

O. *Eutamias alpinus*, ♀ ad., Mount Whitney, Calif. (No. 41212, U. S. Nat. Mus., Biological Survey collection).

P. *Eutamias panamintinus*, ♀ ad., Panamint Mountains, Calif. (No. 39756, U S. Nat. Mus., Biological Survey collection).

PLATE 7

(Slightly less than natural size)

A. *Tamias striatus striatus*, ♂ ad., Roan Mountain, N. C. (No. 54742, U. S. Nat. Mus., Biological Survey collection).

B. *Tamias striatus lysteri*, ♂ ad., Emsdale, Ontario (No. 75860, U. S. Nat. Mus., Biological Survey collection).

C. *Tamias striatus griseus*, ♂ ad., Fort Snelling, Minn. (No. 122227, U. S. Nat. Mus.).

D. *Tamias striatus venustus*, ♂ ad., Stilwell, Okla. (No. 87264, U. S. Nat. Mus., Biological Survey collection).

E. *Tamias striatus fisheri*, ♂ ad., Ossining, N. Y. (No. 135551, U. S. Nat. Mus.).

F. *Eutamias townsendii townsendii*, ♀ ad., Portland, Oreg. (No. 142000, U. S. Nat. Mus.).

G. *Eutamias townsendii cooperi*, ♀ ad., Mount Adams, Wash. (No. 226735, U. S. Nat. Mus., Biological Survey collection).

H. *Eutamias townsendii ochrogenys*, ♀ ad., Mendocino, Calif. (No. 91604, U. S. Nat. Mus., Biological Survey collection).

I. *Eutamias townsendii senex*, ♀ ad., Donner, Calif. (No. 55203, U. S. Nat. Mus., Biological Survey collection).

J. *Eutamias townsendii siskiyou*, ♀ ad., Siskiyou Mountains, Cal. (No. 91460, U. S. Nat. Mus., Biological Survey collection).

K. *Eutamias alleni*, ♀ ad., Nicasio, Calif. (No. 68096, U. S. Nat. Mus., Biological Survey collection).

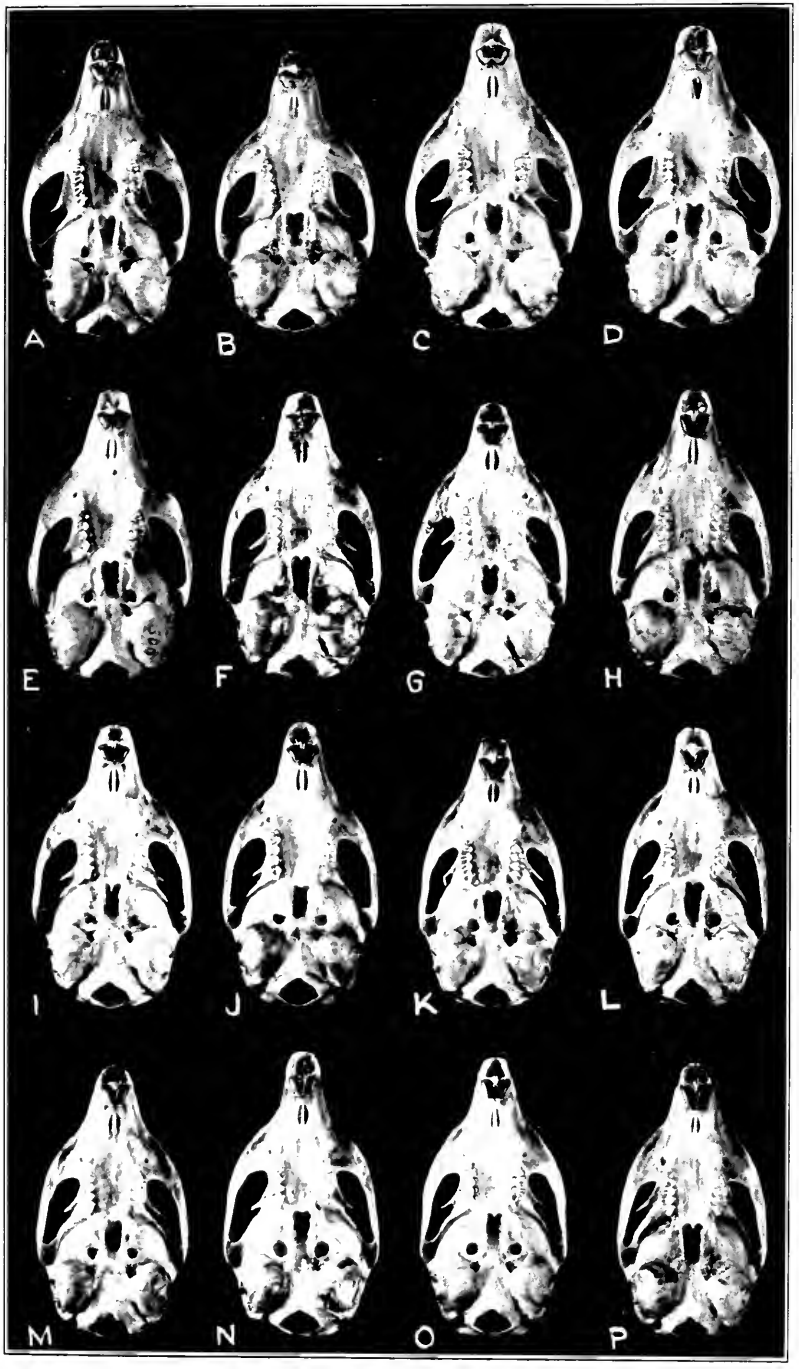
L. *Eutamias townsendii sonomae*, ♀ ad., Mount St. Helena, Calif. (No. 101287, U. S. Nat. Mus., Biological Survey collection).

