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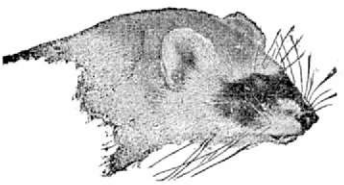

Revision of the Shrews of the American Genera Blarina and Notiosorex
C. HART MERRIAM

The Long-tailed Shrews of the Eastern United States
GERRIT S. MILLER, Jr.

Synopsis of the American Shrews of the Genus Sorex
C. HART MERRIAM

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., August 31, 1895.

SIR: I have the honor to transmit herewith, for publication as No. 10 of North American Fauna, three papers on North American Shrews, embracing results of investigations made by the Division of Ornithology and Mammalogy.

Respectfully,

C. HART MERRIAM,
Chief of Division of Ornithology and Mammalogy.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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REVISION OF THE SHREWS OF THE AMERICAN GENERA BLARINA AND NOTIOSOREX.

By C. HART MERRIAM.

The Short-tailed Shrews of America belong to two genera—*Blarina* and *Notiosorex*. Of the former, 14 alleged species have been described; of the latter, only 2. Respecting the status and geographic ranges of these species much confusion exists. In order to obtain authentic information on these points the Department has made a special effort to secure large series of specimens, and has sent trained collectors to most of the original type localities of the forms that have been named. Moreover, one of the field naturalists of the Division of Ornithology and Mammalogy, Mr. E. W. Nelson, while conducting biological explorations in Mexico, has obtained a number of new species. As a result, upward of 600 specimens of the United States species and more than 200 of the Mexican species are now before me.[1] Either the original types, or duplicate types obtained from the original type localities, of all the United States and Mexican species have been examined. The conclusions derived from a study of this material are embodied in the present paper.

Genus BLARINA Gray, 1838.

Dental formula.—i, $\frac{4 \text{ or } 3}{2}$; c, $\frac{1}{0}$; pm $\frac{2}{1}$; m, $\frac{3}{3} = \frac{9 \text{ or } 10}{6} \times, 2 = \frac{18 \text{ or } 20}{12} =$ 30 or 32.

Teeth, 32 or 30; unicuspids, 5 or 4. First and second unicuspids large and subequal or second largest; third and fourth much smaller; fifth minute or absent; unicuspids (except minute posterior one) broad and bearing a secondary cusplet on inner side; all the teeth heavily tipped with dark chestnut, which usually reaches far down on the crowns. Cranium rather high and usually angular. No apparent external ears; tail short, always less than half the length of head and body; legs short; body usually stout and thickset (but more slender in the *parva* group).

HISTORY AND NOMENCLATURE.

For a long time the Short-tailed Shrews were included in the genus *Sorex*. They were first separated by Gray in 1838 under the name *Blarina*, proposed as a subgenus.[2] Four years later (1842) *Blarina* was raised to full generic rank by Lesson.[3]

[1] In addition to the specimens in the Department collection and my private collection, I have had the privilege of examining about 100 belonging to Mr. Gerrit S. Miller, jr.

[2] Proc. Zool. Soc. London, 1837 (June, 1838), 124.

[3] Lesson, Nouv. Tableau Mammif., 1842, 89.

Baird in 1857 divided the genus *Blarina* in two sections, according to the number of teeth; and Coues in 1877 recognized and named these sections as subgenera: *Blarina* proper, with 32 teeth, and *Soriciscus*, with 30. The reduction is in the unicuspids, of which there are 5 in *Blarina* proper, as in true *Sorex*, and only 4 in *Soriciscus*.[1] The lost tooth in the latter subgenus is the second premolar. So far as the United States species go, the two groups are well defined, the first comprising the larger species with massive, angular skulls, the second the smaller species with relatively light, *Sorex*-like skulls. But in the Mexican species these distinctions fail, the larger species having large, angular skulls, closely resembling that of the northern *Blarina brevicauda*.

The first Short-tailed Shrews known to have fallen under the eye of a naturalist were two specimens secured by Mr. Say, naturalist of Major Long's expedition to the Rocky Mountains, at Engineer Cantonment in eastern Nebraska, a few miles north of the present site of Omaha. It is a singular coincidence that these two specimens became the types of the largest and smallest species of the genus *Blarina* and later, of the two subgenera into which the genus was split. They were collected during the winter of 1819–20, and were described by Mr. Say in 1823, the larger as *Sorex brevicaudus*, the smaller as *Sorex parvus*.[2] It would have been far better if no others had been described from the United States, for excepting the *S. carolinensis* of Bachman all the other names since proposed fall as synonyms under one or the other of Say's species.

Specimens of the larger species (*brevicauda*) from near Lake Simcoe, Ontario, were described by Gapper in 1830, under the name *Sorex talpoides*,[3] which name has been used by some writers in the same sense as *brevicauda*. Other specimens, from New Jersey, were described by Bachman in 1837, under the name *Sorex dekayi*.[4] The same year (1837) Bachman described as new two additional species, *carolinensis* and *cinereus*,[5] both from South Carolina. The latter is a very small animal and proves to be the same as *S. parvus* of Say. This was suspected by Bachman himself and also by Baird. Bachman's *carolinensis* is a well-defined form, intermediate in size between *brevicauda* and *parva*, and restricted to the Austroriparian zone.

In 1857 Baird recognized *brevicauda* of Say, *talpoides* of Gapper, *carolinensis* and *cinereus* of Bachman, and added three others, which he named *angusticeps*, *exilipes*, and *berlandieri*.[6] *B. angusticeps* (from Burlington, Vt.) is an abnormal individual of *brevicauda* (skull small and

[1] But *Soriciscus* is antedated by *Cryptotis* Pomel (1848), which was based on the same type species (*cinerea* Bach. = *parva* Say).

[2] Say, in Long's Exped. to the Rocky Mts., I, 1823, 164.

[3] Gapper, Zool. Jour., V, 1830, 202, Pl. VIII.

[4] Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, 377–381.

[5] Ibid, pp. 366–370 and 373–376.

[6] Baird, Mammals N. Am., 1857, 47–48, 51–54.

deformed); *B. exilipes* (from Washington, Miss.) seems to be identical with *B. parva;* while *B. berlandieri* (from Matamoras, Mexico) is either a distinct species or a subspecies of *parva.*

The status and relationships of *Blarina parva* have never been correctly understood. As stated above the species was described by Say more than seventy years ago from a specimen from eastern Nebraska. In 1837 Bachman described a Shrew from South Carolina under the name *Sorex cinereus.* He had great difficulty in separating it from Say's *S. parvus,* and "felt at one time a strong inclination to set it down as that animal."[1] In 1857 Baird admitted *S. cinereus,* and correctly transferred it from *Sorex* to *Blarina.* But he took pains to state that he was unfamiliar with *Sorex parvus* of Say. Like Bachman, he suspected the identity of the two, for he says that *parva* "comes very close to the *Sorex cinereus* of Bachman, and may possibly some day supplant its name."[2] In the same year (1857) Baird added another supposed species, which he called *Blarina exilipes.*[3] The type specimens came from Washington, Miss.; and specimens from Spottsylvania County, Va., Brownsville, Tenn. [Texas?], St. Louis, Mo., and Dekalb County, Ill., were referred to the same species though those from the two latter localities were provisionally separated under the name *eximius,* afterward adopted by Kennicott.[4]

After careful comparison of specimens from the type localities of *parva, cinerea,* and *exilipes,* I am unable to detect any characters by which any one of them may be distinguished from the others. Baird himself was by no means positive of their distinctness. His remarks about *B. cinerea* have just been quoted; of *B. exilipes* he said: "I can not feel sure that the Mississippi specimens may not prove to be the young of *S. cinereus.*"[5]

In 1861 Tomes described a small species from Coban, Guatemala, and named it *Sorex micrurus.*[6] This is the only member of the genus known from any point south of Mexico.

In 1877 Coues published an additional species, from Jalapa, Mexico, under the name *Blarina* (*Soriciscus*) *mexicana* (Baird MS).[7]

In 1891 Allen described a large *Blarina* which he named *B. costaricensis*[8] because the type and only specimen was supposed to have been taken in Costa Rica; but it really came from the Upper Mississippi Valley and is a typical *brevicauda.*[9]

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[1] Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, p. 375.

[2] Baird, Mammals N. Am., 1857, pp. 50, 56.

[3] Ibid, pp. 51–53.

[4] Ibid, p. 52; Quadrupeds of Illinois, 1858, p. 97.

[5] Ibid., p. 52.

[6] Tomes, Proc. Zool. Soc. London, 1861, 279. The name *micrura* is preoccupied and *tropicalis* is here substituted for it. (See p. 23, foot note.)

[7] Coues, Bull. U. S. Geol. and Geog. Surv., III, May 15, 1877, 652, 653

[8] Allen, Bull. Am. Mus. Nat. Hist., III, No. 2, April, 1891, 205, 206.

[9] See *postea,* under *Blarina brevicauda,* p. 14.

In 1895 Allen described two small species from Costa Rica: *Blarina (Soriciscus) nigrescens*, and *Blarina (Soriciscus) orophila.*

Thus up to the present time 8 valid species have been described, 3 from the United States (*brevicauda*, *carolinensis*, and *parva*), 2 from Mexico (*berlandieri* and *mexicana*), 1 from Guatemala (*micrura* = *tropicalis*) and 2 from Costa Rica. Twelve new forms are here added (1 from Dismal Swamp, Virginia, 2 from Florida, and 9 from Mexico), making 20 members of the genus now known. These, with their type localities, are as follows:

LIST OF SPECIES AND SUBSPECIES OF BLARINA.

Subgenus *Blarina:*	
Blarina brevicauda (Say)	Blair, Nebraska.
carolinensis (Bach.)	Eastern South Carolina.
carolinensis peninsulæ nov.	Miami, Florida.
telmalestes sp. nov	Dismal Swamp, Virginia.
Subgenus *Cryptotis:*	
Blarina parva (Say)	Blair, Nebraska.
floridana sp. nov	Canaveral, Florida.
berlandieri Baird	Matamoras, Mexico.
tropicalis nom. nov	Coban, Guatemala.
soricina sp. nov	Tlalpam, Valley of Mexico.
obscura sp. nov	Tulancingo, Hidalgo, Mexico.
mexicana Baird	Jalapa, Vera Cruz, Mexico.
mexicana goldmani subsp. nov.	Mts. near Chilpancingo, Guerrero, Mexico.
mexicana peregrina subsp. nov.	Mountains near Oaxaca, Oaxaca, Mexico.
mexicana machetes subsp. nov.	Mountains near Ozolotepec, Oaxaca, Mex.
nelsoni sp. nov	Volcano of Tuxtla, Vera Cruz, Mexico.
fossor sp. nov	Mount Zempoaltepec, Oaxaca, Mexico.
alticola sp. nov	Mount Popocatapetl, Mexico.
magna sp. nov	Totontepec, Oaxaca, Mexico.
nigrescens Allen	San Isidro, San José, Costa Rica.
orophila Allen	Volcano of Irazu, Costa Rica.

Geographic distribution.—The genus *Blarina* is confined to North America, where it ranges from the mountains of Central America northward to the southern border of the Boreal zone in Canada. It attains its highest development in the mountains of southern Mexico—the same region in which the family *Geomyidæ* is represented by so large a number of species and genera.[1] Although several of the species now inhabit the boreal summits of mountains, and one is restricted to the Tropical belt, the genus as a whole is clearly of Austral origin. In the course of time, groups having their centers of distribution in particular areas or zones often overflow into adjacent zones, and it is not unusual for tropical and austral types in the neighborhood of high mountains to push up the slopes of these mountains and become acclimated. Such forms commonly undergo a degree of modification sufficient to admit of their ready recognition as distinct species or subspecies. Thus *Blarina soricina*, from an altitude of 7,600 feet in the

[1] See Monograph of the Geomyidæ, N. Am. Fauna, No. 8, Jan., 1895.

Valley of Mexico, while not strictly a mountain form, is clearly an offshoot from the tropical *B. tropicalis*.

In the United States the only species that passes beyond the Austral region is *brevicauda*. It penetrates the southern edge of the Boreal zone along the northern limit of its range, and ascends the higher mountains of North Carolina and Tennessee to the same zone.

In southern Mexico some of the high mountains have been so long isolated that the species of *Blarina* inhabiting them have become differentiated into local races or representative species. Thus the colonies of the widely diffused *B. mexicana* type inhabiting mountains near Oaxaca, Ozolotepec, and Chilpancingo, have developed peculiarities by which each may be recognized from the others and also from the typical form from Vera Cruz. Similarly *B. alticola*, of Mount Popocatapetl and other high mountains about the Valley of Mexico, is represented on Mount Zempoaltepec, Oaxaca, by a closely allied species, *B. fossor*.

NUMBER OF SPECIMENS OF EACH SPECIES EXAMINED.

Subgenus *Blarina*:		Subgenus *Cryptotis*—Continued.	
Blarina brevicauda	436	*Blarina mexicana*	110
carolinensis	89	*goldmani*	5
peninsulæ	7	*peregrina*	25
telmalestes	1	*machetes*	7
Subgenus *Cryptotis*:		*nelsoni*	11
Blarina parva	114	*alticola*	10
floridana	4	*fossor*	5
berlandieri	8	*magna*	2
tropicalis	25	*nigrescens*	1
soricina	3	*orophila*	1
obscura	2		

Subgenus BLARINA Gray.

1838. *Blarina* (subgenus of *Sorex*) Gray, Proc. Zool. Soc. London 1837 (June, 1838), 124. Type, *Sorex talpoides* Gapper = *S. brevicaudus* Say.

1842. *Blarina* (full genus) Lesson, Nouv. Tableau Mammif., 1842, 89.

1842. *Brachysorex* (subgenus) Duvernoy, Mag. de Zool., 2d ser., IV, 1842, 37–41. Type, *Sorex brevicauda* Say. (Specimen from New Harmony, Ind., and somewhat intermediate between *brevicauda* and *carolinensis*.)

1843. *Blaria* Gray, List of Spec. Mammalia British Mus., 1843, XXI; List of Osteol. Spec British Mus., 1847, XI, 23.

1848. *Talposorex* Pomel, Archiv. Sci. Phys. and Nat. Genève, IX, 1848, 248. (Type, *Sorex carolinensis* Dekay = *S. brevicaudus* Say.) Not *Talpasorex* Lesson, 1827.

1848. *Galemys* Pomel, Ibid., IX, 1848, 249 (in part; includes also *Crossopus* and *Pachyura*); not *Galemys* Kaup, 1829.

1855. *Anotus* (subgenus) Wagner, Suppl. Schreber's Säugthiere, V, 1855, 550–551. Type, *Sorex carolinensis* Bach., from South Carolina.

Diagnosis.—Teeth, 32; unicuspids, 5, the anterior 4 in two pairs; first and second largest and subequal; third and fourth abruptly much smaller and subequal; fifth minute (see fig. 1, *a* and *b*, p. 10). Basal lobe of middle incisor elongated anteroposteriorly. Brain case not arched anteroposteriorly, highest at lambdoid suture; plane of occiput nearly flat.

Geographic distribution.—Broadly, the Austral region of the eastern half of the United States. One species (*B. brevicauda*) reaches the southern edge of the Boreal in southern Canada and the mountains farther south; another (*B. peninsulæ*) inhabits peninsular Florida.

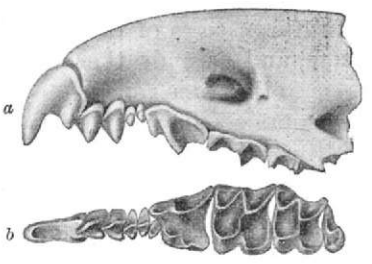

FIG. 1.—Upper series of teeth of *Blarina carolinensis*. *a*. Outer side; *b*. Crowns.

Number of representatives.—Only 4 members of the subgenus *Blarina* are here recognized—the large *B. brevicauda* and *telmalestes*, and the smaller *carolinensis* and *peninsulæ*. Several slightly characterized local forms of *brevicauda* might be defined, but are not deemed worthy of recognition by name. *B. brevicauda* intergrades with *carolinensis*, and *carolinensis* with *peninsulæ*, leaving *telmalestes* as the only completely isolated form now known.

KEY TO SPECIES AND SUBSPECIES.

Size largest (total length about 120 mm. or more); brain case and under jaw strongly angular.
  Postero-internal lobe of molars narrow and elliptical ..... *brevicauda*
  Postero-internal lobe of molars broad and rounded ..... *telmalestes*
Size smaller (length less than 100 mm.); brain case and under jaw less angular.
  Color dull plumbeous washed with brownish (hind foot about 12 mm.) ..... *carolinensis*
  Color slate black (hind foot more than 13 mm.) ..... *peninsulæ*

BLARINA BREVICAUDA (Say). Large Blarina.

Pl. 1, figs. 2–4; Pl. 2, figs. 1–4.

ORIGINAL REFERENCES.

1823. *Sorex brevicaudus* Say in Long's Exped. to the Rocky Mts., I, 1823, 164. (From near Blair, Nebr.)

1830. *Sorex talpoides* Gapper, Zool. Jour., V, 1830, 202, Pl. VIII. (From vicinity of Lake Simcoe, Ontario, Canada.)

1837. *Sorex dekayi* (Cooper) Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, 377–381. (From New Jersey.)

1857. *Blarina angusticeps* Baird, Mammals N. Am., 1857, 47–48. (Deformed skull from Burlington, Vt.).

1891. *Blarina costaricensis* Allen, Bull. Am. Mus. Nat. Hist. New York, III, 1891, 205–206. (Supposed to be from Costa Rica, but really from the Upper Mississippi Valley. See *postea*, p. 12.)

SECONDARY REFERENCES.

Sorex brevicaudus Bach., Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, 3; Aud. and Bach., Quadrupeds N. Am., III, 1854, 335–336.

Corsira (*Blarina*) *talpoides* Gray, Proc. Zool. Soc. London, 1837 (June, 1838), 124 [= *Sorex talpoides* Gapper = *S. brevicaudus* Say].

Blarina brevicaudata Lesson, Nouv. Tableau Mammif., 1842, 89.

Galemys (*Brachysorex*) *micrurus* Pomel, Archiv. Sci. Phys. et Nat., Genève, 1848, 249.

Blarina brevicauda Baird, Mammals N. Am., 1857, 42–45; Merriam, Mammals Adirondacks, 1884, 164–173 (habits).

Type locality.—West bank of Missouri River, near Blair, Nebr. (formerly Engineer Cantonment, 3 miles above mouth of Boyer River).

Geographic distribution.—Upper Austral and Transition zones, from western Nebraska and Manitoba eastward to the Atlantic Coast, penetrating a short distance into lower edge of boreal.

Habitat.—Chiefly deciduous woodlands and fields, where it lives in shallow tunnels that are often marked on the surface by little ridges.

General characters.—Size largest of the subgenus (total length about 125 mm.); skull largest and heaviest of the American *Soricidæ;* pelage glossy.

Color.—Sooty-plumbeous above, becoming ashy-plumbeous below, varying with the light; paler in summer; glossy in fresh pelage.

Cranial characters.—Skull large, massive, and angular (averaging 23 to 25 mm. in greatest length, and about 13 mm. in greatest breadth); occipital plane relatively large, nearly flat, and sloping strongly forward (not arched). The brain case presents the maximum of angularity known in the group, and is highest at the lambdoid suture. The ramus of the jaw is angular, being bent rather abruptly upward opposite the last molar. The upper lateral incisors contrasted with those of *carolinensis* are relatively narrower at base and slope more strongly forward; the first upper premolar (5th unicuspid) is usually visible from the outside.

Measurements.—Average of 8 specimens from near type locality: Total length, 127 mm.; tail vertebræ, 26.5 mm.; hind foot, 16.5 mm. Average of 31 specimens from Lake George, New York: Total length, 122 mm.; tail vertebræ, 26.5 mm.; hind foot, 15 mm. Average of 6 specimens from Marthas Vineyard, Massachusetts: Total length, 115 mm.; tail vertebræ, 22 mm.; hind foot, 13.4 mm.

General remarks.—*Blarina brevicauda* presents considerable variation in size and tint of color. The largest specimens are from western Nebraska, and those from eastern Nebraska (type locality) are larger than specimens from the Northern and Eastern States. From the type locality as a center, decrease in size takes place to the north, east, and south. Specimens from both sides of the Canadian boundary, between Manitoba and Lake Superior, are decidedly smaller than those from Nebraska, Iowa, and southern Minnesota, but larger than those from the Atlantic States. The smallest specimens I have seen are from eastern Massachusetts. Through the courtesy of Mr. Gerrit S. Miller, jr., I have been able to examine a number of skulls in his private collection from the following localities near the coast of that State: West Dedham, Wareham, Provincetown, Seekonk, Marthas Vineyard, and Nantucket. These skulls agree closely among themselves and average 22 mm. in greatest length (including incisors) and 12 mm. in breadth. Specimens from Nova Scotia, Ontario, New Hampshire, and Maine are larger, agreeing with those from the Adirondacks. The latter, however, are decidedly smaller than typical

brevicauda from the Upper Mississippi Valley. This intermediate form was named *Sorex talpoides* by Gapper in 1830 (type from near Lake Simcoe, Ontario, Canada), and has been recognized as a distinct species by Baird (1857) and Miller (1893).[1] The impossibility of assigning logical geographic ranges to the resulting two forms, since the smaller *talpoides* surrounds the larger *brevicauda* on three sides (north, east, and south), and the additional fact that *talpoides* is intermediate between the large Nebraska *brevicauda* and the small form from the coast of New England are material obstacles to the recognition of *talpoides*, even as a subspecies. Furthermore, the species as a whole grades into *carolinensis* when it approaches the edge of the Austroriparian fauna; hence *talpoides*, being in this sense only an intergrade between *brevicauda* and *carolinensis*, is unworthy of recognition by name.

In color eastern specimens average slightly paler than those from the Mississippi Valley, but the seasonal difference is as great as the geographic. There is also much difference in the apparent color of the same specimen, according to the way it is held with reference to the light. A skin that is dusky or sooty when held away from the light and viewed from behind becomes almost ashy gray when looked at from the opposite direction. Winter specimens from Elk River, Minn., sometimes have a well-marked brownish-chestnut dorsal band.

Note on the so-called Blarina costaricensis.—Dr. J. A. Allen has kindly loaned me the type specimen of his *Blarina costaricensis*. It is in every respect a typical *Blarina brevicauda*, and doubtless came from some point in the Upper Mississippi Valley, probably Iowa. The skull and teeth agree perfectly with specimens from this State, where the collector, Mr. Cherrie, lived before he went to Costa Rica. The specimen had no label when it reached Dr. Allen. I do not doubt Mr. Cherrie's entire sincerity in thinking that it came from Costa Rica, but, as too well known, unlabeled museum specimens—particularly alcoholics—often have a way of becoming hopelessly mixed. Dr. Allen states that the skull received from Mr. Cherrie is larger than that of *B. talpoides* and the dentition heavier. These are precisely the ways in which true *brevicauda* from Iowa and Nebraska differs from its smaller representative of the Atlantic States, which has been called *talpoides*. I have just compared the skull of the type specimen of *costaricensis* with skulls from the type locality of *brevicauda* and find that the latter is somewhat larger and has equally heavy or slightly heavier teeth.

In clearing up the status of *costaricensis* an awkward geographical difficulty is also overcome, for the subgenus *Blarina* (with 32 teeth) is absolutely restricted to the United States. All of the specimens examined from Mexico and Guatemala, more than 200 in number, belong to the subgenus *Cryptotis* (with 30 teeth). It surpasses belief that a

[1] After examining the material on which the present paper is based Mr. Miller agrees with me that *talpoides* can not be recognized.

colony of the northern *Blarina brevicauda* should exist in the tropics of Costa Rica, separated from the normal range of its species by a land interval of several thousand miles—and an interval inhabited exclusively by members of another subgenus.

Specimens examined.—Total number, 436, from the following localities:

Ontario: Rat Portage, Lake of the Woods, 6; Ottawa, 2.
Nova Scotia: Digby, 8.
North Dakota: Pembina, 1; Harwood, 1; Portland, 9.
Minnesota: Tower, Vermillion Lake, 3; Elk River, 25; Steele County, 4; Ortonville, 8; Two Harbors, 1.
Nebraska: Valentine, 2; Kearney, 2; Blair, 1; Columbus, 4.
Iowa: Council Bluffs, 8; Knoxville, 2.
Kansas: Onaga, 2.
Missouri: Kimmswick, 1.
Illinois: Dekalb, 2.
Michigan: Frankfort, 3; Ann Arbor, 5.
Ohio: Sandusky, 1; Garrettsville, 11; Canton, 1; Ellsworth, 1.
Pennsylvania: Drurys Run, 3; Nazareth, 1.
New York: Adirondacks, 8; Locust Grove, Lewis County, 77; Lake George, 33; Elizabethtown, 25; Alder Creek, 2; Syracuse, 2; Peterboro, 2; Troy, 1; Sing Sing, 4; Roslyn, Long Island, 1; Shelter Island, 1; Montauk Point, Long Island, 20.
New Hampshire: Ossipee, 10; Mount Washington, 1.
Maine: North Sebago, 1.
Massachusetts: Wilmington, 15; West Dedham, 3; Wareham, 25; Provincetown, 2; Seekonk, 2; Marthas Vineyard, 5; Nantucket, 1.
New Jersey: Tuckerton, 5.
Maryland: Baltimore, 1; Laurel, 1; Sandy Spring, 6; Locust Grove, 1.
District of Columbia: Washington, 35.
North Carolina: Roan Mountain, 16; Magnetic City, 5; mountains of Bun- County, 4; Old Richmond, 2.
Indiana: Richmond, 1.

BLARINA BREVICAUDA CAROLINENSIS (Bachman). Carolina Blarina.

Pl. 1, fig. 1; pl. 3, figs. 1, 5, 12.

Sorex carolinensis Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, 366–370, Pl. XXIII, fig. 1. (From South Carolina.)
Aud. and Bach., Quadrupeds N. Am., II, 1857, 176–178, Col. Pl. LXXV.
Blarina carolinensis Baird, Mammals N. Am., 1857, 45–47.

Type locality.—Eastern South Carolina.

Geographic distribution.—Austroriparian fauna from the mouth of Chesapeake Bay to Arkansas.

Habitat.—Woodlands and open fields, living in tunnels and runways just beneath the surface.

General characters.—Size intermediate between *brevicauda* and *parva;* pelage glossy and velvety, as in *brevicauda;* hind foot small, as in *parva.*

Color.—Uniform dark sooty plumbeous, more or less tinged with brownish, especially in summer; indistinctly paler below.

Cranial and dental characters.—Compared with *B. brevicauda* the skull of *B. carolinensis* is much smaller and lighter (averaging 19 to 20 mm. in greatest length and 10 mm. in breadth); occipital plane more arched;

mandible much less massive and with only a trace of the angle of the ramus; upper lateral incisors relatively broader at base and more nearly vertical (not sloping strongly forward); first premolar (5th unicuspid) usually not visible from outside.

Measurements.—Average of 6 specimens from Columbia, S. C. (presumably near type locality): Total length, 99.5 mm.; tail vertebræ, 20.5 mm.; hind foot, 12.5 mm. Average of 9 specimens from Washington, Miss.: Total length, 94 mm.; tail vertebræ, 20 mm.; hind foot, 12.2 mm.

General remarks.—*Blarina carolinensis* is merely a small edition of *B. brevicauda*, lacking the more accentuated features of the latter in the way of massiveness and angularity of the skull and lower jaw. It differs also in the lateral unicuspidate teeth. They are more nearly vertical and the fifth is generally hidden when viewed from the outside.

In geographic distribution it is strictly confined to the Austroriparian fauna. It thus inhabits the southern half of the region inhabited by *B. parva*, and the two occur together in many localities.

Blarina carolinensis was described by Bachman in 1837, and has had the good fortune to escape synonyms. It is intermediate in size, but not in characters, between the northern *Blarina brevicauda*, with which it intergrades, and the southern *B. parva*, from which it differs subgenerically (having 32 instead of 30 teeth). Intergrades with *brevicauda* are confined to a narrow strip just above the upper edge of the Austroriparian zone. Such intergrades have been examined from Cape Charles, Va.; Eubank, Ky.; Kimmswick, Mo., and the following places in southern Indiana: Brookville, New Harmony, Vigo County, and Putnam County. Specimens from Richmond, Ind., are nearer *brevicauda* than *carolinensis*.

Specimens examined.—Total number, 97, from the following localities:

Virginia: Belle Haven, 1; Cape Charles, 16; Kinsale, 1; Old Point Comfort, 1.
Kentucky: Eubank, 3; Hickman, 4.
Tennessee: Big Sandy, 1.
North Carolina: Raleigh, 39.
South Carolina: Columbia, 6; Lanes, 1; Georgetown, 1.
Georgia: Augusta, 1; Riceboro, 1.
Alabama: Greensboro, 1.
Mississippi: Washington, 10.
Arkansas: Beebe, 1.
Indiana: New Harmony, 2; Brookville, 4; Vigo County, 1; Putnam County, 2.

BLARINA CAROLINENSIS PENINSULÆ subsp. nov. Everglade Blarina.

Type from Miami River, Dade County, Fla. No. 70874, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected March 2, 1895, by J. Alden Loring. Original number, 2777.

Geographic distribution.—Peninsula of Florida, south of latitude 28°.

Habitat.—Swampy places, chiefly in Everglades.

General characters.—Similar to *B. carolinensis*, but with larger hind feet and more slaty coloration; molariform teeth larger.

Color.—Upper parts uniform slate black, duller below; lacks the sepia-brown tint of *carolinensis.*

Cranial and dental characters.—Skull similar to that of *B. carolinensis*, but somewhat larger and heavier, with broader and more massive pterygoids. The upper molariform teeth are decidedly larger, heavier, and less emarginate posteriorly. The large upper premolar is broader, especially in front, and differs in form from that of *carolinensis.*

Measurements (taken in flesh).—Type: Total length, 97 mm.; tail vertebræ, 20 mm.; hind foot, 13.5 mm.

Average measurements of 6 specimens from peninsular Florida: Total length, 97 mm.; tail vertebræ, 18.5 mm.; hind foot, 13.5 (or 14) mm.

General remarks.—*Blarina peninsulæ* is the Tropical Florida representative of the Austroriparian *B. carolinensis.* It is common in the Everglades, where Mr. Loring secured four specimens on Miami River, on the east coast, and one at Everglade (near Chocoloskee), on the west coast. He also trapped one at Micco, Brevard County.

BLARINA TELMALESTES[1] sp. nov. Dismal Swamp Blarina.

Pl. 2, fig. 5.

Type from Lake Drummond, Dismal Swamp, Virginia. No. 71823, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected June 6, 1895, by A. K. Fisher. Original number, 1775.

Geographic distribution.—Dismal Swamp, Virginia.

General characters.—Similar to *B. brevicauda*, but more plumbeous in color; hind feet relatively longer; skull narrower; molariform teeth peculiar. Length of skull, including incisors, 24 mm.

Color.—Uniform dark plumbeous or slate gray above and below, slightly darker on the rump and nose; feet and tail blackish.

Cranial and dental characters.—Compared with its nearest relative, *Blarina brevicauda*, the skull of *B. telmalestes* is narrower, less massive, with less thickened anterior nares; the coloring on the teeth is paler and much less extensive, not reaching the crowns of the teeth except on the apices of the cusps; the large upper premolar and molars, particularly m^2, differ materially in shape, the postero-internal lobe being much more broadly rounded and the posterior concavity much deeper. The thickened angular cusp on the inner side is less marked and there is a much more pronounced and thickened rim running round the posterior lobe, defining a broad saucer-shaped depression. In actual size the skull is slightly shorter than specimens of *brevicauda* from Nebraska and western Iowa, but it is longer than those from New England and the Eastern States generally.

General remarks.—From the standpoint of geographic distribution *Blarina telmalestes* is by far the most interesting member of the genus. While closely resembling the large *B. brevicauda* in size and general

[1] *Telmalestes*, from τέλμα, swamp + λῃστής, robber.

appearance, it is completely surrounded by the small *B. carolinensis*. It is in effect therefore an insular form, like those inhabiting the summits of high mountains within the range of more southern species. Its semi-aquatic habits, necessitated by its watery environment, have led to the unusual development of the hind feet, and the distinctive character of the molars may have resulted from some peculiarity of food.

Measurements (taken in flesh).—Type specimen: Total length, 118 mm.; tail vertebræ, 28 mm.; hind foot, 16 mm. Average of 13 specimens from type locality: total length, 119.5; tail vertebræ, 26.4; hind foot, 16.

Subgenus CRYPTOTIS Pomel.

1848. *Cryptotis* Pomel, Archiv. Sci. Phys. and Nat. Genève, IX, Nov. 1848, 249. Type, *Sorex cinereus* Bach. (= *Sorex parvus* Say).

1877. *Soriciscus* Coues, Bull. U. S. Geol. and Geog. Surv., 1877, 649. "Type *Sorex parvus* Say or *S. cinereus* Bach."

Diagnosis.—Teeth, 30; unicuspids, 4, never in two pairs; fourth always smaller and usually minute; basal lobe of middle incisor a rounded cusp (pl. 3, figs. 2, 3, 13, 14). Brain case more or less arched, highest anterior to lambdoid suture; plane of occiput arched.

Geographic distribution.—Broadly, the less arid parts of the Austral region in Mexico, Guatemala, Costa Rica, and the eastern United States. One species (*parva*) pushes northward in the United States through the Upper Austral or Carolinian zone; one (*tropicalis*) reaches southward into the Tropical region of Mexico and Guatemala, and several ascend the mountains of Mexico into the Boreal.

Number of representatives.—The great majority of American Short-tailed Shrews belong to the subgenus *Cryptotis*. Sixteen species and subspecies are here recognized, contrasted with 4 of *Blarina* proper and 2 of *Notiosorex*. The subgenus attains its greatest development in the highlands of southern Mexico. The species may be roughly assembled in 4 groups: (1) The *parva* group, comprising *parva*, *floridana*, *berlandieri*, *tropicalis*, *soricina*, *orophila*, and *obscura* (the latter approaching the next); (2) the *mexicana* group, comprising *mexicana*, *goldmani*, *peregrina*, *machetes*, *nigrescens*, and *nelsoni*; (3) the *alticola* group, comprising *alticola* and *fossor*; and (4) the *magna* group, comprising, so far as known, the single species of that name.

It is of little consequence whether closely related forms are treated as species or subspecies. When intergradation is known or strongly suspected, or the degree of differentiation slight, the animals are classed as subspecies. In the case of two the smaller forms here accorded specific rank (*floridana* and *berlandieri*) it is not improbable that in each instance intergradation will be found with *parva* (but not with one another) when specimens are collected from intermediate localities.

KEY TO SPECIES AND SUBSPECIES.

Size very large (total length about 130 mm.; hind foot, 17 mm.) ..... *magna*
Size medium or small (length 108 mm. or less):
1. Size medium (length, about 100 to 108 mm.; hind foot, 13 to 15 mm.):
2. Large upper premolar deeply excavated posteriorly—
Large upper premolar with antero-internal angle well developed ..... *alticola*
Large upper premolar with antero-internal angle broadly rounded off ..... *fossor*
2.[1] Large upper premolar not deeply excavated posteriorly—
3. Total length, 106 mm. or more:
Hind foot about 15 mm ..... *machetes*
Hind foot about 13 mm ..... *nelsoni*
3.[1] Total length, about 100 mm.:
4. Unicuspidate teeth with strongly developed cusplet on inner side:
Brain case abruptly inflated above plane of rostrum ..... *mexicana*
Brain case only slightly elevated above plane of rostrum ..... *goldmani*
4.[1] Unicuspidate teeth with inner cusplet feebly developed ..... *peregrina*
1.[1] Size small (length less than 93 mm.; hind foot, 13 mm. or less).
Size smallest; tail about 16 mm.; hind foot, about 10.5 mm ..... *parva*
Size larger; tail 19 mm. or longer; hind foot, 12 to 13 mm.:
Color sooty plumbeous; tail, about 25 mm.—
Large upper premolar deeply excavated behind ..... *soricina*
Large upper premolar not deeply excavated behind ..... *obscura*
Color ash gray or brown—
Total length, about 93 mm.; tail, about 25 mm ..... *tropicalis*
Total length, less than 90 mm.; tail, 22 mm. or less—
Color iron gray to sepia brown ..... *floridana*
Color chestnut brown to ash brown ..... *berlandieri*

BLARINA PARVA (Say). Small Blarina.

Pl. 1, figs. 5, 6; pl. 3, figs. 2, 6, 13.

1823. *Sorex parvus* Say, in Long's Expedition to the Rocky Mountains, I, 1823, 164. (From near Blair, Nebr.)
1837. *Sorex cinereus* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, 373-376, Pl. XXIII, fig. 3. (From Goose Creek, 22 miles from Charleston, S. C.)
1857. *Blarina exilipes* Baird, Mammals N. Am., 1857, 51-53. (From Washington, Miss.)
1857. *Blarina eximius* Baird, Ibid, p. 52 (provisional name based on specimens from St. Louis, Mo. and Dekalb Co., Illinois.)
1858. Kennicott, Quadrupeds of Illinois, Report Commissioner of Agriculture for 1857, 1858, p. 97.

Type locality.—West bank of Missouri, near Blair, Nebr. (formerly Engineer Cantonment, 3 miles above mouth of Boyer River).

Geographic range.—Austral region of the eastern United States (including both the Austroriparian and Carolinian faunas) from Texas and eastern Nebraska eastward to the Atlantic. Not known from New York or New England.

Habitat.—Chiefly open fields and meadows.

General characters.—Smallest of the United States species; cranium light and *Sorex*-like.

Color.—Upper parts varying from sepia to dark hair-brown, darker in winter pelage; under parts ash gray; tail bicolor, each side concolor with body. Some specimens (immature?) are nearly iron gray, lacking the sepia, in this respect resembling immature specimens of *floridana*.

Cranial and dental characters.—Skull small, about equaling *berlandieri*, but decidedly smaller than *floridana*. Last upper unicuspid not usually visible from outside; second unicuspid shorter than in *berlandieri* (pl. 3, fig. 2); upper molars (m^1 and m^2) deeply excavated behind (pl. 3, fig. 13), thus differing from both *floridana* and *berlandieri* which are only slightly concave.

Measurements (taken in flesh).—Average of 13 specimens from type locality (Blair, Nebr.): Total length, 79 mm.; tail vertebræ, 16 mm.; hind foot, 10.6 mm. Average of 25 from Raleigh, N. C.:[1] Total length, 75 mm.; tail vertebræ, 16.4 mm.; hind foot, 10.6 mm. One specimen from Washington, Miss.: Total length, 80 mm.; tail vertebræ, 18 mm.; hind foot, 11 mm.

General remarks.—*Blarina parva* is the smallest of the Short-tailed Shrews known from the United States. Specimens from New Jersey, and from the coast region of southern South Carolina and Georgia, are somewhat larger than the typical form. Thus specimens from Tuckerton, N. J., Georgetown, S. C., and Riceboro, Ga., are appreciably larger than those from Raleigh, N. C. But they agree with true *parva* in the extent and depth of color of the chestnut tips of the teeth and in the deep excavation of the molars posteriorly, thus showing no approach toward *B. floridana*.

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

Nebraska: Blair (type locality), 13.
Indiana: Brookville, 2; Irvington, 2; Terre Haute, 2; Vigo County, 2; Putnam County, 2.
Ohio: Garrettsville, 1.
New Jersey: Tuckerton, 3.
Maryland: Laurel, 1; Sandy Spring, 19.
District of Columbia: Washington, 1.
Virginia: Dismal Swamp, 1.
North Carolina: Raleigh, 46; Bertie County, 5.
South Carolina: Georgetown, 1.
Georgia: Riceboro, 4.
Alabama: Mobile, 1.
Mississippi: Washington, 1.
Louisiana: Iberia Parish, 1.
Texas: Gainesville, 5; Del Rio, 1.

[1] For these measurements I am indebted to the collectors, H. H. and C. S. Brimley, of Raleigh.

BLARINA FLORIDANA sp. nov. Small Florida Blarina.

Pl. 1, fig. 7.

Type from Chester Shoal, 11 miles north of Cape Canaveral, Brevard County, Fla. No. $\frac{10510}{23937}$, U. S. Nat. Mus., Department of Agriculture collection. Collected April 22, 1889, by Morris M. Green. Original number, 44.

Geographic distribution.—Peninsular Florida, south of latitude 29°. Exact limits of range unknown.

Habitat.—Palmetto scrub.

General characters.—Similar to *B. parva*, but larger, with longer skull, whiter teeth, and larger molars, which are less deeply emarginate posteriorly.

Color.—Upper parts in winter uniform iron gray, with a decided 'pepper and salt' appearance; in summer, browner and more inclined to sepia; under parts paler.

Cranial and dental characters.—Skull similiar to that of *parva*, but longer (18 instead of 16 mm.); last unicuspid visible from outside; color of teeth paler and restricted to tips of cusps; posterior border of large molars (m^1 and m^2) only slightly concave, as in *berlandieri*, not deeply excavated as in *parva*. The large molariform upper premolar has only a relatively shallow emargination behind, instead of the deep excavation of *parva;* and the notch on the front of the inner side is much smaller, and does not reach all the way down vertically (see pl. 3, fig.14).

Measurements.—Average of 2 specimens from type locality: Total length, 89 mm.; tail vertebræ, 22 mm.; hind foot, 12 mm.

General remarks.—It is interesting from a geographic standpoint to note that in essential characters *Blarina floridana* agrees with *B. berlandieri*, which latter animal likewise inhabits an extension of the tropical fauna into the United States. That the two are not connected around the Gulf of Mexico is evident from the fact that specimens from southern Louisiana and Mississippi are very different, agreeing in the characters of their molars with true *parva*. Baird had a single specimen of this species, of which he said: "A very badly preserved specimen in alcohol from Indian River, Florida, exhibits some differences, especially in the longer tail and larger size generally, including the skull and feet. For the present, however, I shall refer it to *B. cinerea*."[1]

Specimens examined.—Only 4 specimens of *floridana* have been examined—2 from the type locality, Chester Shoal, 11 miles north of Canaveral; 1 from Micco, and 1 from Gainesville.

[1] Baird, Mammals N. Am., 1857, 49

BLARINA BERLANDIERI Baird. Rio Grande Blarina.

Pl. 3, figs. 3, 7, 10, 14.

1857. *Blarina berlandieri* Baird, Mammals N. Am., 1857, 53-55.

Type locality.—Matamoras, Tamaulipas, Mexico.

Geographic distribution.—Lower Rio Grande Valley, on both sides of the river, and probably the coast region of southern Texas also. Limits of range unknown.

General characters.—Size a little larger than *B. parva;* pelage relatively short; upper lateral incisors long and nearly vertical.

Color.—Upper parts in summer ash brown, with a 'pepper and salt' appearance; tips of hairs in winter pelage almost chestnut; under parts grayish.

Cranial and dental characters.—The upper part of the rostrum seems to be a little more swollen in *berlandieri* than in *parva*, but it is almost impossible to separate the two by cranial characters. The lateral upper incisors (i^3 in particular), when unworn, are higher and more vertical in *berlandieri*, as shown in pl. 3, fig. 3, contrasted with that of *parva*, pl. 3, fig. 2. The best character I have discovered is the shape of the posterior border of the upper molars. In *B. parva* the hinder border of m^1 and m^2 is deeply excavated, much as in the large premolar; in *B. berlandieri* the premolar is much the same, but m^1 and m^2 are only slightly concave behind. In young specimens the large size of the second unicuspid is usually marked, contrasted with *B. parva*.

General remarks.—I have compared a series of specimens from Brownsville, Tex., with Baird's types from Matamoras (on the Mexican side of the river) and find no differences whatever. One of Baird's specimens (No. 1794) is young and has unworn teeth. The lateral incisors (first and second unicuspids) are very long and rather slender, and the apex of the second curves slightly backward. This is the specimen figured by Dobson in his Monograph of the Insectivora, Part III, fasc. 1, Pl. XXIV, fig. 7. It is closely matched by one of our specimens from Brownsville (No. 48810). In the other specimens the tip is worn off, and consequently is not recurved. Whether *berlandieri* is more than a subspecies of *parva* can not be determined from the material at hand.

It is an interesting coincidence that the character of most weight separating *berlandieri* from *parva* is shared by *floridana*, namely, the shallow emargination of the posterior border of m^1 and m^2.

Measurements (taken in flesh).—Average of 6 specimens from Brownsville, Tex. (on opposite side of river from type locality): Total length, 83 mm.; tail vertebræ, 19 mm.; hind foot, 12 mm.

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

Matamoras, Tamaulipas, Mexico (type locality), 2.
Brownsville, Tex., 5.
San Diego, Duval County, Tex., 1.

BLARINA TROPICALIS[1] Merriam. Tropical Blarina.

Pl. 1, fig. 8.

1843. *Corsira tropicalis* Gray, Proc. Zool. Soc., London, 1843, 79. *Nomen nudum.*
1861. *Sorex micrurus* Tomes, Proc. Zool. Soc., London, 1861, 279. (From Coban Guatemala.)
1877. *Blarina micrura* Alston, Proc. Zool. Soc., London, 1877, 446; Biologia Centrali-Americana, Mammalia, 1880, 56, 57, Pl. V, fig. 2.
1877. *Blarina (Soriciscus) micrura* Coues, Bull. U. S. Geol. and Geog. Surv. Terr., 638, footnote.

Type locality.—Coban, Guatemala (altitude about 4,400 feet).

Geographic distribution.—Tropical fauna of western Guatemala and southern Mexico in States of (Chiapas?) Oaxaca and Vera Cruz.

General characters.—Size small, only a little larger than *B. parva* of the United States.

Color.—Upper parts dull cinereous hair-brown, with 'pepper and salt' appearance from admixture of black-tipped hairs; under parts ashy.

Cranial and dental characters.—Skull small, but larger and more angular than that of *parva* and decidedly broader than *floridana;* brain case essentially on plane of rostrum, with only a shallow sulcus between; hinder margin of palate slightly thickened on median line, suggesting a projection. Second unicuspid with inner cusplet prominent and projecting well inward; third unicuspid without inner cusplet; molariform teeth only slightly concave behind; large upper premolar with antero-internal angle prominent and without distinct step behind, the inner border of the tooth more on a plane than usual.

Measurements.—Mean of the two original type specimens from Coban, Guatemala, as measured by Tomes (converted into millimeters): Head and body, 60 mm.; tail, 23.6 mm.; hind foot, 11.4 mm. Average of 6 specimens from Pluma and Juquila, Oaxaca (measured in flesh): Total length, 93 mm.; tail vertebræ, 25 mm.; hind foot, 12 mm.

General remarks.—In pushing northward in the tropical belt (tierra caliente) of Vera Cruz to Catemaco (altitude, 1,000 feet), the Valley of Orizaba (altitude, 4,000 feet), and Jico (altitude, 4,800 feet) *Blarina tropicalis* undergoes certain changes in cranial and dental characters that foreshadow *B. soricina* of the Valley of Mexico (altitude, 7,600 feet). The brain case becomes narrower and less angular, and the large upper

[1] When *Sorex micrurus* Tomes (1861) was transferred to the genus *Blarina* it became preoccupied by *Galemys (Brachysorex) micrurus* Pomel (1848), which is a synonym of *Blarina brevicauda* (Say), and therefore is not available. No other name seems to have been proposed for the species except *tropicalis* Gray, which is a *nomen nudum.* The name, however, is peculiarly appropriate, the species being closely restricted to tropical America; hence I here reinstate it to replace *micrurus,* but it will have to date from the present paper. For *Galemys micrurus* Pomel, see Archiv. Sci. Phys. et Nat. Genève, IX, Nov. 1848, 249.

premolar more concave posteriorly. Mr. Nelson contributes the following note on the habits of this animal:

At Jico this small, pale-colored Shrew was found only in the immediate vicinity of town at an altitude of about 4,600 feet. There they were not uncommon in rather dry, grassy situations under or near hedges bordering fields near the canyon just east of the town. Most of the specimens secured were taken in *Arvicola* runways. Their preference for rather high and dry situations was the converse of the habits of the other two species of Shrews found here.