M. *Eutamias quadrimaculatus*, ♀ ad., Michigan Bluff, Calif. (No. 43157, U. S. Nat. Mus., Biological collection).

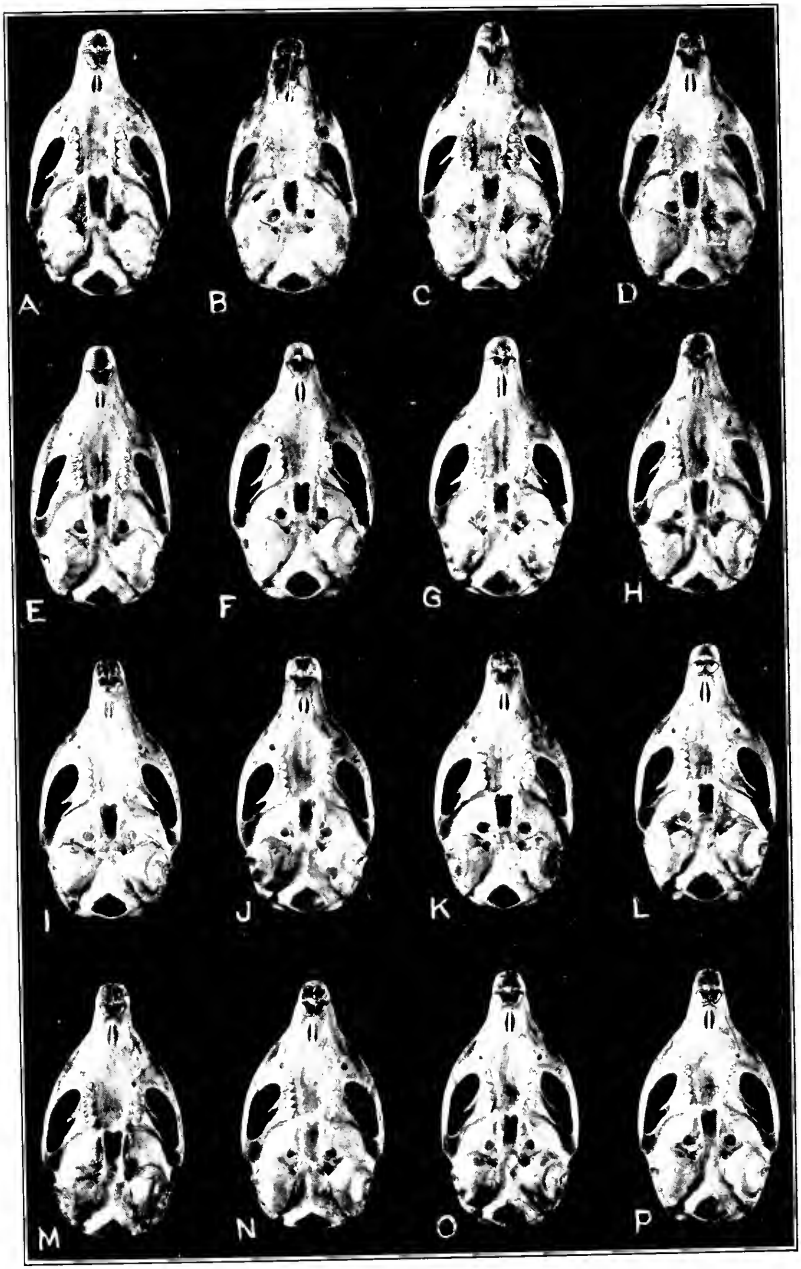
N. *Eutamias merriami merriami*, ♂ ad., San Bernardino Mountains, Calif. (No. 45004, U. S. Nat. Mus., Biological Survey collection).