A single specimen from Tuxtepec, Oaxaca (No. 65425), has the large upper premolar unusually broad, and its posterior border moderately excavated. It resembles a specimen from Choapam, Oaxaca (No. 68555), except that the latter has the premolar less broad.

At Juquila, Oaxaca, Mr. Nelson found *Blarina tropicalis* living under logs in damp places; at Orizaba, Vera Cruz, they were in thick grass in the valley.

I have not seen the type of *B. tropicalis*, but have assumed that the specimens from Pluma and Juquila, Oaxaca, are sufficiently near the type form to be used as a standard of comparison for specimens taken at points farther north.

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

State of Oaxaca: Pluma, 2; Juquila, 7; Choapam, 1; Tuxtepec, 1.
State of Vera Cruz (specimens not typical): Catemaco, 1; Orizaba Valley, 5; Jico, 8.

BLARINA SORICINA sp. nov. Sorex Blarina.

Pl. 1, fig. 9.

Type from Tlalpam, Valley of Mexico (altitude, 7,600 feet). No. 50762, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected December 5, 1892, by E. W. Nelson. Original number, 3989.

General characters.—Similar to *B. tropicalis* in size and general appearance, but much darker, and with narrower, *Sorex*-like skull.

Color.—Upper parts uniform sooty black; under parts paler and browner.

Cranial and dental characters.—Skull resembling that of *B. micrura* in size, but narrower, less angular, and more *Sorex*-like; brain case in particular, higher, narrower, and more rounded. Third unicuspid larger and with chestnut-tipped cusplet on inner side (obsolete in *tropicalis*); large upper premolar broader and rather deeply excavated posteriorly; first upper true molar excavated posteriorly; inferior molars much smaller.

Measurements (taken in flesh).—Type: Total length, 88 mm.; tail vertebræ, 23.5 mm.; hind foot, 12.5 mm. Average measurements of 3 specimens from type locality: Total length, 91 mm.; tail vertebræ, 26.5 mm.; hind foot, 12.5 mm.

General remarks.—*Blarina soricina* is very distinct from typical *tropicalis*, but its relationship to the form of *tropicalis* inhabiting the tropical

belt at Jico, Vera Cruz, directly east of the Valley of Mexico, is much closer and more perplexing. The Jico animal agrees with true *tropicalis* in coloration, but is more or less intermediate in cranial and dental characters. It differs from *soricina* in smaller third and fourth unicuspids (the antero-posterior diameter of third much reduced), less deeply excavated premolar, and absence of excavation in first upper true molar.

Mr. Nelson caught three of these small Blarinas under the banks of a weedy ditch close to the railway station at Tlalpam.

BLARINA OBSCURA sp. nov.

Type from Tulancingo, Hidalgo, Mexico (altitude, 8,500 feet). No. 55634, ♀ yg. ad., U. S. Nat. Mus., Department of Agriculture collection. Collected August 27, 1893, by E. W. Nelson. Original number, 5377.

General characters.—Similar to *B. mexicana*, but smaller and decidedly paler.

Color.—Upper parts dark plumbeous, overlaid by sepia, becoming dusky over the rump; under parts paler plumbeous, tipped with brownish; sides of nose dusky.

Cranial and dental characters.—Similar to *B. mexicana*, but much smaller; rostrum and teeth nearly the same size in both, but postpalatal part of cranium much smaller and shorter; first, second, and third unicuspidate teeth broad at base, with well-developed inner cusplet; large upper premolar only slightly concave behind and with antero-internal angle and cusp well marked.

Measurements (taken in flesh).—Type: Total length, 89 mm.; tail vertebræ, 24 mm.; hind foot, 13 mm. Average of 2 specimens from type locality: Total length, 92 mm.; tail vertebræ, 25 mm.; hind foot, 13 mm.

General remarks.—Only two specimens of this new *Blarina* were obtained by Mr. Nelson. They were caught in fir woods on the mountains near Tulancingo, at an altitude of 8,500 feet, and were living in small runways under the shelter of old logs.

BLARINA MEXICANA[1] Baird. Mexican Blarina.

Pl. I, fig. 11.

1877. *Blarina* (*Soriciscus*) *mexicana* (Baird MS.) Coues, Precursory Notes, Am. Insectivorous Mammals, May, 1877, 652–653. (From Jalapa, Mexico.)

1880. *Blarina mexicana* Alston, Biologia Centrali-Americana, Mammalia, Feb. 1880, 57.

Type locality.—Jalapa, Vera Cruz, Mexico. (No. $\frac{35}{4}\frac{25}{4}\frac{25}{3}$, U. S. Nat. Mus.)

Geographic distribution.—Tropical fauna of southeastern Mexico in States of Vera Cruz and Oaxaca.

General characters.—Size medium (total length, about 100 mm.; hind foot, 13 mm.); coloration very dark.

[1] This animal is probably not the same as *Blaria mexicana* Gray, List of Osteological Specimens in British Museum, 1847, pp. XI and 23, from Coban, South America = Coban, Guatemala. The latter is a *nomen nudum*.

Color.—Dusky or sooty, darkest on back and rump; under parts faintly washed with brownish; feet and tail blackish.

Cranial and dental characters.—Skull in size, angularity, and general characters almost indistinguishable from that of *Blarina carolinensis*, except that the brain case and occiput are higher. The brain case is inflated and rises abruptly above plane of rostrum. Cusps of unicuspidate teeth relatively slender and pointed, that of the second vertical or inclined slightly backward; cusplet on inner side strongly developed and chestnut-tipped. Upper molariform teeth only slightly concave posteriorly. Chestnut tips of all the teeth strong and extending well down.

Measurements.—Average of 22 specimens from Jico, Vera Cruz (practically the type locality): Total length, 99 mm.; tail vertebræ, 27 mm.; hind foot, 13.3 mm.

General remarks.—So far as known, *Blarina mexicana* is the most widely dispersed species of the genus inhabiting southern Mexico. It is common in damp oak forests on the mountains, where its runways resemble those of *Microtus*. The typical form is from Jalapa, Vera Cruz, near the southeastern base of the table-land. Most of the colonies from isolated mountains differ appreciably from the type, and in several the differentiation has gone so far as to necessitate subspecific recognition, as in the forms here described under their names *machetes*, *peregrinus*, and *goldmani*.

Concerning the habits of the typical form Mr. Nelson writes:

> This Shrew was rather common about Jico, and still more numerous along the lower border of the oak forest between the altitudes of 5,500 and 6,000 feet. Near Jico they were found mainly in *Arvicola* runways along the border of the canyons or along ditches bordering fields. They were also found with *Reithrodontomys* and *Sitomys* along the lower border of the oak forest. They live in damp situations grown up rankly with grass and weeds. In several places their little trails were found threading their way among the plant stems and terminating in a small hole at each end.

Specimens examined.—Total number, 110, from the following localities in southern Mexico:

> State of Vera Cruz: Jalapa (type), 1; Jico, 29; Las Vigas, 2; Orizaba, 11.
> State of Oaxaca: Reyes, 13; Cerro San Felipe, 22; near Cajones, 2; Totontepec, 9; Mount Zempoaltepec, 24.

BLARINA MEXICANA PEREGRINA subsp. nov.

Type from mountains 15 miles west of city of Oaxaca, Mexico (altitude, 9,500 feet). No. 68317, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected September 12, 1894, by E. W. Nelson and E. A. Goldman. Original number, 6748.

General characters.—Similar to *B. mexicana* in size and color, but with distinctive dental characters.

Color.—Dusky or sooty black, becoming slightly paler below.

Cranial and dental characters.—Skull similar to that of *mexicana*, but rostrum less swollen; unicuspidate teeth with inner cusplet nearly obso-

lete and without chestnut tip; molariform teeth more deeply concave posteriorly; m^2 with postero-internal lobe larger than antero-internal (reverse of *mexicana*).

Measurements (taken in flesh).—Type: Total length, 106 mm.; tail vertebræ, 31 mm.; hind foot, 15 mm. Average measurements of 20 specimens from type locality: Total length, 101.5 mm.; tail vertebræ, 30 mm.; hind foot, 14 mm.

General remarks.—This subspecies may be recognized most easily by the obsolescence of the postero-internal cusplet of the unicuspidate teeth. Of the forms described in the present paper, it is the least worthy of recognition by name. At the same time, the constancy of its characters and the geographic remoteness of the high mountains it inhabits from the home of typical *mexicana* seem to entitle it to stand. Mr. Nelson found it living in grassy meadows and forests on the mountains, where it had runways like those of the other species. Twenty-five specimens were secured at altitudes varying from 8,800 to 9,500 feet.

BLARINA MEXICANA GOLDMANI subsp. nov. Goldman's Blarina.

Type from mountains near Chilpancingo, Guerrero, Mexico (altitude, 10,000 feet). No. 70244, ♂ yg. ad., U. S. Nat. Mus., Department of Agriculture collection. Collected December 23, 1894, by E. W. Nelson and E. A. Goldman. Original number, 7231.

General characters.—Similar to *B. mexicana* in size and general appearance, but head and shoulders more plumbeous (less dusky) and under parts very much paler.

Color.—Upper parts sooty plumbeous, darkest on rump; bridge of nose darker than rest of head; under parts plumbeous, decidedly paler than upper parts.

Cranial and dental characters.—Skull similar to that of *mexicana*, but brain case flatter, only slightly elevated above plane of rostrum. Unicuspidate teeth narrower at base; large upper premolar broader behind antero-internal cusp and more excavated posteriorly.

Measurements (taken in flesh).—Type: Total length, 100 mm.; tail vertebræ, 28 mm.; hind foot, 13 mm. Average measurements of 5 specimens from type locality: Total length, 100 mm.; tail vertebræ, 28.5 mm.; hind foot, 13.2 mm.

General remarks.—*Blarina goldmani* is closely related to *B. mexicana*, differing chiefly in paler under parts, flatter brain case, and slight dental characters. The close resemblance is surprising, in view of the remoteness of the type localities of the two and the great difference in altitude at which they live. The 5 specimens on which the present species is based were collected in damp thickets among fir trees at an elevation of 10,000 feet.

BLARINA MEXICANA MACHETES subsp. nov. Ozolotepec Blarina.

Type from mountains near Ozolotepec, Oaxaca (altitude, 10,000 feet). No. 71456, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected March 26, 1895, by E. W. Nelson and E. A. Goldman. Original number, 7723.

General characters.—Similar to *B. mexicana* in color and general appearance, but somewhat larger, with decidedly larger fore and hind feet, and peculiar dental characters.

Color.—Dusky or sooty black; bridge of nose darker than rest of face; under parts dark in fresh pelage, but more or less ashy in old pelage.

Cranial and dental characters.—Skull similiar to that of *mexicana*, but slightly larger; brain case less elevated above slope of rostrum; unicuspids with inner cusplet smaller and not chestnut tipped; large upper premolar longer, broader, and more excavated posteriorly, with antero-internal angle and cusp less developed; molars larger and more concave behind; lower molars larger.

Measurements (taken in flesh).—Type: Total length, 104 mm.; tail vertebræ, 31 mm.; hind foot, 15 mm. Average measurements of 7 specimens from type locality: Total length, 108 mm.; tail vertebræ, 30.5 mm.; hind foot, 15 mm.

General remarks.—This is a well-marked form of the *mexicana* series, and it comes from the southernmost locality from which any member of the group has thus far been obtained. Mr. Nelson found it among willows in a cold boggy place in the woods, on the north slope of the mountains, at an altitude of 10,000 feet, where its runways were conspicuous and where 7 specimens were obtained.

BLARINA NELSONI sp. nov. Nelson's Blarina.

Type from Volcano of Tuxtla, Vera Cruz, Mexico (altitude, 4,800 feet). No. 65437, ad., U. S. Nat. Mus., Department of Agriculture collection. Collected May 13, 1894, by E. W. Nelson and E. A. Goldman. Original number, 6253.

General characters.—Similar to *B. mexicana* in size, general appearance, and color, perhaps even darker; differs in important cranial and dental characters.

Color.—Uniform sooty brown.

Cranial and dental characters.—Compared with *B. mexicana* the skull is larger and heavier; brain case larger, flatter, and not abruptly elevated above plane of slope of rostrum; interpterygoid fossa much broader. Molariform teeth decidedly broader and heavier; large upper premolar very broad posteriorly, but not excavated, its antero-internal angle and cusp well developed and followed by a sulcus, behind which the tooth immediately broadens. Unicuspidate teeth with inner cusplet nearly obsolete. In some respects the skull resembles *alticola* more than *mexicana;* it differs conspicuously from both in the broad and short interpterygoid notch. The upper molariform teeth differ from those of

the *alticola* series in lacking the posterior excavation. The obsolescence of the inner cusplet of the unicuspids is even more complete than in *alticola*.

Measurements (taken in flesh).—Type: Total length, 110 mm.; tail vertebræ, 31 mm.; hind foot, 14 mm. Average measurements of 11 specimens from type locality: Total length, 106 mm.; tail vertebræ, 29 mm.; hind foot, 13.3 mm.

General remarks.—The peculiarities of *Blarina nelsoni* may be briefly summed up as follows: In external appearance it is hardly distinguishable from *B. mexicana;* the skull is larger and more closely resembles *B. alticola*, but differs from both in the remarkably broad and short postpalatal notch; the molariform teeth resemble those of *mexicana*, while the unicuspidate teeth resemble those of *alticola*. So far as known, the species is restricted to the isolated volcano of Tuxtla, where Mr. Nelson secured a dozen specimens. Mr. Nelson states that it is common in the forest on the mountain and ranges up to the extreme summit, at an altitude of 5,400 feet. Like most of the other species, it makes trails or runways under the shelter of roots and logs.

BLARINA ALTICOLA sp. nov. Popocatepetl Blarina.

Type from Mount Popocatepetl, Mexico (altitude, 11,500 feet). No. 52047, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected February 25, 1893, by E. W. Nelson. Original number, 4396.

Geographic distribution.—Higher slopes of Mount Popocatepetl and the mountains near Salazar and Ajusco, south of the City of Mexico (from 9,500 to 12,000 feet altitude).

General characters.—Size, medium, slightly larger than the *mexicana* group; hind foot decidedly larger than that of *mexicana* or any other Mexican species except *magna*.

Color.—Sooty plumbeous, decidedly paler on the belly, but without line of demarcation.

Cranial and dental characters.—Skull similar to that of *mexicana*, but somewhat larger; brain case narrower and less sharply angular laterally. Molariform teeth much larger and much more deeply excavated posteriorly, especially the large upper premolar, which tooth has the antero-internal angle and cusp strongly developed; unicuspidate teeth with thicker and blunter crowns.

Measurements (taken in flesh).—Type: Total length, 107 mm.; tail vertebræ, 26 mm.; hind foot, 15 mm. Average measurements of 5 specimens from type locality: Total length, 104 mm.; tail vertebræ, 26 mm.; hind foot, 15 mm.

General remarks.—This species is very distinct from any thus far discovered except the *B. fossor* here described, which is closely related. Externally it resembles *Blarina brevicauda* of the United States, but is smaller. It differs from the *mexicana* series in larger size, much larger hind foot, and in the dental characters just mentioned. It is a high

mountain form living in damp, sheltered places on wooded hillsides and under sacaton grass, at an altitude of 9,500 to 12,000 feet.

Specimens examined.—Total number, 10, from the following localities, all in the State of Mexico: Mount Popocatepetl, 5; Salazar, 3; Ajusco Peak, 1; north slope of volcano of Toluca, 1.

BLARINA FOSSOR sp. nov. Zempoaltepec Blarina.

Type from Mount Zempoaltepec, Oaxaca, Mexico (altitude, 10,500 feet). No. 68545, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected July 10, 1894, by E. W. Nelson and E. A. Goldman. Original number, 6419.

Geographic distribution.—Higher slopes of Mount Zempoaltepec (from 8,200 to 10,500 feet altitude).

General characters.—Similar to *B. alticola* in size, large fore claws, and general characters, but darker, and with differences in molariform teeth.

Color.—Sooty plumbeous, becoming slightly paler anteriorly; root of nose darker than rest of head; under parts indistinctly paler and with a slight brownish cast.

Cranial and dental characters.—Compared with *B. alticola*, to which it is closely related, the skull is slightly shorter. The length of the molariform series is essentially the same, but the unicuspid series is shorter. Upper molariform teeth narrower; large upper premolar decidedly different in form, lacking the antero-internal angle, which is completely rounded off, leaving the tooth much narrower in front than that of *alticola*.

Measurements (taken in flesh).—Type: Total length, 111 mm.; tail vertebræ, 29 mm.; hind foot, 15 mm. Average of 5 specimens from type locality: Total length, 108 mm.; tail vertebræ, 29 mm.; hind foot, 14.6 mm.

General remarks.—On Mount Zempoaltepec Mr. Nelson secured 5 specimens of this new *Blarina*, 25 of *B. mexicana*, and 1 of *B. magna*.

BLARINA MAGNA sp. nov. Big Mexican Blarina.

Pl. 1, fig. 10.

Type from Totontepec, Oaxaca (altitude, 6,800 feet). No. 68575, ♂, old, U. S. Nat. Mus., Department of Agriculture collection. Collected July 24, 1894, by E. W. Nelson and E. A. Goldman. Original number, 6493.

Geographic distribution.—Mountains about Totontepec and Mount Zempoaltepec, Oaxaca (from 6,800 to 8,000 feet altitude).

General characters.—Size largest of subgenus *Cryptotis*, equaling *Blarina brevicauda;* tail long (more than 40 mm.); color dusky; tail scant haired.

Color.—Everywhere dull sooty brown, hardly paler below; chin and throat washed with brownish chestnut (which may be due to food-staining).

Cranial and dental characters.—Skull resembling that of *Blarina brevicauda* in size and general appearance, but narrower, with longer rostrum and more arched brain case. The brain case in profile is strongly convex, and the highest point is near junction of posterior and middle thirds. Unicuspidate teeth narrow, with inner cusplet very small. Molariform teeth not at all excavated posteriorly, and without interspaces. Large upper premolar short and broad, with antero-internal angle broadly rounded off.

Measurements (taken in flesh).—Type: Total length, 134 mm.; tail vertebræ, 42 mm.; hind foot, 17 mm.

General remarks.—*Blarina magna*, owing to its very large size, does not require comparison with any known species. The tail is very long for a *Blarina* (45 percent of the length of head and body). A specimen from Mount Zempoaltepec lacks the chestnut-brown wash on the throat. Mr. Nelson states that the runways of this large *Blarina* are conspicuous in the dense, damp oak forest of the mountains. Only two specimens were obtained.

Average measurements of the species of Blarina.

[All measurements are in millimeters and from fresh specimens.]

Name of species.	Locality.	Total length.	Tail vertebræ.	Hind foot.	Number of specimens.
Blarina brevicauda	Council Bluffs, Iowa	127	26.6	16.5	8
	Lake George, New York	121.5	26.7	14.8	31
	Locust Grove, Lewis County, N. Y.	121	25	14.6	58
telmalestes	Dismal Swamp, Virginia	119.5	26.4	16	13
carolinensis	Columbia, S. C.	99.5	20.6	12.5	6
	Raleigh, N. C.	93.3	20.3	11.6	63
	Washington, Miss.	94	20	12.2	9
peninsulæ	Everglades of Florida	96.8	18.5	13.5	6
parva	Blair, Nebr.	79	16	10.6	13
	Raleigh, N. C.	75.6	17	10.1	25
floridana	Canaveral, Fla.	89	22	12	2
berlandieri	Brownsville, Tex.	83	19	12	6
tropicalis	Pluma and Juquila, Oaxaca, Mexico	93	25	12	6
soricina	Tlalpam, D. F. Valley of Mexico	91	26.5	12.5	3
obscura	Tulancingo, Hidalgo, Mexico	92.5	25	13	2
mexicana	Jico, Vera Cruz, Mexico	99	27	13.5	22
goldmani	Mountains near Chilpancingo, Guerrero, Mexico.	100	28.5	13.2	5
peregrina	Mountains near Oaxaca, Mexico	101.5	30	14	20
machetes	Mountains near Ozolotepec, Oaxaca, Mexico.	108	30.5	14.9	7
nelsoni	Volcano of Tuxtla, Vera Cruz, Mexico.	106	29	13.3	11
alticola	Mount Popocatepetl, Mexico, Mexico	104	26	15	5
fossor	Mount Zempoaltepec, Oaxaca, Mexico.	108	29	14.6	5
magna	Totontepec, Oaxaca, Mexico	134	42	17	1 (type)

Cranial measurements of typical specimens of Blarina.

Name.	Locality.	Greatest length (including front incisor).	Greatest breadth.
Blarina brevicauda	Blair, Nebr. (type locality)	25.4	14
telmalestes	Dismal Swamp, Virginia (type)	24	12
carolinensis	Columbia, S. C. (near type locality)	19	10
peninsulæ	Miami River, Florida (type)	20.3	10.5
parva	Blair, Nebr. (type locality)	16.5	7.5
floridana	Canaveral, Fla. (type)	18.2	8
berlandieri	Brownsville, Tex. (near type locality)	16.8	7.8
soricina	Tlalpam, Valley of Mexico (type)	18	8.2
tropicalis	Pluma, Oaxaca, Mexico	18.2	8.8
obscura	Tulancingo, Hidalgo, Mexico (type)	18	9.8
mexicana	Jico, Vera Cruz, Mexico (near type locality)	20	10.5
goldmani	Mountains near Chilpancingo, Guerrero, Mexico (type)	20	10
peregrina	Mountains near Oaxaca, Oaxaca, Mexico (type)	20.3	10.2
machetes	Mountains near Ozolotepec, Oaxaca, Mexico (type)	20	9.8
nelsoni	Volcano of Tuxtla, Vera Cruz, Mexico (type)	20.5	10.5
alticola	Mount Popocatepetl, Mexico, Mexico (type)	21	10.3
fossor	Mount Zempoaltepec, Oaxaca, Mexico (type)	21.2	10.7
magna	Totontepec, Oaxaca, Mexico (type)	24.5	11.5

NOTE.—The following two species of the subgenus *Cryptotis* were described by Dr. Allen after the present paper was in paged proof. Dr. Allen has kindly sent me the type specimens, and I am glad to be able to add the following descriptions:

BLARINA OROPHILA Allen.

Blarina (Soriciscus) orophila Allen, Bull. Am. Mus. Nat. Hist., New York, VII, p. 340, November 8, 1895.

Type locality.—Volcano of Irazu, Costa Rica.

"Pelage glossy, very short, soft and velvety. Above dark brown (shading slightly on seal brown), becoming lighter on the sides, and passing gradually into smoke gray on the ventral surface, where the hairs are conspicuously tipped with whitish. Feet grayish brown; tail dusky above, distinctly lighter below, well clothed, and with a minute pencil at tip. Ears rudimentary and not easily detected.

"*Measurements.*—Head and body, 55 mm.; tail vertebræ, 21 mm.; hind foot, 11 mm.; head, 20 mm.

"*Skull* (too imperfect for complete measurements).—Length of nasals, 5 mm.; length of upper tooth row, 8 mm.; distance between outer borders of last molars, 5.5 mm."

General remarks.—*Blarina orophila* is closely related to *B. tropicalis*, from which it differs in the shape of the bases of the first and second unicuspids when viewed from the outer side; they are narrow and have a pinched appearance instead of being broadly rounded off. The anterior cusp of the large upper premolar, to which Dr. Allen calls attention, is not longer than in *tropicalis* and falls far short of the middle cusp of the same tooth.

BLARINA NIGRESCENS Allen.

Blarina (Soriciscus) nigrescens Allen, Bull. Am. Mus. Nat. Hist., New York, VII, p. 339, November 8, 1895.

Type locality.—San Isidro (San Jose), Costa Rica.

"Pelage coarse, rather long, and not lustrous. Above dusky plumbeous, in some lights black; lower surface not appreciably different. Feet and tail blackish, nearly naked, the annulations of the latter being distinctly visible.

"*Measurements.*—Head and body, 65 mm.; tail vertebræ, 22 mm.; hind foot, 12 mm.

"*Skull.*—Total length, 20 mm.; mastoid breadth, 9.5 mm.; length of nasals, 7 mm.; length of upper tooth row, 9 mm.; distance between outer edges of last molars, 6.3 mm."

General remarks.—*Blarina nigrescens* is closely related to *B. nelsoni*, from which it may be distinguished by the even larger size of the large upper premolar. This tooth is exceedingly broad transversely and is strongly convex on its inner side. Its anterior cusp is nearly obsolete, while in *nelsoni* it is well developed. As in *nelsoni*, all the molariform teeth are very large and very slightly excavated posteriorly. The unicuspidate teeth have the inner cusplet fairly developed; in *nelsoni* it is nearly obsolete. The skull is slightly smaller, and the brain case narrower behind than in *nelsoni*.

Genus NOTIOSOREX Baird, 1877.

Notiosorex (subgenus of *Sorex*) Baird in Coues, Bull. U. S. Geol. and Geog. Surv., III, 1877, 646-647.

Notiosorex (full genus) Dobson, Mon. Insectivora, Part III, 1890, Pl. XXIII, fig. 20. Flower and Lydekker, Introduction to Study of Mammals, 1891, 624. Merriam, Proc. Biol. Soc. Washington, VII, 1892, 26.

Dental formula.—i, $\frac{3}{2}$; c, $\frac{1}{0}$; pm, $\frac{1}{1}$; m, $\frac{3}{3} = \frac{8}{6} \times 2 = \frac{16}{12} = 28$.

Teeth, 28; unicuspids, 3, forming a uniform series, the third more than half as large as second, never minute. Unicuspids narrow at base, without trace of secondary cusplet on inner side. Anterior teeth lightly tipped with orange; molars pure white. Cranium flat and broadly rounded. External ear conspicuous; tail short, less than half the length of head and body; body slender.

FIG. 2.—Skull of *Notiosorex*.

Geographic distribution.—Lower Sonoran fauna of the United States and Mexico, from southern Texas to southern California and southward in Mexico to Mazatlan, Sinaloa and the peninsula of Lower California.

HISTORY AND NOMENCLATURE.

The genus *Notiosorex* is exceptionally free from complications of nomenclature and synonymy. It was described and named by Baird in 1861, but was not published until 1877, when Coues incorporated it, along with other of Baird's manuscript descriptions, in his Precursory Notes on American Insectivorous Mammals.[1] The original type species was described by Baird under the name *Sorex* (*Notiosorex*) *crawfordi*, and came from Fort Bliss, N. Mex. (practically El Paso, Tex.). In the same publication Coues described a specimen from Mazatlan, Mexico, as a new species and named it *Sorex* (*Notiosorex*) *evotis*. No other species have been described, and there are no synonyms, unless *evotis* should prove a synonym of *crawfordi*.

Notiosorex was proposed as a subgenus of *Sorex*. It is accorded ful, generic rank by Dobson and by Flower and Lydekker. It is closely related to the Eurasian genus *Crocidura*, but the skull is much broader and flatter posteriorly. It is doubtful if the differences that separate it from *Crocidura* are of more than subgeneric weight.

NOTIOSOREX CRAWFORDI Baird.

Sorex (*Notiosorex*) *crawfordi* Baird, Bull. U. S. Geol. and Geog. Surv., III, 1877, 651-652. (From Fort Bliss, N. Mex.). Thomas, Proc. Zool. Soc. London, 1888, 444. (From San Diego, Duval County, Tex.).

Type from near Fort Bliss, New Mexico (practically El Paso, Texas). (No. $\frac{3\,4\,5\,3}{4\,4\,3\,7}$, U. S. Nat. Mus.)

Geographic distribution.—Parts of Lower Sonoran zone from eastern Texas to southern California, and thence southward to the cape region of the peninsula of Lower California.

General characters.—Size small, about equaling *Blarina parva;* ears large for a Shrew, protruding conspicuously beyond the fur; hind feet and tail short, the latter about half the length of the body without the head; color plumbeous.

Color.—Upper parts plumbeous (near the 'olive gray' of Ridgway); under parts whitish; tail bicolor, each side concolor with body.

Cranial and dental characters.—The cranial and dental characters have been described in the generic diagnosis. The first and second unicuspids are large and subequal; the third also is large, considerably more than half the second. Judging from Dobson's figure of the teeth of *evotis* (which he calls *crawfordi:* Mon. Insectivora, Part III, 1890, Pl. XXIII, expl.) those of *crawfordi* are less crowded. The large upper premolar and molars are rather deeply excavated posteriorly, especially the latter.

Measurements of type specimen (alcoholic, as recorded by Coues, converted into millimeters).—Head and body, 48 mm.; tail vertebræ, 28 mm.; hind foot, 10 mm. An alcoholic specimen in the Department collection (No. 31532) from San Diego, Tex., measures: Total length,

[1] Bull. U. S. Geol. and Geog. Surv., III, No. 3, 1877, 646.

82 mm.; tail vertebræ, 26 mm.; hind foot, 10.5 mm.; ear, 6.5 mm. Mean of 3 alcoholics from San Diego, Tex. (as measured by Thomas): Head and body, 56 mm.; tail vertebræ, 28 mm.; hind foot, 10 mm. Skull of type specimen: Total length (including front incisors), 17.3 mm.; greatest breadth, 8 mm.

General remarks.—Notiosorex crawfordi is either a very rare animal or very local and difficult to capture, as only a few specimens have found their way into museums, and most of these were collected in Duval County, Texas, by Mr. William Taylor. The Department of Agriculture collection contains one from San Diego, Texas, collected by William Lloyd; one from San Antonio, Texas, collected in 1890 by Mr. H. P. Attwater, and there is one in the Merriam collection from San Bernardino, California, collected April 19, 1886, by Mr. F. Stephens. The latter is the only one known from California and has not previously been recorded.

While this paper is passing through the press two specimens have been received from Santa Anita in the southern part of Lower California. They were collected by J. Ellis McLellan, May 13 and 18, 1895.

The type specimen of *crawfordi* was described as an alcoholic in very bad condition. It is now little more than a skeleton, but the skull is in good condition, except that the occiput has been injured. The color of the type as described by Baird from the alcoholic specimen was "light chestnut brown above." This is the color of the alcoholic San Diego specimens. But no dependence can be placed on the color of alcoholic Shrews, since most of them change to chestnut or reddish brown. The skin from San Antonio lacks the chestnut and is nearly uniform plumbeous, slightly browner above. The specimen from San Bernardino, Calif., which was at first assumed to be an undescribed species, agrees so closely with the San Antonio specimen that I am unwilling to separate it even subspecifically. It is plumbeous above, paler below, with the hairs of the back faintly washed with brownish. Thus the only two specimens of *Notiosorex* from the United States that have not been in alcohol are plumbeous, washed with brownish instead of chestnut, while all the alcoholics that have been examined (about half a dozen) have the upper parts strongly washed with chestnut.

Skulls of *Notiosorex crawfordi* from San Antonio and San Diego, Texas, are identical with that of the type. The skull from San Bernardino, Calif., differs from the type in the following points: Size slightly smaller; muzzle more abruptly narrowed anteriorly; angle of tooth row (seen in profile) greater at junction of molariform teeth with unicuspidate series; large upper premolar larger (outer side longer and transverse diameter greater). But these differences are not sufficient to warrant separation.

NOTIOSOREX CRAWFORDI EVOTIS (Coues).

Sorex (Notiosorex) evotis Coues, Bull. U. S. Geol. and Geog. Surv., III, 1877, 652. (From Mazatlan, Mexico.)

Notiosorex crawfordi Dobson (*not* Baird), Mon. Insectivora, Part III, 1890, Pl. XXIII, fig. 20. (From Mazatlan, Mexico.)

Type from Mazatlan, Sinaloa, Mexico. (No. 9066, U. S. Nat. Mus.)

Geographic distribution.—Neighborhood of Mazatlan; range unknown.

General characters.—Similar to *N. crawfordi*, but slightly larger and darker.

Color.—Upper parts plumbeous, the tips of the hairs ashy or brownish; under parts soiled whitish.

Cranial and dental characters.—The skull of *evotis* I have not seen, the skull of the type having been lost or mislaid in the United States National Museum; but Dobson has figured the teeth of a specimen from the type locality (Mon. Insectivora, Part III, fasc. 1, 1890, Pl. XXIII, fig. 20), which, if correct, indicates that the teeth are more crowded than in *crawfordi*, and the second or middle unicuspid smaller, being intermediate in height between the first and third. In *crawfordi* the first and second are essentially subequal.

Measurements of type specimen (from dry skin, as recorded by Coues, converted into millimeters).—Head and body, 73 mm.; tail vertebræ, 23 mm. [probably 25 mm.]; hind foot, 11.5 mm.

General remarks.—In the absence of sufficient material of *N. evotis*, it is impossible to determine its exact relations to *crawfordi*. Dobson did not recognize it as distinct, but figured its teeth under the name *crawfordi*. For the present it seems best to retain it as a subspecies.

THE LONG-TAILED SHREWS OF THE EASTERN UNITED STATES.

By GERRIT S. MILLER, Jr.

During the summer of 1894 I was enabled, through the kindness of Mr. Oldfield Thomas, to examine in the British Museum the original specimens of three Shrews (*Sorex palustris*, *S. forsteri*, and *S. parvus*) described by Richardson nearly seventy years ago, but since then not positively identified. In explaining the results of this study it is necessary to consider all the Long-tailed Shrews of the eastern United States.

Writers on the Shrews of eastern North America have without exception worked with inadequate material, and, as a result, left the nomenclature in a chaotic state. Thus, to the common *Sorex personatus* no less than ten specific names have been applied, while another species (*Sorex forsteri* Baird *nec* Richardson) has been allowed to go unnamed. On the other hand, certain names—as, for instance, *Sorex forsteri* or *Sorex richardsoni*—have been used to designate as many as three species. Much of this confusion is the result of a lack of appreciation of the facts that in determining closely allied Shrews it is necessary to compare specimens in the same phase of pelage, and in which the original form of the teeth has not been sensibly altered by wear. The extent to which the form of the teeth changes with age is shown in Pl. IV, fig. 8, as compared with figs. 5, 6, and 7. That there is much individual variation in the form and relative size of the teeth is another circumstance which has not been properly taken into account. As a result, specimens of one Shrew have been referred to two or more species placed in different sections of the genus. Variation of this kind is illustrated by figs. 5, 6, and 7 of Pl. IV, which show the unworn unicuspid teeth of three specimens of *Sorex personatus* taken at one locality. The seasonal changes in color are much greater than has been supposed. *Sorex albibarbis* is in summer nearly unicolor, while in winter the belly is so much paler than the back and sides as to give the animal a resemblance to the bicolored *S. palustris*. Many specimens of *Sorex fumeus* taken during mid-summer are by color alone with difficulty separated from *S. personatus*, to which in winter it bears no likeness. In most Shrews the fur is noticeably longer and softer in autumn and winter than in summer, and at the same time the colors are richer and more strongly contrasted.

In preparing the following revision of the species of *Sorex* occurring in the United States east of the Great Plains I have examined about 500 Shrews from that region. This material is in part from my own

collection and the private collections of Dr. C. Hart Merriam, Mr. Outram Bangs, and Mr. S. N. Rhoads. I have also had at my disposal, in addition to the specimens in the British Museum already referred to, the Shrews belonging to the American Museum of Natural History, the United States Department of Agriculture, and certain specimens determined by Baird in the United States National Museum.

The three most important studies of the Shrews of eastern North America are those of Bachman, 1837;[1] Baird, 1857,[2] and Dobson, 1890.[3]

The following table shows the names used by these authors for the seven species admitted in the present paper.

	Bachman, 1837.	Baird, 1857.	Dobson, 1890.
Sorex hoyi		S. hoyi	S. hoyi.
		S. thompsoni	
palustris			S. palustris.
albibarbis			
richardsoni	S. richardsoni	S. pachyurus	S. vulgaris (= S. araneus).
fumeus		S. forsteri	S. platyrhinus.
		S. richardsoni	
longirostris	S. longirostris	S. personatus?	
personatus	S. forsteri	S. cooperi	S. richardsoni.
	S. fimbripes	S. platyrhinus	S. personatus.
	S. cooperi	S. haydeni	S. haydeni.

The subject is so complicated that it is necessary to consider in detail the history of each species.

Sorex hoyi.—*Sorex hoyi* was first described in 1857 by Baird, and since then has been almost unknown. At present there are perhaps two dozen specimens in collections. *Sorex thompsoni*, from Burlington, Vt., described in the same paper with *S. hoyi*, is probably indistinguishable from the latter.

In 1877 Dr. Coues published in his Precursory Notes on American Insectivorous Mammals[4] a diagnosis by Baird of the subgenus *Microsorex* based on *Sorex hoyi*. In this paper, as well as in the original description of the species, Baird overlooked the minute fourth incisor and stated that *Sorex hoyi* had only 30 teeth. This error was not detected until 1890, when Dobson figured the teeth correctly.

Sorex palustris.—The first notice of an American Marsh Shrew was published in 1828, when Richardson described *Sorex palustris*,[5] an animal which he had found frequenting the borders of lakes in the region between Hudson Bay and the Rocky Mountains.

[1] Jour. Acad. Nat. Sci. Phila., VII, Part II.
[2] Mamm. N. Am.
[3] Mon. Insectivora, Part III, fasc. 1.
[4] Bull. U. S. Geol. and Geog. Surv., III, No. 3, 1877.
[5] Zool. Jour., III, p. 517.

In 1857 Baird placed *Sorex palustris* among the species unknown to him, but which he considered as probably worthy of recognition. At the same time he described the new genus *Neosorex* and the species *Neosorex navigator*, from Washington.

Our first accurate knowledge of *Sorex palustris* dates from 1890, when Dr. Dobson figured the teeth of the type specimen,[1] and in another paper published the same year[2] discussed the validity of the genus *Neosorex*. Dr. Dobson came to the conclusion that *Sorex palustris* and *Neosorex navigator* are the same, and that *Neosorex*, so far from being a genus, can not even be recognized as a subgenus. A year later Dr. Merriam recorded *Sorex palustris* from Idaho, at the same time remarking that he considered *Neosorex* a very good subgenus.[3]

The type specimen of *Sorex palustris* in the British Museum is dingy and discolored. For years it was exhibited as a mounted specimen, but is now kept as a skin. In color it is unlike any Shrew that I have seen, but resembles *S. bendirii* more than any other. The fur is gone from the middle of the belly, but what remains on the chin, throat, and sides agrees in color with that of the corresponding parts in *S. bendirii*. The color is, however, so obviously unnatural that it can not be considered of any importance, especially as it is not in the least as described by Richardson. Reasons have already been given for believing that Richardson's name should be applied to the paler-bellied western form of Marsh Shrew (Proc. Bost. Soc. Nat. Hist., XXVI, March 24, 1894, 181, 182), and after examining the type I see no necessity for changing this opinion. The specimen being in such condition as to furnish no evidence, it is still necessary to judge the old descriptions on their own merits. As all the early accounts of *Sorex palustris* refer to its pale, ash-gray belly, and as the geographical range—indefinite though it is—coincides with that of the western animal, it is proper to apply the name to the latter. That the type of *Sorex palustris* is a *Neosorex* and not an *Atophyrax* is shown by the teeth, which are nearly unworn.[4]

Sorex albibarbis.—The type of *Sorex albibarbis* was taken by Prof. E. D. Cope in 1859 at Profile Lake, New Hampshire. The original description of the species appeared three years later in the Proceedings of the Philadelphia Academy of Sciences.[5]

Soon after Professor Cope published his account of *Sorex albibarbis* Prof. A. E. Verrill recorded a specimen from Warwick, Mass., and attempted to prove the identity of the animal with Richardson's *Sorex palustris*.[6] In this attempt he was so far successful that he has been followed by Mr. J. A. Allen in his Catalogue of the Mammals of Mass.[7]

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[1] Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 18.

[2] Proc. Zool. Soc. London, p. 51.

[3] N. Am. Fauna No. 5, p. 35, July, 1891.

[4] The teeth as figured by Dobson (Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 18) appear somewhat too deep from apex to root.

[5] Proc. Acad. Nat. Sci. Phila., 1862, p. 188.

[6] Proc. Bost. Soc. Nat. Hist., IX, p. 164, 1862.

[7] Bull. Mus. Comp. Zool., I, p. 211, 1869.

In 1892, however, Dr. Merriam enumerated both *Sorex albibarbis* and *S. palustris* among the mammals of the boreal zone,[1] while two years later the species was again recorded from Profile Lake, New Hampshire, and also from Essex County, N. Y.[2] Still more recently Mr. Rhoads has taken *S. albibarbis* in Pennsylvania.[3]

Sorex richardsoni.—The American representative of *Sorex araneus* was discovered by Forster, who in 1772 recorded the species from Hudson Bay. Although Forster called the animal *Sorex araneus* he noticed that it had a blacker back and brighter colored sides than the common European Shrew.

The species was next described by Richardson in the Fauna Boreali-Americana (1829). Here it was referred with some hesitation to *Sorex parvus* Say, a Shrew which is not even congeneric with *S. richardsoni.* The specimen on which Richardson based his description of *Sorex parvus* is in the British Museum, and though faded and dingy is perfectly identifiable. The color pattern can still be distinctly seen, while in size it agrees exactly with a specimen from Elk River, Minnesota.

In 1837 Bachman, who already felt convinced that the Shrews called *Sorex parvus* by Richardson and Say were not the same, received a specimen from Mr. William Cooper, on the strength of which he named Richardson's animal *Sorex richardsoni.* Cooper's specimen came from the Northwest Territory, which in the early thirties embraced the present States of Wisconsin, Iowa, Minnesota, northern Illinois, and the northern peninsula of Michigan. As the *Sorex parvus* of Richardson is known to occur in this region, and as nothing in Bachman's description points to any other animal, the propriety of applying to it the name *richardsoni* is hardly open to question, though there is the possibility that the Cooper specimen was really *S. fumeus.*

The animal was not noticed again until the year 1857, when Baird described a specimen in full winter coat as a new species under the name *Sorex pachyurus.* The *Sorex richardsoni* of Baird is a pale, worn summer specimen of *S. fumeus.*

The most recent mention of *Sorex richardsoni* is by Dobson, who figures the teeth for the first time. Dobson, like Forster, referred the animal to *Sorex vulgaris* [= *S. araneus*], the species to which it is certainly most nearly allied.

Sorex fumeus.—The large slaty-plumbeous Shrew characteristic of the Canadian fauna was first described by Baird in 1857. Baird had two specimens, one from Carlisle, Pa., and the other from Racine, Wis. These he identified respectively as *Sorex forsteri* [= *S. personatus*] and *Sorex richardsoni*, species widely different from each other and from *Sorex fumeus.* Both specimens are now in the National Museum. The type of Baird's *forsteri* is in the dark autumnal or winter pelage, and

[1] Proc. Biol. Soc. Washington, VII, p. 25, 1892.

[2] Miller, Proc. Bost. Soc. Nat. Hist., XXVI, p. 183, 1894.

[3] Proc. Acad. Nat. Sci., Phila. 1894, 395, Jan., 1895.

hence recognizable at a glance from the external characters alone. The original of his *richardsoni*, on the other hand, is a much worn summer specimen, the determination of which might be a matter of uncertainty were it not for the excellent condition of the teeth and anterior part of the skull, which show it to be unquestionably *Sorex fumeus*.

From 1857 to 1890 *Sorex fumeus* escaped notice. The references to *Sorex forsteri* and *S. richardsoni* during this period are based on Baird's statements concerning the species rather than on identification of specimens. In 1890, however, Dobson figured the teeth of an individual from Lake George, New York. This specimen he identified with De Kay's *Otisorex platyrhinus*, a totally different animal.

That this species should have remained until now unnamed is a matter of surprise. Nevertheless, a careful examination of the literature shows that none of the many names proposed for North American Shrews can be applied to it. Of these names it is necessary to consider in the present connection *Otisorex platyrhinus* De Kay and *Sorex platyrhinchus* Linsley only. The former was based on a specimen from Tappan, Rockland County, N. Y. The essential part of the original description is as follows:

Characteristics: Dark brown, paler beneath. Total length, 4 inches.

Description: * * * Ears very large, rounded and membranaceous, subangular on the upper margin, sparsely covered within and without with long hairs; * * * hind feet slender, 0.8 inch long, sparsely covered with light rufous hairs; * * * fur over whole body quite long and thick, ranging from 0.2 to 0.4 inch; * * * teeth minute, tinged with piceous at their tips. Dental formula: Incisors, $\frac{2}{2}$; cheek teeth, $\frac{16}{16}=32$. * * * Color: Dark cinereous, slightly tinged with dusky rufous, particularly on the upper part of the muzzle and inferior portion of the neck; beneath, ash gray.

Length of head and body, 2.5 inches; length of tail, 1.6 inches; length of head, 0.9 inch; length of ear, 0.2 inch.

Nothing in this description refers unquestionably to the Shrew under consideration. It is true that the statements concerning the color might refer to this animal. Since, however, they apply with equal pertinence to the majority of known species of *Sorex*, they can not be considered of any diagnostic value. The stress that De Kay lays on the large ears of his specimen has led to the belief that he had in hand the larger of the two common species of *Sorex*, an animal with actually though not proportionally larger ears than *S. personatus*. The measurement—length of ear, 2 lines (4 mm.)—was made no one knows how. As it stands it is about 2 mm. shorter than the ear of *S. fumeus* measured (in the dry skin) from the meatus, while it exceeds by a full millimeter, or 33 percent, the height of ear above crown in dried specimens of the same animal.

On the other hand, *Otisorex platyrhinus* agrees in size with *Sorex personatus*. "Total length, 4 inches" (100 mm.), and "length of tail, 1.6 inches" (38 mm.), are statements which apply to the latter species and not to *S. fumeus*.[1] The measurement of the hind foot, "8 lines"

[1] Ten specimens of *S. personatus* average: Length, 101 mm.; tail, 38.8 mm.; while a like number of *S. fumeus* average: Length, 119 mm.; tail, 44.9 mm.

(19 mm.), is evidently an error, since it is about right for a Shrew the size of *Sorex albibarbis*, and can apply to no true *Sorex* known from the eastern United States.

Although De Kay's account of *Otisorex platyrhinus* is so faulty as to make the identification of his animal a matter of uncertainty, the description published by Linsley[1] of a specimen seen and named by De Kay is enough[2] to fix the name on the animal already called *Sorex personatus* by Isidore Geoffroy Saint Hilaire.

Sorex longirostris.—In 1837 Bachman described a Shrew from the swamps of the Santee River, South Carolina.[3] This animal he named *Sorex longirostris*. Although there is nothing in Bachman's long account by which the animal can be positively identified, the name may be applied to a very distinct species of Shrew occurring in the Southern States. Efforts to secure topotypes of *Sorex longirostris* have thus far failed, and the nearest point to the type locality from which specimens are known is Bertie County, N. C. It is very unlikely, however, that a different Shrew occurs in the Santee region.

This Shrew is now recognized for the first time since Bachman described it, unless the *Sorex personatus* of Baird was the same. The type of Baird's *personatus* is a skin without skull of an apparently immature Shrew taken near Washington, D. C. The specimen is in such condition as to be wholly unidentifiable, and nothing is known about the Long-tailed Shrews that occur in the vicinity.

Sorex personatus.—Isidore Geoffroy Saint Hilaire described in 1827,[4] a Shrew which he called *Sorex personatus*. No type locality is given, but the original specimen was collected by Milbert in the United States, possibly in New York.[5] The description is sufficiently accurate to show that the animal was the smaller common Long-tailed Shrew of the eastern United States.