O. *Eutamias merriami pricei*, ♀ ad., Santa Cruz Mountains, Calif. (No. 107893, U. S. Nat. Mus., Biological Survey collection).

P. *Eutamias merriami kernensis*, ♂ ad., Kernville, Calif. (No. 41479, U. S. Nat. Mus., Biological Survey collection).



SKULLS OF TAMIAS AND EUTAMIAS



SKULLS OF EUTAMIAS

PLATE 8

(Slightly less than natural size)

A. *Eutamias merriami obscurus*, ♀ ad., San Pedro Martir Mountains, Lower California, Mexico (No. 138617, U. S. Nat. Mus., Biological Survey collection).

B. *Eutamias merriami meridionalis*, ♀ ad. (type), Aguaje de San Esteban, Lower California, Mexico (No. 139597, U. S. Nat. Mus., Biological Survey collection).

C. *Eutamias dorsalis dorsalis*, ♀ ad., Head of Mimbres River, N. Mex. (No. 147257, U. S. Nat. Mus., Biological Survey collection).

D. *Eutamias dorsalis utahensis*, ♀ ad., Ogden, Utah (No. 55127, U. S. Nat. Mus., Biological Survey collection).

E. *Eutamias quadrivittatus quadrivittatus*, ♀ ad., Canyon City, Colo. (No. 47905, U. S. Nat. Mus., Biological Survey collection).

F. *Eutamias quadrivittatus hopiensis*, ♂ ad., Keam Canyon, Ariz. (No. 67766, U. S. Nat. Mus., Biological Survey collection).

G. *Eutamias quadrivittatus frater*, ♀ ad., Donner, Calif. (No. 88662, U. S. Nat. Mus., Biological Survey collection).

H. *Eutamias quadrivittatus sequoiensis*, ♀ ad., Sequoia National Park, Calif. (No. 42154, U. S. Nat. Mus., Biological Survey collection).

I. *Eutamias quadrivittatus inyoensis*, ♂ ad., White Mountains, Calif. (No. 41469, U. S. Nat. Mus., Biological Survey collection).

J. *Eutamias quadrivittatus speciosus*, ♂ ad., San Bernardino Mountains, Calif. (No. 90042, U. S. Nat. Mus., Biological Survey collection).

K. *Eutamias callipeplus*, ♀ ad., Mount Piños, Calif. (No. 55967, U. S. Nat. Mus., Biological Survey collection).

L. *Eutamias palmeri*, ♂ ad., Charleston Peak, Nev. (No. 208904, U. S. Nat. Mus., Biological Survey collection).

M. *Eutamias ruficaudus ruficaudus*, ♀ ad., St. Mary Lake, Mont. (No. 72470, U. S. Nat. Mus., Biological Survey collection).

N. *Eutamias ruficaudus simulans*, ♀ ad., Coeur d'Alene, Idaho (No. 40593, U. S. Nat. Mus., Biological Survey collection).

O. *Eutamias umbrinus*, ♀ ad., Lone Tree, Wyo. (No. 179210, U. S. Nat. Mus., Biological Survey collection).

P. *Eutamias adsitus*, ♀ ad., Beaver Mountains, Utah (No. 158131, U. S. Nat. Mus., Biological Survey collection).

PLATE 9

(Slightly less than natural size)

A. *Eutamias cinereicollis cinereicollis*, ♀ ad., San Francisco Mountain, Ariz. (No. 24531, U. S. Nat. Mus., Biological Survey collection).

B. *Eutamias cinereicollis cinereus*, ♂ ad., Magdalena Mountains, N. Mex. (No. 167028, U. S. Nat. Mus., Biological Survey collection).