A few months later Richardson redescribed the species as *Sorex forsteri*.[6] The type in the British Musuem has been mounted, but is now kept as a skin. The fur has a peculiar brownish-fulvous cast, the

[1] Sill. Am. Jour. Sci., XLIII, 346.

[2] This beautiful little quadruped was taken in a decayed apple-tree log in Stratford January 22, 1840. Total length, 4 inches [101.6 mm.]; body and head, 2.5 inches [63.5 mm.]; * * * length of tail, 1.5 inches [38 mm.]; * * * height of ear, .1 inch [2.5 mm.]; * * * total weight of animal, 27 grains. Color: Upper parts dark, reddish brown; nose and tail, upper side dull red, under parts dark gray or light mouse colored; end of tail a pencil of black hair; feet and legs white, or pale flesh color; * * * length of hind feet to elbow, 5; * * * orifice of the ear very large and curiously folded, being nearly 3 lines [6.25 mm.] across. It was named by Dr. De Kay, to whom I sent it, *S. platyrhinchus*, and he describes it as a subgenus, *Otisorex* * * * and he is the least and most delicate mammiferous quadruped I ever beheld.

[3] Jour. Acad. Nat. Sci. Phila., VII, Part II, p. 270, Pl. XXIII, fig. 2.

[4] Mém. Mus. d'Hist. Nat., Paris, XV, p. 122.

[5] Milbert collected the type of *Rhinichthys cataractæ* Cuv. and Val. at Niagara Falls, N. Y.

[6] Zool. Jour., III, p. 516, Jan. to Apr., 1828.

result probably of long exposure. The teeth are so worn that the incisors are reduced to mere stubs. In spite of all this, there can be no doubt that the specimen is a typical *Sorex personatus*. The hind foot measures 11 mm.

The next reference to *Sorex personatus* was made by Gapper, who described and figured the animal under the name *Sorex forsteri* in the Zoological Journal for 1830. Gapper's specimens came from the region between York and Lake Simcoe, Ontario.

The *Sorex cooperi* which Bachman named in 1837 is without doubt the present species.

Bachman's *Sorex fimbripes*, described in the same paper with *S. richardsoni* and *S. cooperi*, is said by Dr. Coues,[1] who has examined the supposed type, to be a perfectly normal *Sorex personatus*. How Bachman could see in such a specimen the remarkable characters ascribed to *S. fimbripes* is beyond comprehension. On Bachman's account of *S. fimbripes* is based the generic name *Hydrogale* Pomel.[2] The type of *Sorex fimbripes* was collected in Lycoming County, Pa., on Drurys Run, a branch of the Schuylkill River.

The *Amphisorex lesueuri* of Duvernoy[3] from Indiana, is apparently an abnormal example of *Sorex personatus*. It is said to have a whitish streak running from the eye to the corner of the mouth.

Sorex platyrhinchus Linsley and *Otisorex platyrhinus* De Kay have been discussed in detail under *Sorex fumeus*. There can be no question that both names are synonyms of *Sorex personatus*.

In 1857 Baird recognized five small Shrews from the eastern United States. Two of these—*Sorex platyrhinus* and *S. cooperi*—were based on individual variations of the present species. Specimens with the unicuspid teeth, as shown in Pl. IV, fig. 5, were referred to *S. cooperi*, while those with the teeth, as in Pl. IV, figs. 6 or 7, were called *S. platyrhinus*. At the same time Baird described as a new species *Sorex haydeni*,[4] from Fort Buford, N. Dak. Certain slight peculiarities in a few specimens from this general region indicate that *Sorex haydeni* may eventually be recognized as a local race of *S. personatus*. For the present, however, the forms are best united under the latter name.

From 1857 to 1890 *Sorex personatus* has been referred to as *S. cooperi*, *S. platyrhinus*, or *S. personatus* indifferently. In 1890, however, Dr. Dobson added to the list of synonyms by figuring the teeth of an individual from Halifax, Nova Scotia, under the name *Sorex richardsoni*.[5]

The next year Dr. Merriam described specimens from Idaho as a new species, *Sorex idahoensis*.[6]

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[1] Bull. U. S. Geol. and Geog. Surv., III, No. 3.

[2] Archiv. Sci. Phys. and Nat., Genève, IX, 248, Nov., 1848.

[3] Magasin de Zoologie, Mamm., p. 33, Pl. L, 1842.

[4] Mamm. N. Am., p. 29.

[5] Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 9.

[6] North American Fauna, No. 5, p. 32.

In 1894 Mr. J. A. Allen recorded a large series of *Sorex personatus* from New Brunswick as *Sorex forsteri*,[1] the name first applied to the animal by Richardson more than sixty years before.

KEY TO THE SPECIES OF SOREX OCCURRING IN THE UNITED STATES EAST OF THE GREAT PLAINS.

A distinct secondary cusp on the inner side of the canine and second and third upper incisors (subgenus *Microsorex*) ..... *S. hoyi*
No secondary cusp on the canine or any of the incisors except the first.
Feet conspicuously fringed; size large (total length usually more than 150 mm.; hind foot, over 18 mm). (Subgenus *Neosorex*.)
Distinctly bicolor; belly nearly white, in strong contrast with color of back; chin not paler than rest of ventral surface.... *S. palustris*
Nearly unicolor, or with belly somewhat grayer than back; chin paler than rest of ventral surface ..... *S. albibarbis*
Feet not fringed; size medium or small (total length, less than 140 mm.; hind foot never more than 16 mm). (Subgenus *Sorex*.)
Average length, over 110 mm.; tail more than 40 mm.
A well-defined dark dorsal area ..... *S. richardsoni*
Back not noticeably darker than sides ..... *S. fumeus*
Average length, under 105 mm.; tail less than 40 mm.
Canine normally smaller than fourth incisor, rostrum broad (ratio of greatest anteorbital breadth to palatal length, 78) ..... *S. longirostris*
Canine normally equal to or larger than fourth incisor, rostrum narrow (ratio of greatest anteorbital breadth to palatal length, 61 : 71) ..... *S. personatus*

Subgenus MICROSOREX Baird.

Microsorex Baird in Coues Precursory Notes on American Insectivorous Mammals, Bull. U. S. Geol. and Geog. Surv., III, No. 3, 646, 1877. Type, *Sorex hoyi* Baird.

Inner side of canine and second and third upper incisors with a distinct secondary cusp (fig. 1*c*); fourth upper incisor very minute and

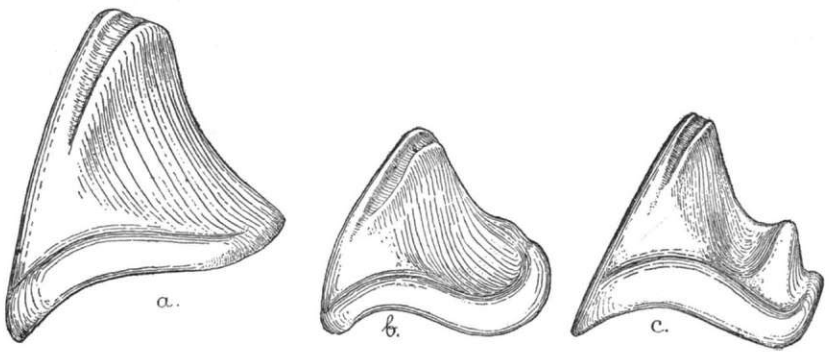


FIG. 1.—Third upper incisor (greatly enlarged and semi-diagrammatic). *a*, *Sorex araneus*; *b*, *S. personatus*; *c*, *S. hoyi*.

nearly hidden between the third incisor and canine; brain case low and narrow (ratio of cranial breadth to total length of skull ranging from 42 to 47); mandible short and heavy; feet never fringed.

[1] Bull. Am. Mus. Nat. Hist., VI, p. 100, Apr. 24.

Baird established the subgenus *Microsorex* in 1877 in a paper published by Dr. Coues. The characters as originally given were false, since it was supposed that *Sorex hoyi*, the type of the subgenus, had only 30 teeth, while in reality it has 32, the number normally present in the genus. Although the subgenus can not be distinguished by the number of teeth, it is amply characterized by cranial and dental peculiarities which will be more fully discussed in the description of *Sorex hoyi*. The form of the skull, and especially of the mandible, in this Shrew is so peculiar as to suggest that it may be necessary eventually to recognize *Microsorex* as a full genus.

So far as known, *Microsorex* is peculiar to America, where it is represented by one species, *Sorex hoyi* Baird.

SOREX HOYI Baird.

(Pl. V, figs. 6 and 7; Pl. VI, figs. 10 and 10*a*.)

1857. *Sorex hoyi* Baird, Mamm. N. Am., p. 32. (Racine, Wis.)
1857. *Sorex thompsoni* Baird, Mamm. N. Am., p. 34. (Burlington, Vt.)
1862. *Sorex thompsoni* Verrill, Proc. Bost. Soc. Nat. Hist., IX, p. 169. (Maine.)
1890. *Sorex hoyi* Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, figs. 15, 16*a*. (New York and Manitoba.)

Type locality.—Racine, Wisconsin.

Geographic distribution.—Boreal zone and adjacent part of Transition zone from Minnesota to New Brunswick and Nova Scotia.

General characters.—*Sorex hoyi* is the only known species of *Microsorex*. It may be recognized by the subgeneric characters.

Color.—Back and sides hair brown, more or less darkened with clove brown on the former, and shading, without line of demarcation, into the pale hair brown or silver gray of the belly. Dorsum of manus and pes and ventral surface of tail pale Isabella color. Region between front legs usually tinged with fulvous.

The color of the back varies slightly, being more darkened with clove brown in some individuals than in others. The chest is often very strongly tinged with fulvous, and at least a trace of this color is present in every specimen that I have examined.

Skull.—The skull of *Sorex hoyi* (Pl. VI, figs. 10, 10*a*) is small, thin, and papery. In form it differs from that of other species of *Sorex* in the flattened and narrowed brain case and in the short thick mandible, the latter resembling that of the smaller species of *Blarina*. The peculiarities in form as compared with *Sorex personatus* and *S. richardsoni* are shown in the following table of approximate cranial ratios:

	Sorex hoyi.	Sorex personatus.	Sorex richardsoni.
Ratio of cranial breadth to total length of skull	45	51	51
Ratio of greatest anteorbital breadth to total length of skull	28	28	27
Ratio of rostral breadth to palatal length	80	70	66
Ratio of palatal breadth to cranial breadth	60	55	52
Ratio of palatal depth to cranial depth	40	51	40
Ratio of cranial depth to cranial width	49	51	53

Teeth.—The teeth of the upper molariform series can scarcely be distinguished from the corresponding teeth in *Sorex personatus*, except by the slightly different form of the excavations on the posterior borders. These excavations in *S. personatus* are deepest near the middle of the teeth, while in *S. hoyi* the deepest points are distinctly nearer the inner borders.

The unicuspid teeth of *Sorex hoyi* are (Pl. V, figs. 6, 7) slender, deep, and heavily pigmented, the colored area occupying nearly one-third of the outer face of the second and third incisors, and somewhat less on the canine. The second and third incisors are of equal height, the second slightly the larger. The canine is about half the size of the third incisor. The premolar and the fourth incisor are very minute, though both are visible from the outer side. The fourth incisor is so small that it is readily overlooked in alcoholic specimens or in skulls that are not properly cleaned. In a specimen from Trousers Lake, New Brunswick, both premolar and fourth incisor are remarkably large (Pl. V, fig. 6), but no other specimens from the Eastern States show any peculiarities to separate them from true *S. hoyi*.

The crowns of the second and third incisors, and to a less degree the canine in *Sorex hoyi* are remarkable for the prominence of the ridge forming the inner edge of the pyramidal main cusp. This ridge, which is present in all species of *Sorex*, is here greatly developed, and provided near its base with a distinct, pigmented, secondary cusp (fig. 1*c*). This cusp is not homologous with the minute cusp on the inner side of the unicuspid teeth of *Blarina*, as the latter is developed from the cingulum and is near the hinder edge of the tooth, while the secondary cusp in *Microsorex* is distinct from the cingulum and lies somewhat in front of the middle of the tooth. Although the ridge which bears the secondary cusp in *Microsorex* is not equally developed in all species of true *Sorex*, it is never entirely absent. It is greatly reduced in *S. araneus* (fig. 1*a*), *S. alpinus*, and *S. richardsoni*, much more conspicuous and sometimes even tending to form a rudimentary cusp in *S. minutus*, *S. personatus* (fig. 1*b*), and others.

The mandibular teeth, like the mandible itself, are remarkably short and strongly built. While the individual teeth are distinctly broader than in *S. personatus*, the tooth row as a whole is shorter. The teeth show no essential differences in form beyond those already noticed.

Measurements.—Unfortunately, most of the specimens of *Sorex hoyi* that I have seen were not measured in the flesh; hence it is impossible to give satisfactory measurements for the species. An alcoholic specimen from Steele County, Minn., measures: Length, 88 mm.; tail vertebræ, 27 mm.; hind foot, 10 mm. Three alcoholic specimens from Elk River, Minn., average: Length, 81.7 mm.; tail vertebræ, 30.7 mm.; hind foot, 10.7 mm.

General remarks.—*Sorex hoyi* differs so widely from other species of *Sorex* in its subgeneric characters that it needs no comparison with any. Superficially it has much the appearance of a small, abnormally short-tailed *S. personatus*.

Subgenus NEOSOREX Baird.

Neosorex Baird, Mamm. N. Am., p. 11, 1857. Type, *Neosorex navigator* Baird.

Inner side of canine and incisors without secondary cusps; fourth upper incisor well developed; brain case broad (ratio of cranial breadth to total length of skull ranging from 52 to 56); mandible slender and lightly built; feet conspicuously fringed with bristle-like hairs, as in *Crossopus*.

The subgenus *Neosorex* was first described in 1857 by Baird, who considered the single species known to him entitled to full generic rank. In this decision he was followed by authors until 1890, when Dr. Dobson (Proc. Zool. Soc. London, p. 51) came to the conclusion that *Neosorex* "can not even be considered as * * * a subgenus" Dr. Merriam has more recently (North American Fauna, No. 5, July, 1891, p. 35) expressed the opinion that *Neosorex* is "a very good subgenus," and this ruling appears to be the most satisfactory.

Neosorex is confined to America, and although not closely related to the Old World *Crossopus*, shows a remarkable parallelism with the latter both in habits and in external appearance. Both are aquatic, inhabiting marshes and the borders of streams, and the likeness between freshly killed specimens of the two Shrews is very remarkable. *Crossopus* is, however, the more robust animal with shorter tail and broader muzzle.

SOREX PALUSTRIS Richardson.

(Pl. V, fig. 1; Pl. VI, figs. 1 and 1*a*.)

1828. *Sorex palustris* Richardson, Zool. Jour., III, p. 517. (Hudson Bay to Rocky Mts.)
1853. *Sorex palustris* Aud. and Bach., Quadrupeds N. Am., III, p. 108, Pl. CXXV.
1890. *Sorex palustris* Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 18 (teeth of type).
1894. *Sorex palustris* Miller, Proc. Bost. Soc. Nat. Hist., XXVI, p. 183. (Minnesota.)

Type locality.—Unknown; somewhere in the region between Hudson Bay and the Rocky Mountains. (Type in the British Museum.)

Geographic distribution.—Boreal zone from Hudson Bay and central Minnesota west to the Rocky Mountains.

General characters.—*Sorex palustris* is distinguished by its subgeneric characters from all other eastern American Shrews except *S. albibarbis*. From the latter it is separated by its shorter, broader, more heavily pigmented unicuspid teeth, and the sharply defined whitish color of the belly.

Color.—Dorsal surface very dark seal brown with a slight gloss, each hair with a narrow subterminal band of smoke gray separating the seal-brown tip from the slate-gray under fur, and producing a grizzled appearance when the animal is viewed in certain lights; ventral surface very pale smoke gray, nearly white, and often faintly tinged with cream color; the color of the belly extending a short distance on the

sides, where it shades quickly into the color of the back; inner surfaces of all four legs colored like the belly; dorsum of manus and pes sepia, paler on the inner half; tail clear seal brown dorsally and at tip, pale smoke gray ventrally, this gray area broad proximally, but soon narrowing to a mere line, which persists to the extreme tip.

In the worn summer coat the belly is variously discolored with brownish and yellowish, the animal usually, however, remaining sharply and distinctly bicolor.

Skull.—The skull of *Sorex palustris* is large and heavily built, with the brain case broad and high. Otherwise it does not differ essentially from the skull of *S. araneus* or *S. richardsoni*. The anterior opening of the infraorbital canal is large and elliptical in outline, sharply defined on all sides except in front. The posterior border is over a point slightly behind the middle of the first molar. Close to the posterior border of this opening is the small lachrymal foramen.[1]

Teeth.—The teeth of *Sorex palustris* are large, strong, and heavily pigmented (Pl. V, fig. 1). The molariform teeth do not differ in form from those of *S. araneus* and *S. richardsoni*, except that the posterior borders of the upper molars are more extensively excavated, the widest part of the excavation being nearer the inner borders of the teeth. The unicuspid teeth, however, show more obvious differences. The second and third incisors are subequal, the latter slightly the larger. The fourth incisor is less than half the size of the canine, which in turn is distinctly smaller than the second incisor. The premolar is minute but in the tooth row and distinctly pigmented at the tip.

Measurements.—It happens that very few of the specimens of *Sorex palustris* that I have seen were measured in the flesh. A male from South Edmonton, Alberta: Length, 157 mm.; tail vertebræ, 68 mm.; hind foot, 20 mm. Another male, from Tower, Minn.: Length, 156 mm.; tail vertebræ, 65 mm.; hind foot, 19 mm.

SOREX ALBIBARBIS (Cope).

1862. *Neosorex albibarbis* Cope, Proc. Acad. Nat. Sci. Phila., p. 188. (New Hampshire.)
1862. *Neosorex palustris* Verrill, Proc. Bost. Soc. Nat. Hist., IX, p. 164. (Massachusetts.)
1892. *Sorex albibarbis* Merriam, Proc. Biol. Soc. Washington, VII, p. 25.
1894. *Sorex albibarbis* Miller, Proc. Bost. Soc. Nat. Hist., XXVI, p. 183. (New Hampshire and New York.)

Type locality.—Profile Lake, New Hampshire.

Geographic distribution.—Boreal zone in the eastern United States and Canada from Pennsylvania north at least to Nova Scotia and Quebec. Specimens examined from Nova Scotia, Quebec (Lac aux Sables),

[1] I am somewhat in doubt as to the correct name for this foramen. Parker apparently alludes to it in his description of the adult skull of *Sorex araneus* (Phil. Trans. Royal Soc., CLXXVI, 213, 1886) when he says "the canal wall for the infraorbital nerve is itself perforated," though in reality the foramen in question does not open into the infraorbital canal, but on the contrary into a tube lying superficial to the latter and penetrating the skull in the direction of the nasal cavity.

New York (Essex County), New Hampshire (Profile Lake), Maine (Lincoln), and Pennsylvania (Monroe County).

General characters.—In size equal to *Sorex palustris*. Teeth narrower, longer, and less heavily pigmented than in the latter. Color of belly never sharply defined from that of the sides.

Color.—In summer: Dorsal surface very dark seal brown, almost black, with faint reflections, the hairs marked subterminally with smoke gray, thus producing a slight grizzled appearance; fur everywhere slate gray at base; ventral surface sepia, a little mixed with smoke gray, becoming clear, pale smoke gray on chin and fading insensibly into color of back; dorsum of manus and pes sepia, paler on inner side, the former also paler distally; tail clove brown dorsally, grayish ventrally. In winter: Back as in the summer pelage; belly pale hair brown or silvery smoke gray, according to light; a distinctly darker shade between the front legs and a paler area on chin. On the sides the color of belly shades gradually into that of back; otherwise as in the worn summer pelage.

Skull.—The skull of *Sorex albibarbis* (Pl. VI, fig. 2) resembles that of *S. palustris* so closely that the description of the former will suffice for both.

Teeth.—The teeth of *Sorex albibarbis* differ somewhat from those of *S. palustris* in the form and pigmentation of the unicuspids (Pl. V, fig. 2). These are slightly narrower and longer from point to base, and are less extensively pigmented at the tips than in *S. palustris*.

Measurements.—Seven adults from Elizabethtown, N. Y. Average: Length, 154.7 mm.; tail vertebræ, 71.3 mm.; hind foot, 19.3 mm. Two specimens from Profile Lake, New Hampshire, measure, respectively: Length, 157 mm.; tail vertebræ, 68 mm.; hind foot, 19 mm.; and, length, 149 mm.; tail vertebræ, 65 mm.; hind foot, 19 mm.

General remarks.—*Sorex albibarbis* needs comparison with *S. palustris* only. In color summer specimens of *S. albibarbis* are very different from *S. palustris* and remarkably like *S.* (*Atophyrax*) *bendirii*, a species readily distinguished by its cranial and dental characters. The winter coats of *Sorex albibarbis* and *S. palustris* sometimes resemble each other rather closely. In the former the color of the belly shades gradually into that of the back, while the chin is noticeably paler than the rest of the ventral surface. In the latter the color of the ventral surface is uniformly pale and separated from that of the back by a sharp line of demarcation. On the other hand, the two animals are, as already stated, very differently colored in summer, when *Sorex albibarbis* may be recognized at a glance by its brownish belly, *S. palustris* being then colored practically as in autumn and winter.

Subgenus SOREX Linn.

Sorex Linnæus, Syst. Nat., ed. X, p. 53, 1758. Type, *Sorex araneus* Linn.

Inner side of canine and incisor without secondary cusps (figs. 1*a*, 1*b*); fourth upper incisor well developed; brain case moderately broad (ratio of cranial breadth to total length of skull, about 50); mandible slender and lightly built; feet never fringed.

The Shrews of the subgenus *Sorex* occurring in eastern North America fall naturally into three groups. Two of these are found in Europe also; the third appears to be peculiar to America. The first, or *araneus* group, represented in Europe by the type of the genus, *Sorex araneus*, and the closely related *S. alpinus*, is replaced in eastern North America by *S. richardsoni* and *S. fumeus;* the second, or *minutus* group, to which belongs the American *S. personatus*, has for its European member *S. minutus;* the third, or *longirostris* group, contains the one species, *Sorex longirostris* Bachman. The species of the *araneus* group are characterized by their large size, strongly built skulls, and the slight development of the ridge on the antero-internal edges of the cusps of the unicuspidate teeth (fig. 1*a*). The Shrews of the *minutus* group are all small, with light papery skulls, and the antero-internal ridge on the cusps of the unicuspidate teeth well developed and occasionally showing the first suggestion of the minute secondary cusp characteristic of the subgenus *Microsorex* (fig. 1*b*). *Sorex longirostris*, also a very small animal, is distinguished from the members of the *minutus* group by its remarkably short, broad rostrum, and by the small size of the fourth incisor. This tooth in *S. longirostris* is smaller than the canine, while in the *minutus* group it is as large or larger.

SOREX RICHARDSONI Bachman.

(Pl. V, fig. 4; Pl. VI, figs. 4 and 4*a*.)

1772. *Sorex araneus* Forster, Philos. Trans., LXII, p. 381. (Hudson Bay.)

1829. *Sorex parvus* Richardson, Fauna Boreali-Americana, I, p. 8. Not *S. parvus*. Say, 1823. (No locality.)

1837. *Sorex richardsoni* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, p. 383, Pl. XXIV, fig. 5. (Northwest Territory.)

1857. *Sorex pachyurus* Baird, Mamm. N. Am., p. 20. Not *S. pachyurus* Küster, 1835. (Pembina, Minn.)

1890. *Sorex vulgaris* Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 4. (Manitoba.)

Type locality.—Unknown.

Geographic distribution.—Boreal zone from Minnesota and Manitoba west to Alberta. Limits of range not determined.

General characters.—Size large, equaling *S. araneus;* back with a dark median area evident at all seasons, but especially so in winter.

Color.—In winter: Fur everywhere slaty blackish at base; back with a broad, sharply defined area of very dark walnut brown extending from base of tail to occiput, beyond which it fades into color of

face; this area broadest over lumbar region and shoulders, narrowest just back of shoulders; sides yellowish hair brown in striking contrast, this color clear and pure from flanks to sides of head but across the face mixing with the walnut brown of the back; belly pale hair brown; an indistinct line of demarcation between colors of belly and sides; ventral surface of tail and dorsum of manus and pes concolor with sides; tail seal brown dorsally and at tip, though not sharply bicolor. In summer: Back dull seal brown, darker over rump and lumbar region; sides light sepia, darker on shoulders and flanks; belly uniform pale broccoli brown. Feet and tail as in winter. There is in summer much more color variation than in winter. A few individuals are then as dark as in winter, but the majority are paler. The palest specimen that I have seen is dark hair brown on the back, pale sepia on the sides, and broccoli brown on the belly. The line of demarcation between the colors of the back and sides is always well marked, though the color of the latter often fades insensibly into that of the belly.

Skull.—The skull of *Sorex richardsoni* (Pl. VI, fig. 4) is indistinguishable from that of *Sorex araneus* (Pl. VI, fig. 3). The brain case is well rounded and moderately high, less so than in *Sorex palustris* and *S. albibarbis*. The rostrum is slender (narrower than in *S. fumeus*), and as compared with the species of the *minutus* group rather deep (see table, page 43). The anterior opening of the infraorbital canal is subcircular, the outline distinct on the lower and posterior borders, the posterior border over a point a little in advance of the middle of the first molar. The lachrymal foramen opens exactly over the middle of the first molar.

Teeth.—In general the teeth of *Sorex richardsoni* resemble those of *S. araneus* very closely, differing chiefly in their slightly larger size and in a few details in the proportions of the unicuspids. The latter (Pl. V, fig. 4), like the skull, are strongly and heavily built. The second and third incisors are subequal, the second usually the larger. The canine and the fourth incisor are subequal, the latter always the larger of the two and either intermediate in size between the canine and the third incisor or more nearly the size of the canine. The premolar is small, but distinctly visible from the outer side. The teeth are strongly colored at the points, the colored area on the front incisors of both jaws being continuous, and on the unicuspids occupying a little less than one-third of the outer face of the unworn teeth.

While the teeth of *Sorex richardsoni* resemble those of both *Sorex fumeus* and *Sorex araneus*, they are more like the latter. From the teeth of the former they differ in larger size, more extensive pigmentation, and greater relative size of the canine and fourth incisor. From the teeth of *S. araneus* those of *S. richardsoni* may be distinguished by the proportionally smaller premolar and larger canine. From both *araneus* and *fumeus*, *richardsoni* differs in the less extensive excavation of the posterior borders of the upper molariform teeth.

Measurements.—Ten specimens from South Edmonton, Alberta. Average: Length, 112.6 mm.; tail vertebræ, 40.1 mm.; hind foot, 13.8 mm. Maximum: Length, 118 mm.; tail vertebræ, 42 mm.; hind foot, 15 mm. Minimum: Length, 108 mm.; tail vertebræ, 38 mm.; hind foot, 13 mm,

General remarks.—While *Sorex richardsoni* is totally different in color from all other American Shrews, it closely resembles the European *Sorex araneus* Linn.[1] So close is this resemblance that the animals have been thought identical by at least two authors—Forster, in 1772, and Dobson, one hundred and twenty years later. As Forster remarks, however, the back is distinctly darker in the American animal. *Sorex richardsoni* in winter, at least, is very constant in color, but *Sorex araneus* varies so excessively at all seasons that it is not easy to make a proper comparison between the two species. In a series of about 30 of the latter collected near Lyndhurst, in the New Forest, southern England, during June, 1894, there is every shade of intergradation between specimens practically indistinguishable in color from the paler winter examples of *S. richardsoni*, and those with no distinct marking of any kind, the whole body being a dull, pale brownish drab, slightly darker on the back. Taking, however, the darker examples of *S. araneus* it is seen that the dorsal area is constantly less dark than in *S. richardsoni*, while the colored area on the sides is narrower, paler, and not so sharply defined from the color of the belly. Even in winter the fur on the back is in *S. araneus* scarcely more than half as long as in *S. richardsoni* at the same season.

The close agreement in size of *Sorex richardsoni* and *Sorex araneus* is shown by comparison of the measurements of the former with the following averages and extremes of 10 specimens of the latter animal from the New Forest, England: Average: Length, 117.9 mm.; tail vertebræ, 39.3 mm.; hind foot, 13.9 mm. Maximum: Length, 124 mm.; tail vertebræ, 42.6 mm.; hind foot, 14.8 mm. Minimum: Length, 113 mm.; tail vertebræ, 35 mm.; hind foot, 13 mm. The slight discrepancy in the total length of the two animals is more apparent than real, since it may easily be accounted for as the result of different methods of taking this measurement.

SOREX FUMEUS sp. nov.

(Pl. V, fig. 5; Pl. VI, figs. 5 and 5*a*.)

1857. *Sorex forsteri* Baird, Mamm. N. Am., p. 22. From Carlisle, Pa. (nec Richardson, 1819).

1857. *Sorex richardsoni* Baird, Mamm. N. Am., p. 24. From Racine, Wis. (nec Bachman, 1837).

1890. *Sorex platyrhinus* Dobson, Mon. Insectivora, Part III, fasc. 1; Pl. XXIII, fig. 5. From Lake George, New York (nec De Kay, 1842).

Type locality.—Peterboro, N. Y. Type, ♀ ad., No. 2582, collection of G. S. Miller, jr., taken September 24, 1893.

[1] *Sorex araneus* Linn., Syst. Nat., ed. X, p. 53, 1758. See Thomas, The Zoologist, p. 63, 1895.

Geographic distribution.—Boreal zone and locally the cooler parts of the Transition zone in the eastern United States, Nova Scotia, and New Brunswick, west to Ontario and the Great Lakes.

General characters.—About the size of *Sorex richardsoni*. Back without distinct dark median area. Color smoky plumbeous gray.

Color.—In autumn and winter: Back smoke gray, the hairs everywhere tipped with seal brown, producing a finely grizzled appearance; the dark tips slightly more conspicuous over rump and lumbar region, less numerous on the sides, and disappearing entirely on the belly, where the fur is pale broccoli brown. Everywhere the fur, which is slate color at base, has a faint gloss. The result is a combination of colors very hard to describe, but unlike that of any other Shrew occurring in eastern North America. Tail indistinctly bicolor, seal brown dorsally, yellowish white ventrally; feet yellowish white. In summer: Dull hair brown throughout, paler on the belly, and very slightly darker on the back.

Specimens in the dull, short summer coat are much like the average *S. personatus* in color, but are usually paler, and may always be distinguished by a peculiar bluish cast. A specimen taken at Lake George, New York, July 10, 1892, has the full, dark autumnal pelage appearing on the rump and buttocks in strong contrast with the short pale fur on the rest of the body.

Skull.—The skull of *Sorex fumeus* (Pl. VI, fig. 5) is a trifle smaller than that of *S. araneus* or *S. richardsoni*. The brain case is narrower than in the other members of the *araneus* group, while the rostrum and interorbital region are broader. The anterior opening of the infraorbital canal is larger than in *S. richardsoni* and placed farther back, the posterior border of the foramen lying over a point decidedly behind the middle of the first molar instead of in front of the middle, as in *S. richardsoni* and *S. araneus*. The lachrymal foramen is over the space between the first and second molars.

Teeth.—The teeth of *Sorex fumeus* resemble in a general way those of *S. richardsoni* and *S. araneus*, but are smaller and less pigmented. The posterior borders of the upper molariform teeth are more extensively excavated than in *S. richardsoni*, thus resembling *S. araneus*.

The unicuspid teeth in profile (Pl. V, fig. 5) are shorter and broader than in the other members of the *araneus* group. The second and third incisors are subequal, the second usually slightly the larger; the fourth abruptly smaller than the third, and distinctly larger than the canine; the first premolar very small, but visible from the outer side. When slightly worn the unicuspid teeth show a peculiarity shared by the members of the *minutus* group, but not often occurring in the allies of *S. araneus*; the points of these teeth wear away more rapidly on the outer side, so that when seen in profile the less worn inner edge often appears as a prominence suggesting an incipient secondary cusp projecting backward below the tip of the main cusp. In *Sorex araneus*

and *S. richardsoni* the inner side of the cusp wears away as fast, or nearly as fast, as the outer side, and this semblance to an accessory cusp seldom appears.

Measurements.—Type specimen: Length, 116 mm.; tail vertebræ, 44 mm.; hind foot, 12.6 mm. Six others from type locality average: Length, 116 mm.; tail vertebræ, 45.4 mm.; hind foot, 13.2 mm. Seven adults from Elizabethtown, Essex County, N. Y., average: Length, 119 mm.; tail vertebræ, 43.7 mm.; hind foot, 13.1 mm.

General remarks.—*Sorex fumeus* is very different from any of the other Shrews found in the eastern United States. In size it about equals *S. richardsoni*, but is readily distinguished from the latter by the absence of a well-marked dark dorsal area and by cranial and dental characters. The anterior orifice of the infraorbital canal lies farther back in *S. fumeus*, while the unicuspid teeth are narrower and less robust, as well as different in form.

Overstuffed skins of *Sorex personatus* are superficially much like *S. fumeus* in the dull summer coat, but there is never any difficulty in determining specimens that have been measured in the flesh or that are accompanied by skulls.

SOREX LONGIROSTRIS Bachman.

(Pl. IV, figs. 2, 3, and 4; Pl. VI, fig. 9.)

1837. *Sorex longirostris* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, p. 270, Pl. XXIII, fig. 2. (Swamps of Santee River, South Carolina.)

1857. ?? *Sorex personatus* Baird, Mamm. N. Am., p. 30. (Washington, D. C.)

Type locality.—Swamps of the Santee River, South Carolina.

Geographic distribution.—*Sorex longirostris* is at present known to occur in Bertie County, N. C., and at Raleigh, N. C.

General characters.—In size and external appearance *Sorex longirostris* is very similar to *S. personatus*. It differs from all the Shrews of the eastern United States in its broad rostrum and small fourth upper incisor.

Color.—Dorsal surface uniform sepia, faintly tinged with chestnut on rump, fading to broccoli brown on the sides, and this in turn to smoke gray on the belly; no lines of demarcation anywhere; fur everywhere slate colored at base; dorsum of manus and pes pale Isabella color; tail obscurely bicolor, sepia dorsally and at tip, dirty white ventrally. The three specimens which I have before me, all taken at Raleigh, N. C., in January and February, show no variation in color, except that one has the belly distinctly washed with broccoli brown.

Skull.—The skull of *Sorex longirostris* (Pl. VI, fig. 9) is shorter than that of *S. personatus* and has the rostrum broader as compared with the brain case. The bony palate is remarkably broad and short, the rows of unicuspid teeth being especially widely separated as compared with *S. personatus*. The anterior opening of the infraorbital canal is moderately large and subcircular in outline. The posterior border is over a

point slightly in front of the middle of the first molar. The lachrymal foramen is of the same size and shape as in the other small Shrews, and is placed a little behind the middle of the first molar.

Teeth.—Except for the different proportions of the unicuspids the teeth of *Sorex longirostris* closely resemble those of *S. personatus*. The excavations on the posterior borders of the upper molariform teeth, however, are less extensive in *S. longirostris* and are widest near the middle of each tooth, while in *S. personatus* the widest part is nearer the internal border. The difference is most strongly marked in the large second premolar.

The unicuspid teeth (Pl. IV, figs. 2, 3, and 4) resemble those of no other *Sorex* found in the eastern United States. The second and third incisors are large and subequal, the latter being slightly the larger, the fourth very much smaller than the second or third, and also distinctly smaller than the canine. The first premolar is minute and just visible from the outer side. All the teeth are tipped with chestnut brown to a slightly greater extent than usual in *S. personatus*.

The teeth vary somewhat in relative size, as shown by the figures, the fourth incisor occasionally nearly equaling the canine. In one specimen the size and form of the fourth incisor differs appreciably in the opposite sides of the jaw.

Measurements.—Four adults from Raleigh, N. C. Average: Length, 87.75 mm.; tail vertebræ, 33.25 mm.; hind foot, 10.75 mm.

General remarks.—*Sorex longirostris* resembles *S. personatus* in external appearance, but differs from this species very widely in the remarkably broad, short rostral part of the skull. This difference is especially noticeable when the palates of the two are compared.

SOREX PERSONATUS Isidore Geoffroy Saint Hilaire.

(Pl. IV, figs. 1, 5, 6, 7, and 8; Pl. VI, figs. 7 and 8.)

1827. *Sorex personatus* I. Geoffroy Saint Hilaire, Mém. Mus. d'Hist. Nat., Paris, XV, p. 122. (United States.)

1828. *Sorex forsteri* Richardson, Zool. Jour., III, p. 516. (Fur countries to lat. 67°.)

1837. *Sorex cooperi* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, p. 388, Pl. XXIV, fig. 7. (Northwest Territory.)

1837. *Sorex fimbripes* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, p. 391, Pl. XXIV, fig. 8. (Drurys Run, Pennsylvania.)

1842. *Amphisorex leseueri* Duvernoy, Magasin de Zoologie, Mamm., p. 33, Pl. L. (Wabash River, Indiana.)

1842. *Sorex platyrhinchus* Linsley, Sill. Am. Jour. Sci., XLIII, p. 346. (Stratford, Conn.)

1842. *Otisorex platyrhinus* De Kay, Zoology of New York, I, p. 22, Pl. V, fig. 1. (Tappan, Rockland County, N. Y.)

1857. *Sorex platyrhinus* Baird, Mamm. N. Am., p. 25. (Mass. and Vermont to Ohio.)

1857. *Sorex cooperi* Baird, Mamm. N. Am., p. 27. (Labrador to Massachusetts, Illinois, and Nebraska.)

1857. *Sorex haydeni* Baird, Mamm. N. Am., p. 29. (Fort Union [now Fort Buford], N. Dak.)

1857. ?? *Sorex personatus* Baird, Mamm. N. Am., p. 30. (Washington, D. C.)

1890. *Sorex personatus* Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXVIII, fig. 1 (Ottawa); Pl. XXIII, fig. 10. (Manitoba.)
1890. *Sorex richardsoni* Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 9. (Halifax, Nova Scotia.)
1890. *Sorex haydeni* Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 7.
1891. *Sorex idahoensis* Merriam, North American Fauna, No. 5, p. 32. (Idaho.)

Type locality.—United States.

Geographic distribution.—Northern North America from the Atlantic to the Pacific. In the eastern part of its range *Sorex personatus* occurs in the Boreal zone, Transition zone, and locally in the northernmost part of the Upper Austral zone.

General characters.—*Sorex personatus* is one of the smallest Shrews occurring in the eastern United States. It is slightly larger than *S. longirostris*, from which, while not differing widely in color, it is readily distinguished by its slender muzzle as well as by dental characters.

Color.—Dorsal surface of body sepia tinged with chestnut on rump, lumbar region, and sides of head, fading on the sides of the body; belly, throat, and chin silvery smoke gray or pale broccoli brown; no sharp line of demarcation between color of belly and sides, but change taking place rather abruptly. Throughout the pelage the hairs are slate color at base. On the back, especially just behind the shoulders, the fur is usually a little intermixed with grayish. Tail obscurely bicolor, brownish dorsally, paler ventrally. Dorsum of manus and pes Isabella color.

Skull.—The skull of *Sorex personatus* (Pl. VI, figs. 7, 8) is scarcely distinguishable from that of the European *Sorex minutus* (Pl. VI, fig. 6). As in the latter, the brain case is moderately high and rounded and the rostrum slender. The palatal depth at middle of molar series is less as compared with the cranial depth in all the members of the *minutus* group than in those of the *araneus* group. This is readily seen in comparison of the skulls of *S. personatus* and *S. richardsoni* (see table, page 43).

Teeth.—The teeth of *Sorex personatus* very closely resemble those of *S. minutus*, the only differences being in the relative size of the first premolar and in the form of the excavations on the posterior borders of the upper molariform teeth. The first premolar in *S. personatus* is minute and often scarcely visible from the outer side, while in *S. minutus* it is nearly as large as the canine. The deepest part of the excavations on the posterior borders of the upper molariform teeth is near the middle of the tooth in *S. minutus*, while in *S. personatus* it is carried farther toward the inner edge. The unworn unicuspid teeth of *S. personatus* (Pl. IV, figs. 1, 5, 6, and 7) vary considerably in form, pigmentation and relative size. The first, second, third, and fourth, however, diminish gradually in size, while the fifth is very small. The third incisor is usually slightly larger than the second, and distinctly larger than either the fourth incisor or the canine. The fourth incisor and the

canine may be exactly the same size, or the latter slightly the smaller. The fourth incisor, however, is very rarely smaller than the canine (cf. *S. longirostris*). Occasionally the second incisor is the largest, the three succeeding teeth each slightly and uniformly smaller than the one before. Again, the second and third incisors may be equal and considerably larger than the fourth incisor or the canine, which in their turn are of approximately equal size.

The unicuspid teeth are usually about as broad as deep when viewed in profile (Pl. IV, figs. 5, 6, and 7). Occasionally, however, they are distinctly deeper than broad, and the whole row of unicuspids is a little shortened (Pl. IV, fig. 1). These differences appear to be in no way correlated with geographic distribution, specimens with the narrow, deep teeth occurring at Montauk Point, New York, Roan Mountain, North Carolina, and South Edmonton, Alberta. The cusps and ridges on the teeth of *Sorex personatus* are moderately tipped with light reddish brown. This brown tipping is variable both in extent and in depth of color (cf. fig. 1 with figs. 5, 6, and 7, Pl. IV). Like the variations in form of the unicuspid teeth, the character of the pigmentation is a purely individual matter.

Measurements.—Twelve adults from Nantucket Island, Massachusetts, average: Length, 100.8 mm.; tail vertebræ, 38.6 mm.; hind foot, 12.2 mm. Four specimens from North Truro, Mass., average: Length, 97.2 mm.; tail vertebræ, 37.2 mm.; hind foot, 11.35 mm. Two males from Mount Washington, New Hampshire (5,300 feet): Length, 105 mm.; tail vertebræ, 41 mm.; hind foot, 12.8 mm.; and, length, 106 mm.; tail vertebræ, 41.4 mm.; hind foot, 11.6 mm. Six specimens from Steele County, Minn., average: Length, 87.5 mm.; tail vertebræ, 33.5 mm.; hind foot, 11.1 mm. Two males from South Edmonton, Alberta, measure, respectively: Length, 94 mm.; tail vertebræ, 37 mm.; hind foot, 11 mm.; and length, 92 mm.; tail vertebræ, 36 mm.; hind foot, 11 mm.

General remarks.—Among the Shrews of the eastern United States *Sorex personatus* is distinguished by its small size from all but *S. longirostris* and *S. hoyi*. From both of these it differs so widely in cranial characters that no detailed comparison is needed.

In color average *Sorex personatus* are exactly like two English specimens of *S. minutus*, but I have seen too few skins of the latter to know whether this remarkable agreement is constant. *Sorex minutus* is readily distinguished from *S. personatus* by its very large fifth unicuspid tooth.

Sorex personatus varies considerably in color, winter specimens usually being darker and more strongly tinged with chestnut than those taken in midsummer. Sometimes there is a faint line of demarcation between the darker chestnut-tinged sepia of the back and the clear paler sepia of the sides, the latter again shading abruptly into the color of the belly. The color pattern so produced is similar to that of *S. araneus* and *S. richardsoni*, but is never so striking and well

marked as in typical specimens of these animals. Individuals now and then occur with the whole pelage suffused with chestnut, but these are rare.

Specimens from the plains are paler than the average, but whether these represent a distinct local race it is at present impossible to say. Should the plains animal prove to be separable, it must take the name *haydeni* Baird.

Table of average cranial measurements and ratios.

Name.	Locality.	Number of specimens.	Greatest length exclusive of incisors.	Breadth of cranium.	Greatest anteorbital breadth.	Length of bony palate.	Ratio to total length.			Ratio of anteorbital breadth to palatal length.	Ratio of anteorbital breadth to cranial breadth.
							Of cranial breadth.	Of anteorbital breadth.	Of palatal length.		
Sorex hoyi	Elk River, Minn	8	14.4	6.5	4.1	5.2	45.14	28.47	36.09	78.84	61.69
Sorex palustris	do	4	20.4	10.6	6.7	8.4	52.2	33.09	40.93	80.95	63.38
Sorex albibarbis	Elizabethtown, N. Y.	3	20	10.3	6.26	8.3	51.5	31.3	41.3	75.79	60.77
Sorex araneus	New Forest, England.	10	18.3	9.4	5.2	7.5	51.3	28.4	40.9	66.56	55.43
Sorex richardsoni	Elk River, Minn	10	18.4	9.5	5.3	7.6	51.79	28.18	41.24	69.65	55.46
Sorex fumeus	Peterboro, N. Y	6	17.3	8.9	5.1	6.9	51.76	29.47	39.88	73.91	52.02
	Elizabethtown, N. Y.	8	17.8	9.1	5.1	7	51.12	28.65	35.35	72.85	56.04
Sorex longirostris	Raleigh, N. C	4	14.7	7.5	4.4	5.6	51.02	27.21	38.09	78.65	58.66
Sorex personatus	Nantucket, Mass	10	15.2	7.8	4	6.1	51.31	26.31	41.31	64.61	51.28
	Elk River, Minn	8	15.3	7.7	4.3	6	49.9	27.5	39.42	71.26	55.7

NOTE.—The material on which *Sorex fisheri* Merriam from Dismal Swamp, Virginia (North American Fauna, No. 10, p. 86), is based came to hand too late for description in this paper. The teeth of a specimen at first supposed to be an unusually large *Sorex longirostris* are, however, figured in Plate IV.

SYNOPSIS OF THE AMERICAN SHREWS OF THE GENUS SOREX.

By C. Hart Merriam.

The object of the present paper is to furnish descriptions, on a common plan, of the principal types of American Shrews. Hence the multiplication of closely related forms has been avoided, and several fairly well marked subspecies have been allowed to go unnamed. Forty-one species and subspecies are here recognized, of which number 33 belong to the restricted genus *Sorex*, 1 to the subgenus *Microsorex*, 4 to the subgenus *Neosorex*, and 3 to the subgenus *Atophyrax*. The subgenera are restricted to the northern United States and Canada, while *Sorex* proper ranges from the Arctic Circle to Guatemala. The genus as a whole is clearly of boreal origin, and, excepting the austral *Sorex longirostris* and its relative *S. fisheri*, all of the southern forms are confined to high mountains.

The collection of mammals made by the Division of Ornithology and Mammalogy of the Department of Agriculture contains about 1,200 specimens of long-tailed Shrews (genus *Sorex*). In studying this material and mapping the geographic distribution of the various species, 20 new forms were discovered and are here described. Four of these are from Alaska, 1 from British Columbia, 4 from Mexico, and 11 from the United States.

All American Shrews have two pelages, which may be roughly designated as summer and winter coats, though by no means corresponding strictly with these seasonal limitations. As usual among small mammals, the molt takes place at different dates among individuals of the same species, so that it is not rare to capture specimens in different pelages on the same day. The winter pelage is usually plumbeous, dusky, or ash gray; the summer pelage sepia brown or chestnut. In some species, as *Sorex trowbridgii*, the change of color is slight and unimportant; in others, as *S. vagrans* and *S. personatus*, the difference is striking.

In defining the various species, cranial characters have proved serviceable and dental characters indispensable. The most useful cranial characters are the size and form of the brain case, breadth of the palate, length and degree of attenuation of the rostrum, and in some cases the breadth of the interorbital constriction. The most important dental characters are the size and depth of emargination of the molariform teeth and the proportions of the unicuspidate teeth.

In studying the skulls and teeth of Shrews it is absolutely essential to take into account changes due to age and wear. Old and young skulls of the same species from the same locality differ surprisingly in size, form, and massiveness. With increasing age the cranium as a

whole becomes broader, shorter, and flatter, and in some species a low sagittal ridge is developed. The brain case and palate broaden measurably, and the arch of the brain case falls away. The molar teeth wear obliquely, so as to take on an appearance of greater breadth, and the long middle incisors not only wear off in front but turn down at a right angle to the cranial axis (see Pl. XI). Hence, in comparing skulls and teeth of related forms it is of the utmost importance to use specimens of approximately the same age.