C. *Eutamias cinereicollis canipes*, ♂ ad., Guadalupe Mountains, Tex. (No. 109228, U. S. Nat. Mus., Biological Survey collection).

D. *Eutamias bulleri solivagus*, ♀ ad., Sierra Guadalupe, Coahuila, Mexico (No. 116881, U. S. Nat. Mus., Biological Survey collection).

E. *Eutamias bulleri bulleri*, ♂ ad., Valparaiso Mountains, Zacatecas, Mexico (No. 91967, U. S. Nat. Mus., Biological Survey collection).

F. *Eutamias bulleri durangae*, ♀ ad., Sierra Madre, near Guadalupe y Calvo, Chihuahua, Mexico (No. 95333, U. S. Nat. Mus., Biological Survey collection).

G. *Eutamias amoenus amoenus*, ♀ ad., Fort Klamath, Oreg. (No. 90122, U. S. Nat. Mus., Biological Survey collection).

H. *Eutamias amoenus monoensis*, ♂ ad., Pine City, near Mammoth, Calif. (No. 42100, U. S. Nat. Mus., Biological Survey collection).

I. *Eutamias amoenus caurinus*, ♂ ad. (type), Olympic Mountains, Wash. (No. 90636, U. S. Nat. Mus., Biological Survey collection).

J. *Eutamias amoenus affinis*, ♀ ad., Ashcroft, British Columbia (No. 67015, U. S. Nat. Mus., Biological Survey collection).

K. *Eutamias amoenus ochraceus*, ♂ ad., Siskiyou Mountains, Calif. (No. 161049, U. S. Nat. Mus., Biological Survey collection).

L. *Eutamias amoenus canicaudus*, ♂ ad., Spokane, Wash. (No. 31382, U. S. Nat. Mus., Biological Survey collection).

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N. *Eutamias amoenus ludibundus*, ♀ ad., Yellowhead Lake, British Columbia (No. 174107, U. S. Nat. Mus., Biological Survey collection).

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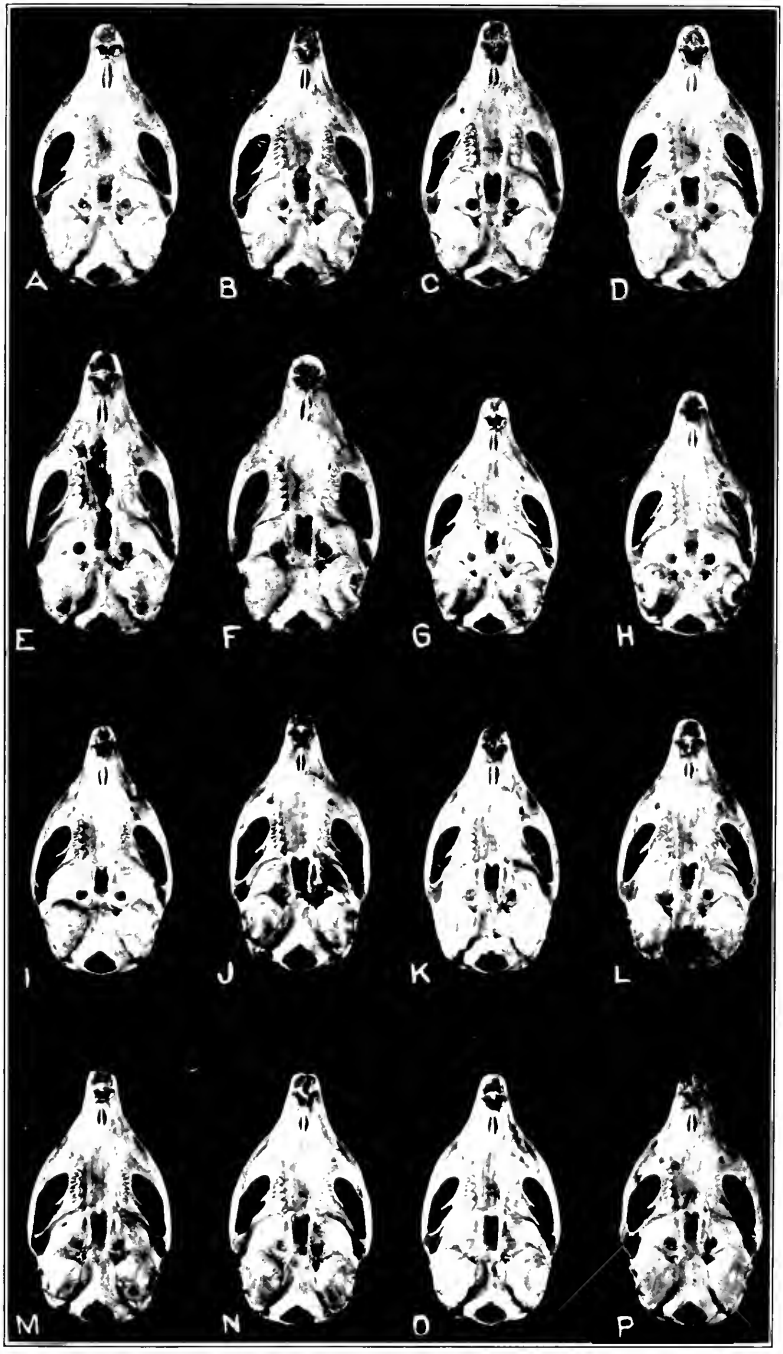
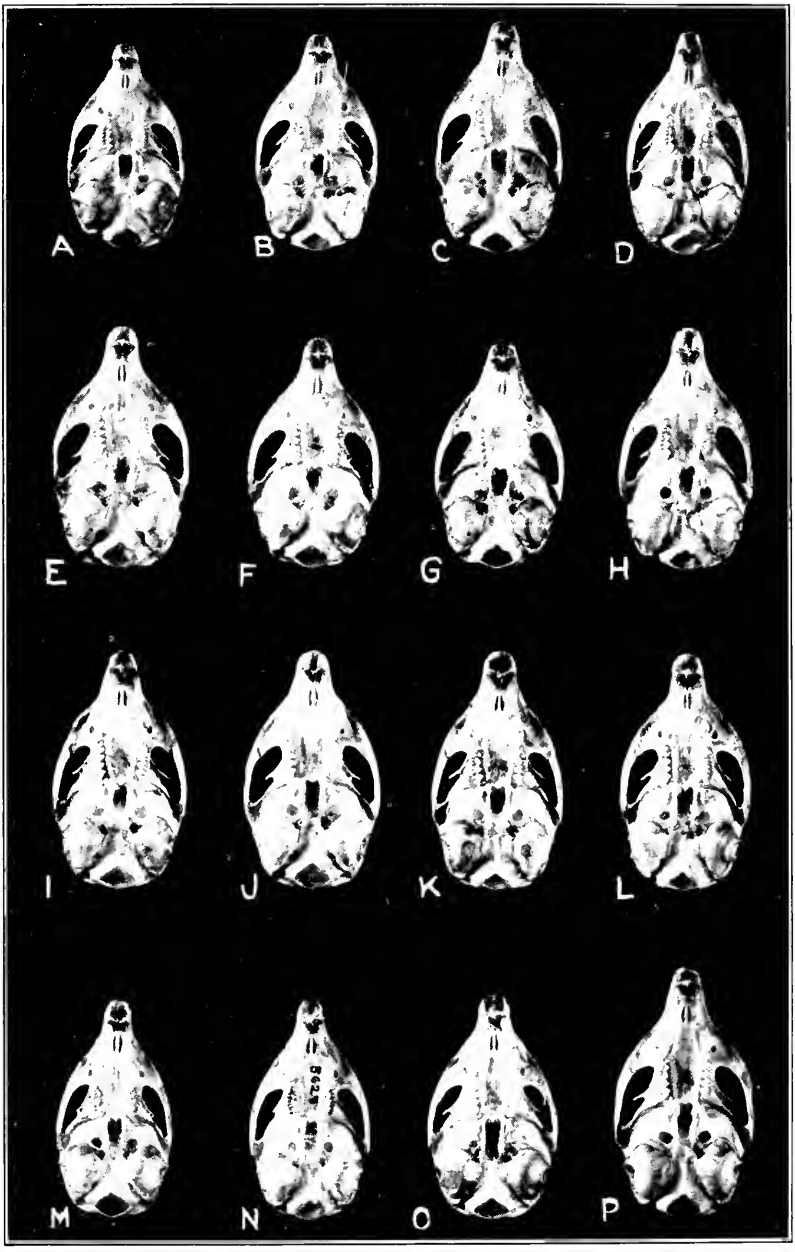