Much labor has been expended upon the plates of Shrew teeth that accompany this paper, but they are not camera lucida drawings and can not be relied upon for small details.

List of American forms of Sorex, with type localities and number of specimens examined.

	Name.	Type locality.	No. of specimens.
1	*Sorex personatus*	Eastern United States (exact locality unknown).	235
2	*streatori* nob	Yakutat, Alaska	36
3	*obscurus*	Salmon River Mountains, Idaho	175
4	*ventralis* nob	Cerro San Felipe, Oaxaca, Mexico	21
5	*longicauda* nob	Wrangel, southeast Alaska	48
6	*alascensis* nob	Yakutat Bay, Alaska	27
7	*orcopolus*	Sierra Nevada de Colima, Jalisco, Mexico.	3
8	*richardsoni*	Probably plains of Saskatchewan, Canada.	114
9	*sphagnicola*	Fort Liard, British Columbia	2
10	*fumeus*	Peterboro, Madison County, N. Y.	27
11	*vagrans*	Shoalwater Bay, Washington	104
12	*dobsoni*	Saw Tooth Mountains, Idaho	46
13	*monticola*	San Francisco Mountain, Arizona	9
14	*amœnus* nob	Mammoth Pass, Sierra Nevada, Calif.	7
15	*vancouverensis* nob	Goldstream, Vancouver Island, B. C.	1
16	*orizabæ* nob	Mount Orizaba, Puebla, Mexico	18
17	*nevadensis* nob	Reese River Valley, Nevada	4
18	*ornatus* nob	San Emigdio Canyon, Mount Piños, Calif.	7
19	*californicus* nob	Walnut Creek, Contra Costa County, Calif.	7
20	*tenellus* nob	Alabama Hills, Owens Valley, California.	3
21	*nanus* nob	Estes Park, Colorado	4
22	*pribilofensis* nob	St. Paul Id., Pribilof Islands, Bering Sea.	5
23	*merriami*	Fort Custer, Mont	1
24	*bairdi* nob	Astoria, Oreg	9
25	*trowbridgii*	do	19
26	*montereyensis* nob	Monterey, Calif	33
27	*macrodon* nob	Orizaba, Vera Cruz, Mexico	10
28	*vericpacis*	Coban, Guatemala	5
29	*saussurei*	Sierra Nevada de Colima, Jalisco, Mexico.	24
30	*caudatus* nob	Reyes, Oaxaca, Mexico	41
31	*longirostris*	Santee river, South Carolina	3
32	*fisheri* nob	Dismal Swamp, Virginia	5
33	*pacificus*	Mouth of Umpqua River, Oregon	13
	Subgenus *Microsorex*:		
34	*hoyi*	Racine, Wis.	23
	Subgenus *Neosorex*:		
35	*palustris*	Between Hudson Bay and Rocky Mts.	9
36	*navigator*	Probably northern Idaho[1]	77
37	*albibarbis*	Profile Lake, Franconia Mountains, N. H.	5
38	*hydrodromus*	Unalaska Id., Aleutian Islands, Alaska	
	Subgenus *Atophyrax*:		
39	*bendirii*	Klamath Basin, Oregon	21
40	*palmeri* nob	Astoria, Oreg	3
41	*albiventer* nob	Olympic Mountains, Washington	3

[1] See page 92, footnote.

KEY TO SPECIES OF SOREX PROPER.

A. *Species living north of Mexico.*

Size very large (total length about 150 mm.; hind foot, 17 mm.) ..... *pacificus*
Size medium or small (total length never more than 135 mm.; hind foot, 15.5 mm. or less).
Third unicuspid larger than fourth.
Size rather large (head and body about 70 mm.).
Coloration distinctly tricolor (sides different from back).
Hind foot about 14 mm.; tail about 40 mm.; skull, 20 mm ..... *richardsoni*
Hind foot about 13 mm.; tail about 35 mm.; skull, 16 mm..... *pribilofensis*
Coloration bicolor (sides same color as back).
Color plumbeous or sepia brown; pelage normal ..... *fumeus*
Color almost sooty black; pelage exceedingly long..... *sphagnicola*
Size rather small (head and body about 60 mm.).
Skull short and broad; unicuspids on same plane with molars..... *merriami*
Skull long and narrow; unicuspid series strongly deflected, forming angle with molar series.
Tail about 40 mm. or less..... *personatus*
Tail 45 mm. or more..... *streatori*
Third unicuspid smaller than fourth.
Hind foot about 15 mm.
Anterior unicuspids much swollen..... *bairdi*
Anterior unicuspids not much swollen.
Color dark plumbeous or sooty..... *montereyensis*
Color dull chestnut brown, varying to sepia brown.
Tail very long (about 60 mm.)..... *longicauda*
Tail medium (about 50 mm.) ..... *alascensis*
Hind foot about 14 mm. or less.
Hind foot about 14 mm. (color dark plumbeous or sooty)..... *trowbridgii*
Hind foot about 13 mm. or less.
Sides pale; rump with a dark patch; molariform teeth broadly and deeply excavated posteriorly ..... *ornatus*
Coloration normal; excavation of molariform teeth moderate.
Hind foot about 13 mm.
Tail less than 45 mm..... *dobsoni*
Tail more than 45 mm..... *obscurus*
Hind foot decidedly less than 13 mm.
Brain case low and flat.
Brain case broadly rounded ..... *californicus*
Brain case narrow.
Hind foot more than 12 mm..... *tenellus*
Hind foot about 10 mm..... *nanus*
Brain case normal.
Total length less than 100 mm.
Coloration tricolor; sides much paler than back..... *nevadensis*
Coloration normal; sides not paler than back.
Hind foot less than 11 mm..... *longirostris*
Hind foot 12 mm or more..... *fisheri*
Total length more than 100 mm.
Tail less than 40 mm.; color dusky or sooty..... *amœnus*
Tail more than 40 mm.
Color pale sepia brown..... *monticola*
Color dark.
Back and sides dark brown, varying to almost russet.. *vagrans*
Back almost dusky; sides sepia brown..... *vancouverensis*

B. *Species living in southern Mexico and Guatemala.*

Size rather large (total length 118 mm. or more).
  Hind foot 15 mm. or more.
    Color nearly black; under parts hardly paler ..... *veræpacis*
    Color mixed sepia and black; under parts seal brown ..... *macrodon*
  Hind foot less than 15 mm.
    Tail very long (55 mm. or more) ..... *caudatus*
    Tail moderate (50 mm. or less) ..... *saussurei*
Size rather small (total length about 105 mm. or less).
  Belly pale ..... *orizabæ*
  Belly dark.
    Under parts dull chestnut ..... *ventralis*
    Under parts drab ..... *oreopolus*

SOREX PERSONATUS Geoffroy Saint Hilaire.

(Pl. VII, figs. 5, 5*a*; Pl. IX, figs. 7, 7*a*.)

Sorex personatus Geoffroy Saint Hilaire, Mém. du Muséum, Paris, XV, 122-125, 1827. (From United States.)

Sorex forsteri Richardson, Zool. Jour., III, 516-517, January to April, 1828. (From the fur countries.)

Sorex cooperi Bachman, Jour. Acad. Nat. Sci. Phila., VII, 388, Pl. XXIV, fig. 7, 1837. (Probably from northern part of Mississippi Valley.)

Amphisorex lesueuri Duvernoy, Mag. Zool., 2e ser., IV, Mamm., 33-34, Pl. L, 1842. (From Wabash River, Indiana.)

Sorex platyrhinchus Linsley, Silliman's Am. Jour. Sci., XLIII, 346-347, October, 1842. (From Stratford, Conn.)

Otisorex platyrhinus De Kay, Zool. New York, Mammalia, 22, Pl. V, fig. 1, 1842. (From Tappan, Rockland County, N. Y.)

Sorex platyrhinus Baird, Mammals N. Am., 25-26, Pl. XXVIII, 1857.

Sorex haydeni Baird, Mammals N. Am., 29-30, Pl. XXVII, 1857. (From Fort Union, now Fort Buford, N. Dak.)

Sorex idahoensis Merriam, N. Am. Fauna, No. 5, pp. 32-33, Pl. IV, fig. 1, August, 1891. (From Salmon River Mountains, Idaho.)

Type locality.—Eastern United States.

Geographic distribution.—Boreal and Transition zones of North America from New England to Alaska, except the southern Rocky Mountains and the Cascade-Sierra systems; south in the higher Alleghenies to Tennessee and North Carolina.

General characters.—Size small (total length, about 100 mm.; hind foot, about 12 mm.); tail shorter than body without head; coloration dark; skull and palate narrow; unicuspid series gradually diminishing (third tooth not normally smaller than fourth).

Color.—Upper parts sepia brown, very finely (and usually inconspicuously) mixed with dark-tipped hairs; under parts ashy gray; tail bicolor: upper side and tip all round dusky, under side dull whitish. A chestnut pelage or phase occurs, but is rare. Out of 20 specimens from Roan Mountain, North Carolina, only 2 are chestnut; both were collected in September.

Cranial and dental characters.—Skull small, rather slender; palate narrow and arched; anterior part of rostrum compressed and attenuate; unicuspids decreasing in size from first to fifth. (Viewed from the side they are sometimes in pairs, first and second subequal and third and fourth subequal.) Specimens from the northern plains have the anterior part of the rostrum slightly more attenuate, with the unicuspidate series nearer together and more nearly parallel. The unicuspid teeth also are more crowded, more vertical, less imbricating, and somewhat more heavily pigmented. This form was named *forsteri* by Richardson, but the characters are inconstant and are matched by some specimens from the east, notably from Montauk Point, Long Island, New York.

Measurements.—Average of 8 specimens from Montauk Point, Long Island, New York: Total length, 98.3 mm.; tail vertebræ, 38 mm.; hind foot, 12 mm. Average of 4 from Roan Mountain, North Carolina: Total length, 100.5 mm.; tail vertebræ, 41 mm.; hind foot, 12.3 mm. (For table of measurements see p. 63.)

General remarks.—*Sorex personatus*, the common Shrew of the eastern United States, has a larger area of distribution than any other American species, stretching all the way across the continent from New England to Alaska. Throughout this wide range its variations are surprisingly slight. Certain inconstant departures have been already mentioned under the skull characters. In coloration also there are geographic differences. The most marked of these is a pale form from the prairies and plains of the Dakotas. In this animal the whitish of the under parts reaches far up over the sides, and is bordered above by a band of buffy, restricting the dark color of the back to a dorsal band. This tricolor pattern is well shown in a specimen from Portland, N. Dak. (No. 36854, U. S. Nat. Mus.), collected October 26, 1892, by J. Alden Loring. This form was separated by Baird, under the name *S. haydeni*, and is probably entitled to recognition. 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.[1]

Specimens of *S. personatus* from the Rocky Mountains, near the eastern boundary of British Columbia (Field and Glacier), are noticeably larger and have larger skulls than those from the neighboring plains on the east, in which respect they tend toward subspecies *streatori* of southeastern Alaska.

[1] Unfortunately, the skull of the specimen from New Harmony can not be found.

Respecting the pertinence of the name *personatus* for this Shrew, Dr. G. E. Dobson wrote me from Netley, England, under date of October 5, 1885, as follows:

I have lately returned from Paris, where I have been studying the Soricidæ in the Museum of the Jardin des Plantes. I have found there the type of *Sorex personatus* Geoff., which is certainly = *S. cooperi*, the latter name becoming, therefore, a synonym.

Specimens examined.—Total number, 235, from the following localities:

Province of Quebec, Canada: Godbout, 30.
New Brunswick: St. John, 1.
Maine: South West Harbor, 2.
New Hampshire: Ossipee, 1.
Massachusetts: Wilmington, 2.
New York: Adirondacks, 2; Locust Grove, 7; Montauk Point, 8; Amityville (Long Island), 1.
Pennsylvania: Drury Run, 3.
New Jersey: Tuckerton, 5.
North Carolina: Roan Mountain, 20.
Indiana: New Harmony, 1; North Manchester, 1.
Michigan: Ann Arbor, 4.
Minnesota: Elk River, 64; Minneapolis, 12; Tower (Vermillion Lake), 1; Hinckley, 2; Browns Valley, 1.
Ontario: Rat Portage, 1; Ottawa, 1; Parry Sound, 4; Sand Lake, 3.
Manitoba: Carberry, 6.
Assiniboia: Indian Head, 4.
Alberta: South Edmonton, 2; St. Albert, 1; Island Lake, 1; Banff, 2; Canmore, 1.
British Columbia: Glacier, 6; Field, 3; Kamloops (Cariboo Lake), 1; Sicamous, 1; Mount Baker Range, 1.
Washington: Head of Lake Chelan, 1.
Montana: Fort Custer, 8; Dry Creek, 1; St. Marys Lake, 3.
Idaho: Salmon River Mountains, 4; Saw Tooth Lake, 2.
Wyoming: Big Horn Mountains, 1.
North Dakota: Portland, 2; Steele, 1; Grank Forks, 1; Bottineau, Turtle Mountain, 1.
South Dakota: Black Hills, Custer, 2; Deadwood, 1; Vermillion, 1

SOREX PERSONATUS STREATORI subsp. nov.

Type from Yakutat, Alaska (about latitude 59° 35′). Type, No. 73537, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected July 9, 1895, by C. P. Streator. Original number, 4674.

General characters.—Similar to *S. personatus*, but larger and darker (total length, 106.6 mm.; hind foot, 12.7 mm.); tail nearly equal to body without head.

Color.—Upper parts finely mixed sepia brown and dusky, the dusky strongest on posterior half of back and nearly absent on sides; under parts ash gray; tail sharply bicolor: dusky above and all round at tip, whitish below.

Cranial and dental characters.—Skull and teeth as in *personatus*, but skull averaging slightly longer.

Measurements.—Type specimen: Total length, 107 mm.; tail vertebræ, 50 mm.; hind foot, 12.5 mm. Average of 8 specimens from type

locality (Yakutat Bay, Alaska): Total length, 106.6 mm.; tail vertebræ, 45.6 mm.; hind foot, 12.7 mm.

General remarks.—The slight change that *Sorex personatus* undergoes in crossing the continent from the Atlantic to the Pacific is surprising. Skulls from Montauk Point, Long Island, New York, are hardly distinguishable from those from Yakutat Bay, Alaska, except that the latter are somewhat larger. Externally, the difference is a little more marked; there is a slight increase in size and in length of tail, and a decided darkening of the color of the upper parts as a whole.

Specimens examined.—Total number, 36, from the following localities in southeastern Alaska: Yakutat, 8; Sitka, 16; Wrangel, 7; Loring, Revillagigedo Island, 5.

Mean measurements of Sorex personatus and S. p. streatori from different localities.

	Total length.	Tail.	Hind foot.	No. of specimens in average.
Sorex personatus:				
Ann Arbor, Mich.	94.5	35.3	11.3	4
Drury Run, Clinton County, Pa.	96	39.3	11.7	3
Tuckerton, N. J.	98.6	40.6	12.8	5
Montauk Point, New York	98.3	38	12.1	8
Hinckley, Minn.	98	39.5	12.5	2
Wilmington, Mass.	100	40.5	12	2
Godbout, Quebec, Canada	100	41	12	15
Roan Mountain, North Carolina	100.5	41	12.3	4
Glacier, British Columbia*	106.4	42.2	12.8	5
Salmon River Mountains, Idaho†	95.7	40	11.7	4
South Edmonton, Alberta‡	93	36.5	11	2
S. personatus streatori:				
Yakutat, Alaska (type locality)	106.6	45.6	12.7	8
Sitka, Alaska	108.1	46.9	13.4	15
Wrangel, Alaska	108.1	45.5	13.2	7
Loring, Alaska	105	46	13	4

* Inclining toward *streatori.* † Type locality of '*idahoensis*.' ‡ Typical of '*forsteri*.'

SOREX RICHARDSONI Bach.

(Pl. IX, figs. 1, 1*a*.)

Sorex parvus Richardson, Fauna Boreali-Americana, 8, 1829 (Not *S. parvus* Say, 1823).
Sorex richardsonii Bachman, Jour. Acad. Nat. Sci. Phila., VII, 383, Pl. XXIV, fig. 5, 1837.

Type locality.—Unknown; probably plains of Saskatchewan.

Geographic distribution.—Plains of Saskatchewan and boreal parts of Minnesota; limits of range unknown.

General characters.—Size large (hind foot, 14 mm.); tail short; animal tricolor.

Color.—Upper parts uniform dull dark brown (almost seal brown in some specimens), without plumbeous tinge, and free from admixture of hoary or pale-tipped hairs; sides dull fulvous or ochraceous, in strong contrast; under parts dark plumbeous washed with chestnut; tail

dusky above and all round at tip, pale brownish below on basal two-thirds. In one pelage the colors are duller, the under parts brownish and the side stripe indistinct. Minnesota specimens have the side stripe buffy ash or with the faintest possible tinge of fulvous, and the belly ash gray.

Cranial and dental characters.—Skull similar to that of *fumeus*, but slightly larger (20 mm. by 9.3 mm.); rostrum and brain case higher; constriction higher and narrower; anterior part of rostrum longer and more pinched in laterally, making the unicuspid series more nearly parallel; interpterygoid fossa narrower; anterior opening of infraorbital canal smaller and situate far forward, over front of m^1; lachrymal canal opening over middle of m^1 instead of over interspace between m^1 and m^2, as in *fumeus;* molariform teeth much less deeply excavated posteriorly; unicuspidate teeth very much heavier and more swollen, and lacking the distinct vertical ridge on inner side.

Measurements.—Average of 25 specimens from South Edmonton, Alberta (assumed to be near the type locality): Total length, 113.2 mm.; tail vertebræ, 40.4 mm.; hind foot, 13.9 mm. Average of 3 from Wingard, Saskatchewan (near Carlton House): Total length, 112.7 mm.; tail vertebræ, 41.3 mm.; hind foot, 14 mm.

General remarks.—This large saddle-back Shrew hardly requires comparison with any other species, though specimens in the dull pelage sometimes resemble the brown pelage of *S. fumeus*. The two may always be distinguished by the cranial characters above given.

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

Manitoba: Carberry, 2.
Alberta: South Edmonton, 25; St. Albert, 31; Island Lake, near Lake St. Ann, 3.
Assiniboia: Indian Head, 1.
Saskatchewan: Wingard, 4.
Minnesota: Bridgman, 1; Elk River, 44; Minneapolis, 3.

SOREX SPHAGNICOLA Coues.

Sorex sphagnicola Coues, Precursory Notes American Insectivorous Mammals, Bull. U. S. Geol. and Geog. Surv., Vol. III, p. 650, May 15, 1887.

Sorex belli Dobson MS., 1885; Merriam, Proc. Biol. Soc. Wash., VII, 25, 1892 (*nomen nudum*).

Type locality.—Vicinity of Fort Liard, British Columbia (about latitude 60°).

Geographic distribution.—Sub-Arctic America from extreme northern British Columbia (and probably Alaska) to Hudson Bay.

General characters.—Size medium (hind foot 13.5 mm.); tail decidedly shorter than body without head; unicuspids large and gradually diminishing (fourth smaller than third); fur remarkably long and full (9 mm. on back); tail large, of uniform diameter from base to tip, and densely haired; no fringe on feet; claws conspicuous.

Color.—Upper parts rich, dark seal-brown, almost sooty black, darkest on rump and palest on head; color of upper parts extending well down on sides, leaving a rather narrow strip of grayish brown along

the belly from chin to root of tail; color of upper parts rather abruptly different from that of belly; tail concolor, same color as rump.

Dental characters.—Unicuspids large and strongly imbricating; first and second subequal; third smaller but decidedly larger than fourth. Viewed from below, unicuspids 1 to 4 are subquadrate in outline.

Measurements (from dry skin, probably too short).—Total length, 110 mm.; tail vertebræ, 42 mm.; pencil, 6 mm.; hind foot, 13.5 mm.

General remarks.—The above description and measurements were taken by me from a specimen collected by Dr. Robert Bell on Shamattawa River, a tributary of Hayes River, Hudson Bay, and now in the Museum of the Geological and Natural History Survey of Canada, at Ottawa. The specimen was compared with the type of *S. sphagnicola*, in the United States National Museum, by Mr. F. W. True, Gerrit S. Miller, jr., and myself. The type specimen of *sphagnicola* is in very bad condition, but we were unable to discover any character by which the Hayes River specimen could be separated from it. The only apparent difference is in the hairs of the under side of the tail, which in the worn specimen are much shorter and stiffer, like bristles. Precisely this difference may be seen in a series of *Sorex richardsoni* from South Edmonton, Alberta, and is evidently the result of wear.

Sorex sphagnicola seems to be closely related to *S. richardsoni*, from which it may be distinguished by the color of the sides. In *sphagnicola* the sooty black of the upper parts reaches down over the sides and encroaches on the belly; in *richardsoni* the sides are buffy or pale fulvous, in sharp contrast with the color of the back.

Dr. Bell's specimen from Hayes River, Hudson Bay, on which the above description is based, was named *Sorex belli* by Dobson in 1885, but his description was never published. Dr. Dobson suspected its identity with *S. sphagnicola*, and suggested that the type specimens be compared, which has been done, with the result above stated. Dr. Bell's specimen "was the 'totem' of an Indian chief from whom it was stolen, and when he missed it he went on the war path."

SOREX FUMEUS Miller.

(Pl. IX, figs. 2, 2*a*.)

Sorex platyrhinus Dobson, Monog. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 5, May, 1890.

Sorex fumeus Miller, N. Am. Fauna, No. 10, December, 1895, pp. 50-52.

Type locality.—Peterboro, Madison County, N. Y.

Geographic distribution.—Canadian and upper part of Transition faunas of eastern United States; southward in higher Alleghenies to mountains of North Carolina and Tennessee.

General characters.—Size rather large (hind foot, 13 mm.); tail rather short; ears prominent; animal nearly concolor.

Color.—Plumbeous pelage: Upper parts dark slate color, becoming gradually paler below; under parts plumbeous, more or less washed

with grayish ash; tail bicolor: dusky above, flesh color below; feet flesh color. Brown pelage: Everywhere dull chestnut brown, paler below; tail and feet as in other pelage.

Cranial and dental characters.—Skull similar to that of *S. richardsoni*, but averaging slightly smaller; rostrum and brain case lower; constriction flatter and broader; interpterygoid notch slightly broader; anterior opening of infraorbital canal large and covering nearly whole of m^1; opening of lachrymal canal over interspace between m^1 and m^2 (instead of over middle of m^1, as in *richardsoni*). Molariform teeth much more deeply excavated; unicuspids very much smaller and less swollen, but with a well developed vertical ridge on inner side.

Measurements.—Average of 6 specimens from Peterboro, N. Y. (type locality): Total length, 116 mm.; tail vertebræ, 45.4 mm.; hind foot, 13.2 mm. Average of 4 specimens from Renovo, Pa.: Total length, 108.5 mm.; tail vertebræ, 43.5 mm.; hind foot, 12.3 mm. Average of 3 specimens from Lake George, N. Y.: Total length, 118.7 mm.; tail vertebræ, 47 mm.; hind foot, 13 mm.

General remarks.—*Sorex fumeus* is the larger and more boreal of the two species of *Sorex* inhabiting the northeastern United States and the higher Alleghenies farther south. It does not require close comparison with any other species. Specimens from the Adirondacks, the mountains of New England, and Roan Mountain, North Carolina, are larger and have higher brain cases than the typical form from central New York (Peterboro) and Pennsylvania (Renovo). The two pelages in this species are very different and are clearly seasonal—the plumbeous is the winter coat, the brown the summer. This is well shown in a series of 18 specimens from Roan Mountain, on the boundary between North Carolina and Tennessee. Eight of these are in the plumbeous pelage, and were collected from October 11 to May 3; and ten are in the chestnut-brown pelage, and were collected from June 2 to September 11.