SKULLS OF EUTAMIAS



SKULLS OF EUTAMIAS

PLATE 10

(Slightly less than natural size)

A. *Eutamias minimus minimus*, ♂ ad., Green River, Wyo. (No. 55268, U. S. Nat. Mus., Biological Survey collection).

B. *Eutamias minimum consobrinus*, ♀ ad., Park City, Utah (No. 30038, U. S. Nat. Mus., Biological Survey collection).

C. *Eutamias minimus operarius*, ♂ ad., Estes Park, Colo. (No. 74122, U. S. Nat. Mus., Biological Survey collection).

D. *Eutamias minimus caryi*, ♂ ad., Medano Ranch, San Luis Valley, Colo. (No. 150741, U. S. Nat. Mus., Biological Survey collection).

E. *Eutamias minimus pallidus*, ♂ ad., Billings, Mont. (No. 161352, U. S. Nat. Mus., Biological Survey collection).

F. *Eutamias minimus cacodemus*, adult, Cheyenne River, S. Dak. (No. 61444, U. S. Nat. Mus.).

G. *Eutamias minimus oreocetes*, ♀ ad., Summit Station, Mont. (No. 72468, U. S. Nat. Mus., Biological Survey collection).

H. *Eutamias minimus atristriatus*, ♀ ad., Cloudcroft, N. Mex. (No. 118823, U. S. Nat. Mus., Biological Survey collection).

I. *Eutamias minimus borealis*, ♀ ad., Slave River, Alberta (No. 115758, U. S. Nat. Mus., Biological Survey collection).

J. *Eutamias minimus caniceps*, ♀ ad., Lake Marsh, Yukon (No. 99229, U. S. Nat. Mus., Biological Survey collection).

K. *Eutamias minimus jacksoni*, ♂ ad., Herbster, Wis. (No. 232137, U. S. Nat. Mus., Biological Survey collection).

L. *Eutamias minimus arizonensis*, ♂ ad., White Mountains, Ariz. (No. 209275, U. S. Nat. Mus., Biological Survey collection).

M. *Eutamias minimus grisescens*, ♂ subadult (type), Farmer, Wash. (No. 89701, U. S. Nat. Mus., Biological Survey collection).

N. *Eutamias minimus pictus*, ♀ ad., Kelton, Utah (No. 193198, U. S. Nat. Mus., Biological Survey collection).

O. *Eutamias alpinus*, ♀ ad., Mount Whitney, Calif. (No. 41212, U. S. Nat. Mus., Biological Survey collection).

P. *Eutamias panamintinus*, ♂ ad., Panamint Mountains, Calif. (No. 39756, U. S. Nat. Mus., Biological Survey collection).

INDEX

[Synonyms in italics]

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*No. 25. Biological Survey of Texas: Life Zones, with Characteristic Species of Mammals, Birds, Reptiles, and Plants. By Vernon Bailey. Pp. 222, pls. 16 (incl. 6 maps), figs. 24 (incl. 16 maps). 1905.

*No. 26. Revision of the Skunks of the Genus Spilogale. By Arthur H. Howell. Pp. 55, pls. 10 (incl. 1 map). 1906.

No. 27. A Biological Investigation of the Athabaska-Mackenzie Region. By Edward A. Preble. Pp. 574, pls. 25 (incl. 4 maps), figs. 16. 1908 (*Price, $1.25*).

*No. 28. Revision of the Mice of the American Genus Peromyscus. By Wilfred H. Osgood. Pp. 285, pls. 8 (incl. 1 map), figs. 12 (maps). 1909.

*No. 29. The Rabbits of North America. By E. W. Nelson. Pp. 314, pls. 13, figs. 19 (incl. 16 maps). 1909.

*No. 30. Biological Investigations in Alaska and Yukon Territory: 1. East-central Alaska; 2. Ogilvie Range, Yukon; 3. Macmillan River, Yukon. By Wilfred H. Osgood. Pp. 96, pls. 5 (1 map), figs. 2 (maps). 1909.

*No. 31. Revision of the Wood Rats of the Genus Neotoma. By Edward A. Goldman. Pp. 124, pls. 8, figs. 14 (maps). 1910.

*No. 32. A Systematic Synopsis of the Muskrats. By N. Hollister. Pp. 47, pls. 6 (incl. 1 map). 1911.

*No. 33. A Biological Survey of Colorado. By Merritt Cary. Pp. 256, pls. 12 (incl. 1 colored map), figs. 39 (incl. 29 maps). 1911.

No. 34. Revision of the Spiny Pocket Mice (Genera Heteromys and Liomys). By Edward A. Goldman. Pp. 70, pls. 3, figs. 6 (maps). 1911 (*Price, 10 cents*).

No. 35. Life Zones and Crop Zones of New Mexico. By Vernon Bailey. Pp. 100, pls. 16 (incl. 1 colored map), figs. 6. 1913 (*Price, 45 cents*).

No. 36. Revision of the American Harvest Mice (Genus Reithrodontomys). By Arthur H. Howell. Pp. 97, pls. 7, figs. 6 (maps). 1914 (*Price, 20 cents*).

*No. 37. Revision of the American Marmots. By Arthur H. Howell. Pp. 80 pls. 15, figs. 3 (maps). 1915.

*No. 38. A Review of the American Moles. By Hartley H. T. Jackson. Pp. 100, pls. 6, figs. 27 (incl. 6 maps). 1915.

*No. 39. Revision of the Pocket Gophers of the Genus Thomomys. By Vernon Bailey. Pp. 136, pls. 8, figs. 10 (incl. 7 maps). 1915.

*No. 40. A Systematic Account of the Prairie-Dogs. By N. Hollister. Pp. 37, pls. 7, figs. 2 (maps). 1916.

*No. 41. Review of the Grizzly and Big Brown Bears of North America (Genus Ursus), with Description of a New Genus, Vetularctos. By C. Hart Merriam. Pp. 136, pls. 16. 1918.

*No. 42. Life Zone Investigations in Wyoming. By Merritt Cary. Pp. 95, pls. 15 (incl. 1 colored map), figs. 17 (incl. 1 map). 1917.

No. 43. The Rice Rats of North America (Genus Oryzomys). By Edward A. Goldman. Pp. 100, pls. 6, figs. 11 (incl. 10 maps). 1918 (*Price, 20 cents*).

*No. 44. Revision of the American Flying Squirrels. By Arthur H. Howell. Pp. 64, pls. 7, figs. 4 (maps). 1918.

No. 45. A Biological Survey of Alabama: Part I. Physiography and Life Zones; Part II. The Mammals. By Arthur H. Howell. Pp. 88, pls. 11 (incl. 1 colored map), figs. 10 (maps). 1921 (*Price, 25 cents*).

No. 46. A Biological Survey of the Pribilof Islands, Alaska: I, Birds and Mammals, by Edward A. Preble and W. L. McAtee; II, Insects, Arachnids, and Chilopods, by various entomologists, with an introduction by W. L. McAtee. Pp. 255, pls. 15 (incl. 3 maps). 1923 (*Price, 40 cents*).

No. 47. Revision of the American Pikas (Genus Ochotona). By Arthur H. Howell. Pp. IV+57, pls. 6, figs. 4 (maps). 1924 (*Price, 15 cents*).

No. 48. Voles of the Genus Phenacomys: I, Revision of the Genus Phenacomys; II, Life History of the Red Tree Mouse (*Phenacomys longicaudus*). By A. Brazier Howell. Pp. 64, pls. 7, figs. 11 (incl. 5 maps). 1926 (*Price, 20 cents*).

No. 49. A Biological Survey of North Dakota: I, Physiography and Life Zones; II, The Mammals. By Vernon Bailey. Pp. 226, pls. 21 (incl. 1 colored map), figs. 8 (maps). 1926 (*Price, 60 cents*).

No. 50. Revision of the American Lemming Mice (Genus Synaptomys). By A. Brazier Howell. Pp. 38, pls. 2, figs. 11 (incl. 5 maps). 1927 (*Price, 10 cents*).

No. 51. A Taxonomic Review of the American Long-tailed Shrews (Genera Sorex and Microsorex). By Hartley H. T. Jackson. Pp. VI+238, pls. 13, figs. 24 (incl. 19 maps). 1928 (*Price, 50 cents*).

No. 52. Revision of the American Chipmunks (Genera Tamias and Eutamias). By Arthur H. Howell. Pp. 157, pls. 10, figs. 9 (maps). 1929 (*Price, 35 cents*).

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