Sorex fumeus of the northeastern States resembles *S. trowbridgii* of the Pacific coast of Oregon and Washington in many respects. In color both are plumbeous or dark slate, in which particular they differ from all other members of the genus inhabiting the United States. Their skulls and teeth also are very much alike, though *S. trowbridgii* has the small third unicuspid characteristic of most west American Shrews. The skull of *fumeus* is somewhat the larger, but the tooth rows are of approximately the same length. The molars are essentially the same in both, but the premolar and unicuspids are materially larger in *fumeus*—the premolar larger in every way and the unicuspids broader. The last upper molar, on the other hand, is largest in *trowbridgii*. In *fumeus* the large premolar is much more deeply excavated posteriorly.

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

New York: Peterboro (type locality), 1; Lake George, 3.
New Hampshire: Ossipee, 1.
Pennsylvania: Renovo, 4.
North Carolina: Roan Mountain, 18.

SOREX VAGRANS Baird.

(Pl. VIII, figs. 2, 2*a*.)

Sorex vagrans Baird, Mammals N. Am., pp. 15-18, Pl. XXVI, fig. 1675, 1857. (Type from Shoalwater Bay, Washington.)

Sorex suckleyi Baird, Mammals N. Am., pp. 18-20, Pl. XXVII, fig. 1677, 1857. (Type from Steilacoom, Washington.)

Type locality.—Shoalwater Bay, Washington.

Geographic distribution.—Southern British Columbia, western Washington and Oregon, and northern California (south on the coast to Monterey and in the mountains to old Fort Crook and Cassel). Restricted to lower Boreal and upper Transition zones.

General characters.—Size small; tail medium, about equaling body without head; third unicuspid smaller than fourth.

Color.—Upper parts dark brown, varying to almost russet; under parts ashy; tail dusky above, pale below.

Cranial and dental characters.—Skull normal, presenting no marked peculiarities, and measuring about 17 mm. in greatest length (including unworn middle incisors) by 8 mm. in greatest breadth, thus being the smallest of the northwest coast Shrews. Interpterygoid fossa rather broad and short. Compared with the skull of *S. obscurus*, which it resembles closely, it averages about 1 mm. shorter, while the breadth of the brain case remains essentially the same. The upper molars and large upper premolar are decidedly smaller than in *obscurus* and this character affords the best means of distinguishing the two species.

Measurements.—Average of 20 specimens from Aberdeen, Wash.: Total length, 103 mm.; tail vertebræ, 43 mm.; hind foot, 12.3 mm.

General remarks.—*Sorex vagrans* is the common small Shrew of the northwestern coast region of the United States and southern British Columbia. In some localities it occurs with the slightly larger *S. obscurus*, from which it is not easily distinguished except by actual comparison of the molariform teeth. It is less boreal than *obscurus*, inhabiting the upper part of the Transition and lower part of the Boreal zones, while *obscurus* is exclusively boreal. In the Rocky Mountain region *Sorex vagrans* is represented by *S. dobsoni*, with which it apparently intergrades, as specimens from eastern Washington (Marshall and Wawawai) seem to be intermediate between the two.

Sorex suckleyi Baird is identical with *S. vagrans*, as I have determined by comparison of the type specimens. In describing *suckleyi* as distinct Baird was misled by an immature and defective skull (No. $\frac{1276}{3652}$, U. S. Nat. Mus.). The base of this skull is broken and foreshortened, causing the brain case to bulge laterally, and all the anterior teeth are absent, so that the skull has an abnormal appearance (roughly shown on Pl. XXVII, Hist. N. Am. Mammals). Baird's other specimen from the type locality (No. 1677, Steilacoom) is alcoholic, and its skull is normal and identical with the type of *vagrans*, and also with other specimens of *vagrans* in the Department collection from Steilacoom. Baird's

alcoholic cotype (No. 1677) agrees with typical *vagrans* in size. It now measures: Total length, 95 mm.; tail vertebræ, 43.5 mm.; hind foot, 12 mm.

Specimens examined.—Total number, 104, from the following localities:

British Columbia: Port Moody, 4; Sumas, 1; Mount Baker Range, 1.

Washington: Steilacoom, 4; Olympic Mountains (Lake Cushman), 11; Sauk, 1; Mount Vernon, 1; Hamilton, 1; Avon, 3; Aberdeen, 22; Shoalwater Bay, 1; Easton, 3; Marshall, 7; Wawawai (5 miles northeast), 1.

Oregon: Salem, 8; Oregon City, 2; Sheridan, 2; Gold Beach, 3; Port Orford, 1; Florence, 1; Fort Klamath, 4.

California: Crescent City, 3; San Mateo, 1; Monterey, 1; Fort Crook, 10 (inclining toward *amœnus*); Cassel, 2; Carberry ranch, 5 (intergrade with *amœnus*).

SOREX VAGRANS DOBSONI Merriam.

(Pl. IX, figs. 8, 8*a*.)

Sorex dobsoni Merriam, N. Am. Fauna, No. 5, pp. 33-34, Pl. IV, fig. 2, August, 1891. Type from Saw Tooth or Alturas Lake, east base Saw Tooth Mountains, Idaho.

Geographic distribution.—Rocky Mountain region in northern Idaho and western Montana; also isolated mountains in Montana (Big Snowy and Pryor mountains), Wyoming (Big Horn Mts.), and Utah (Wasatch Mts.). Restricted to lower Boreal and upper Transition zones.

General characters.—Intermediate in size and cranial characters between *S. vagrans* and *obscurus;* third unicuspid smaller than fourth.

Color.—Upper parts uniform dull sepia brown with a faint chestnut tinge; under parts ashy gray washed with drab; tail bicolor: dark brown above, drab below. In winter pelage the upper parts are iron gray or ash gray with very little sepia, and the under parts are white or nearly white.

Cranial and dental characters.—Skull and teeth similar to those of *S. obscurus*, but skull slightly smaller; palate narrower; anterior part of rostrum more attenuate; unicuspid series decidedly narrower, especially the first and second teeth. Compared with *S. vagrans* the skull is larger, particularly the brain case; the molariform teeth also are larger.

Measurements.—Type specimen: Total length, 105 mm.; tail vertebræ, 47 mm.; hind foot, 12.5 mm. Average of 7 specimens from type locality (east base of Saw Tooth Mountains, Idaho): Total length, 104 mm.; tail vertebræ, 43.4 mm.; hind foot, 12.8 mm.

General remarks.—*Sorex dobsoni* is the interior form of *S. vagrans;* it inhabits the Rocky Mountain plateau, while true *vagrans* is confined to the coast region and Cascade-Sierra system. Intermediate specimens have been examined from Marshall and Wawawai on the elevated sage plain of eastern Washington. Skulls of *dobsoni* from the Big Horn Mountains have the brain case flatter (more depressed posteriorly) than those from the adjacent Pryor Mountains. The latter agree with specimens from the Big Snowy Mountains in having the brain case high posteriorly and the teeth heavily pigmented. The interrela-

tions of *dobsoni* and *obscurus* are intricate and perplexing. The two animals resemble one another very closely, but no intergrades have been found, and each has, so far as known, an independent distribution. They are best distinguished by the size of the teeth, the measurements of which are given under *S. obscurus* (p. 72). In the type specimen the third unicuspidate tooth is abnormally large.

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

Idaho: Alturas Lake (type locality), 7; Mullan, 2; Osburn, 1; Cœur d'Alene, 2; Seven Devils Mountains, 1.

Montana: Pryor Mountains, 5; Big Snowy Mountains, 4; Tobacco Plains, 1; Flathead Lake, 6; Nyack, 1; Summit (Great Northern Railroad), 2; Prospect Creek, near Thompson, 3; Thompson Pass, 2.

Wyoming: Bighorn Mountains, 4; Le Barge Creek (Wyoming Range), 1.

Utah: Ogden, 4.

SOREX VAGRANS MONTICOLA Merriam.

Sorex monticolus Merriam, N. Am. Fauna, No. 3, 43–44, September 11, 1890.

Type locality.—San Francisco Mountain, Arizona (altitude, 3,500 meters—11,500 feet).

General characters.—Size, small; pelage short; third unicuspid much smaller than fourth. Similar to *S. vagrans* in size and general appearance, but color grayish brown instead of chestnut brown; teeth broader.

Color.—Upper parts pale sepia brown without chestnut tinge, under parts ashy gray; tail bicolor: brownish above, whitish beneath except near tip, which is dark all round.

Cranial and dental characters.—Skull similar to that of *vagrans*, but slightly shorter (the shortening postrostral); palate and constriction between brain case and rostrum broader; unicuspids and molariform series broader.

Measurements.—Average of 4 specimens from type locality: Total length, 108 mm.; tail vertebræ, 44.2 mm.; hind foot, 12.7 mm. Average of 4 from Chiricahua Mountains, Arizona: Total length, 110 mm.; tail vertebræ, 47.5 mm.; hind foot, 12.2 mm.

General remarks.—*Sorex monticola* is only a slightly differentiated form of *vagrans*. It is known only from the mountains of Arizona, but is likely to be found in those of northern Mexico also.

Specimens examined.—Total number, 9, from the following localities in Arizona: San Francisco Mountain (type locality), 4; Springerville, 1; Chiricahua Mountains, 4.

SOREX AMŒNUS sp. nov.

Type from Mammoth Pass, head of Owens River, east slope Sierra Nevada, California (altitude, about 10,000 feet). Type, No. $\frac{20784}{41863}$, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected July 22, 1891, by E. W. Nelson. Original number, 1129.

General characters.—Similar in general to *S. vagrans*, but larger; tail shorter; color widely different: sooty instead of dull chestnut brown.

Color.—Upper parts dark fuliginous or dusky, faintly grizzled with brownish; sides pale dull brownish; under parts buffy whitish; tail blackish above, whitish below, becoming darker toward the tip. There is no trace of plumbeous in the fuliginous of the back, which is finely grizzled by a slight admixture of brownish hairs similar to those of the sides. The two specimens from the type locality are distinctly tricolor, though less markedly so than *S. richardsoni*, to which very different species *amœnus* bears a superficial likeness.

Cranial and dental characters.—As in *S. vagrans*.

Measurements.—Average of 2 specimens from type locality: Total length, 103 mm.; tail vertebræ, 37 mm.; hind foot, 12.3 mm. Average of 5 specimens from Carberry ranch, near summit of Sierra Nevada, Shasta County, Calif.: Total length, 104 mm.; tail vertebræ, 39 mm.; hind foot, 12.3 mm.

General remarks.—This handsome Shrew may be known at a glance by its short tail and peculiar color. This color may be in part seasonal, as specimens from a point farther north in the Sierra Nevada (Carberry ranch) vary from nearly as dark as typical *amœnus* to ashy brown. Intergradation with *vagrans* may occur in northern California or southern Oregon. A female caught by Mr. Nelson at the type locality July 22, 1891, contained 9 embryos.

SOREX VANCOUVERENSIS sp. nov.

Type from Goldstream, Vancouver Island, British Columbia. Type, No. 71913, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected May 10, 1895, by Clark P. Streator. Original number, 4592.

General characters.—Similar to *S. vagrans*, but larger, with decidedly larger forefeet and much darker coloration.

Color.—Upper parts finely mixed dusky and sepia brown, the dusky prevailing on the back, the sepia brown on the sides, where it forms an indistinct band; under parts plumbeous, lightly tipped with ash and irregularly washed (in type specimen) with rusty, which may be due to staining. Tail very dark brown, becoming almost dusky all round near tip; paler below on basal half.

Cranial and dental characters.—Skull and teeth similar to those of *S. vagrans;* molariform teeth a little smaller, though the difference is slight.

Measurements (of type specimen, in flesh).—Total length, 110 mm.; tail vertebræ, 43 mm.; hind foot, 12 mm.

General remarks.—In external appearance *Sorex vancouverensis* differs conspicuously from its nearest relative, *S. vagrans*, being of a very different color and having larger feet; but in cranial and dental characters the two are practically indistinguishable.

SOREX ORIZABÆ sp. nov.

Type from Mount Orizaba, State of Puebla, Mexico (altitude, 9,500 feet). Type, No. 53633, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected April 24, 1893, by E. W. Nelson. Original number, 4733.

General characters.—Size small; tail short; ears conspicuous; hind foot, 13 mm. Similar to *S. vagrans* and *monticola*, but tail shorter, coloration darker, pelage longer, with numerous long hairs on rump; molariform teeth smaller.

Color.—Upper parts finely mixed sepia brown and dusky (no chestnut tinge), darkest on posterior half of back; under parts ashy gray, sometimes faintly washed with brownish; tail bicolor: dark brown above, whitish beneath, with line of demarcation usually distinct.

Cranial and dental characters.—Skull hardly distinguishable from that of *S. monticola* (from Arizona), but molariform teeth smaller and anterior unicuspids narrower, having much less of the ridge on inner side that is so prominent in *monticola* and *vagrans*.

Measurements.—Type specimen: Total length, 103 mm.; tail vertebræ, 38 mm.; hind foot, 13 mm. Average of 7 specimens from type locality (Mount Orizaba): Total length, 99.6 mm.; tail vertebræ, 35.4 mm.; hind foot, 13 mm.

General remarks.—*Sorex orizabæ* is the smallest Shrew thus far discovered in Mexico. It is also the only one with a light belly. It belongs to the *vagrans* group, and is very closely related to *S. monticola* of the mountains of Arizona.

Specimens examined.—Total number, 18, from the following localities in southern Mexico: Mount Orizaba, Puebla (type locality), 7; Mount Malinche, Tlaxcala, 2; Cofre de Perote, Vera Cruz, 1; Salazar, Mexico, 2; north slope Volcan Toluca, Mexico, 3; Nahuatzin, Michoacan, 3.

SOREX NEVADENSIS sp. nov.

Type from Reese River, Nevada. Type, No. $\frac{24891}{32302}$, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected November 24, 1890, by Vernon Bailey. Original number, 2150.

General characters.—Size small; tail shorter than body without head; hind foot, about 12.5 mm.; coloration peculiar, indistinctly tricolor. Similar in general to *S. vagrans*, but tail shorter and color very different.

Color.—Upper parts finely mixed slate black and hoary; sides indistinctly buffy or very pale brownish fulvous; under parts hoary, without sharp line of demarcation. Ears brownish; tail sharply bicolor: dusky above and whitish below, except near tip, which is dark all round.

Cranial and dental characters.—Skull similar to that of *S. vagrans*, but slightly smaller; brain case flatter; interpterygoid fossa narrower. Teeth as in *vagrans*.

Measurements.—Average of 4 specimens from type locality: Total length, 96.5 mm.; tail vertebræ, 39 mm.; hind foot, 12.5 mm.

General remarks.—*Sorex nevadensis* is an easily recognized species, its dark back, finely mixed with hoary, and indistinctly tricolor coloration which suggests *S. richardsoni*, serving to distinguish it from its nearest allies. It is the only Shrew thus far discovered in the interior of the Great Basin.

SOREX OBSCURUS Merriam.

(Pl. VIII, figs. 1, 1*a*.)

Sorex vagrans similis Merriam, N. Am. Fauna, No. 5, pp. 34–35, Pl. IV, fig. 3, August, 1891. (Name preoccupied by *Sorex similis* Hensel, 1855,[1] and here changed to *obscurus*.)

Type locality.—Timber Creek, Salmon River Mountains, Idaho (altitude, 8,200 feet).

Geographic distribution.—British Columbia and mountains of western Washington, Idaho, Montana, Wyoming, Utah, and Colorado; south along the High Sierra Nevada in California to Mount Whitney. Restricted to Boreal zone.

General characters.—Size rather small; tail about equal to body without head; ears inconspicuous; third unicuspid much smaller than fourth. Similar to *Sorex dobsoni*, but with smaller ears, broader palate, and broader unicuspidate teeth. Compared with *S. vagrans*, it is slightly larger, with longer tail and larger molariform teeth.

Color.—Upper parts uniform dull sepia brown, under parts ashy; tail bicolor: upper side concolor with back or slightly darker, under side whitish. In winter pelage the upper parts are ash gray and the under parts nearly white.

Cranial and dental characters.—Skull similar to that of *S. dobsoni*, but palate broader; molariform teeth larger; unicuspidate teeth broader, particularly the first and second; third unicuspid decidedly smaller than fourth. Compared with *S. vagrans*, the skull is slightly longer (averaging 18 mm. instead of 17 mm.), with larger and heavier molariform teeth (particularly the large upper premolar) and broader first and second unicuspids. The actual differences in the size of the molariform teeth are shown in the following table:

Mean measurements of upper molariform teeth of Sorex obscurus, dobsoni, and vagrans.

[Measurements in $\frac{1}{100}$ mm.]

Species.	Locality.	Series.*a*	pm.	m^1.	m^2.
Sorex obscurus	Salmon River Mountains, Idaho	400	145	140	120
dobsoni	Saw Tooth Mountains, Idaho	372	137	128	115
vagrans	Aberdeen, Wash	345	125	120	105

a From antero-external angle of pm to postero-external angle of m^2.

[1] Hensel, Zeitschr. der Deutsch. Geolog. Gesellsch., VII, 1855, 459. From bone deposits of Cagliari, Sardinia.

Measurements.—Average of 8 specimens from type locality: Total length, 108 mm.; tail vertebræ, 46 mm.; hind foot, 12.8 mm.

General remarks.—*Sorex obscurus* is a common and widely distributed species, being the prevailing Shrew in southern British Columbia and northern Washington and in the Rocky Mountains and Sierra Nevada. A closely allied form (subspecies *longicauda*) occupies a narrow strip along the Pacific coast from the mouth of the Columbia northward to Wrangel, Alaska; another (subspecies *ventralis*) inhabits the mountains of Oaxaca, in southern Mexico.

Specimens examined.—Total number, 175, from the following localities:

Idaho: Salmon River Mountains (type locality), 8; Pahsimeroi Mountains, 1; Preuss Mountains, 1.

Utah: Wasatch Mountains, 1; Provo, 1; Manti, 3.

Colorado: Longs Peak, 1; Boulder County, 8; Fort Garland, 2; 3 miles east of Cochitope Pass (Monshower Meadows), 2; Silverton, 4.

Wyoming: Yellowstone Park, 3; Bridger Pass, 2; Woods, 1.

Montana: St. Marys Lakes, 9; Bear Paw Mountains, 2; Bear Tooth Mountains, 17; Upper Stillwater, Flathead County, 1.

California (all in Sierra Nevada): Carberry Ranch, Shasta County, 1; Greenville, Plumas County, 1; Donner, 1; Pine City, east slope Mammoth Pass, 1; head San Joaquin River, 3; Bishop Creek, 5; Mineral King, 2; Sequoia National Park (Halsted Meadows), 4; Horse Corral Meadows, 3; Mulkey Meadows, 1; North Fork Kern River, 1; East Fork Kaweah River, 7; South Fork Kern River, 3; Mount Whitney, 6; Round Valley, 12 miles south of Mount Whitney, 1; Kern Lakes (Soda Springs), 1.

Oregon: Drain (not typical), 4.

Washington (inclining toward *longicauda*): Head of Lake Chelan, 4; head of Cascade River, 2; Easton, 10; Lake Cushman, Olympic Mountains, 3.

British Columbia: Nelson, 6; Ward, 1; Field, 2; Glacier, 5; Golden, 1; Kamloops (Cariboo Lake), 2; Sicamous, 1; Goldstream, Vancouver Island, 5; Comox, 1; Sumas, 2; Port Moody (nearly *longicauda*), 4.

Alberta: Henry House, 2.

Mean measurements of Sorex obscurus, longicauda, and alascensis, showing progressive geographic variation in size.

	Total length.	Tail.	Hind foot.	No. of specimens in average.
Sorex obscurus:	*mm.*	*mm.*	*mm.*	
Salmon River Mountains, Idaho (type locality)	108	46	12.8	8
Yellowstone Park, Wyoming	111	46.6	13	3
Bear Tooth Mountains, Montana	112	46.5	13.1	15
St. Mary Lakes, Montana	116.5	47.6	13.5	9
Easton, Wash.	118.7	52.8	13.8	10
Sorex longicauda:				
Lake Cushman, Washington	123	53.7	13 8	4
Neah Bay, Washington	131	62	15	2
Wrangel, Alaska (type locality)	128.8	58.1	15.5	27
Loring, Alaska	129	58.1	15.3	11
Sorex alascensis:				
Juneau, Alaska	122.5	53.5	14.6	16
Yakutat, Alaska (type locality)	116.3	49.2	14.8	10

SOREX OBSCURUS LONGICAUDA subsp. nov.

Type from Wrangel, southeast Alaska. Type, No. 74711, ♂ yg. ad., U. S. Nat. Mus., Department of Agriculture collection. Collected September 9, 1895, by Clark P. Streator. Original number, 4891.

Geographic distribution.—Coast of southeast Alaska, from Wrangel southward; also coast of Washington, including Puget Sound and Skagit Valley.

General characters.—Size rather large; tail long, nearly equaling head and body; ears conspicuous. Similar to *S. bairdi* in color, length of tail, and external appearance; similar to *S. obscurus* in cranial and dental characters.

Color.—Upper parts dull, dark chestnut brown; under parts buffy ash, more or less suffused with dull, pale chestnut brown on the belly; tail bicolor: dark brown above, buffy below.

Cranial and dental characters.—Skull and teeth almost indistinguishable from *S. obscurus*, but larger; molariform teeth more deeply emarginate posteriorly, and middle upper molar narrower on inner side.

Measurements.—Average of 27 specimens from Wrangel, Alaska (type locality): Total length, 128.8 mm.; tail vertebræ, 58.1 mm.; hind foot, 15.5 mm. Average of 2 specimens from Neah Bay, Washington: Total length, 131 mm.; tail vertebræ, 62 mm.; hind foot, 15 mm. Average of 4 specimens from Aberdeen, Wash.: Total length, 122 mm.; tail vertebræ, 57 mm.; hind foot, 14.2 mm.

General remarks.—*Sorex obscurus* is a strictly boreal species, and in the United States it is exclusively a mountain animal, not descending to base level until British Columbia is reached. In the Puget Sound region, however, and along the ocean coast of Washington, and thence northerly to Alaska, it sends a representative all the way down to sea level. This representative is larger, has developed an exceedingly long tail, and has taken on certain peculiarities of coloration. It is here described as a subspecies, in the belief that intergradation with *obscurus* takes place.

Specimens examined.—Total number, 48, from the following localities:

Alaska: Wrangel (type locality), 27; Loring, Revillagigedo Island, 11.
Washington: Neah Bay, 2; Seattle, 1; Avon, 1; Hamilton, 1; Mount Vernon, 1; Aberdeen, 4.

In addition to the above, specimens more or less intermediate between *longicauda* and *obscurus* have been examined from Port Moody, British Columbia (3), and the following places in the State of Washington: Olympic Mountains (Lake Cushman), 4; head of Cascade River, 2; Easton, 10; head of Lake Chelan, 3.

SOREX OBSCURUS VENTRALIS subsp. nov.

Type from Cerro San Felipe, Oaxaca, Mexico (altitude, 10,000 feet). Type, No. 68342, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected August 26, 1894, by E. W. Nelson and E. A. Goldman. Original number, 6636.

General characters.—Size small; tail short; hind foot, 13 mm. Similar to *S. obscurus*, but tail shorter and coloration darker, particularly on under parts.

Color.—Upper parts finely mixed brownish (inclining to dull chestnut) and dusky, the one or the other predominating according to the pelage (the type specimen is in the brown pelage); under parts dull chestnut, passing gradually into color of sides. Tail bicolor: dusky above, soiled whitish beneath; line of demarcation usually distinct.

Cranial and dental characters.—Skull and teeth similar to those of *S. obscurus*, but molariform teeth slightly larger. The first true molar is essentially the same size in both, but the large premolar and second molar are slightly larger in *ventralis*.

Measurements.—Type specimen: Total length, 104 mm.; tail vertebræ, 37 mm.; hind foot, 13 mm. Average of 7 specimens from type locality: Total length, 105.4 mm.; tail vertebræ, 37.3 mm.; hind foot, 13 mm.

General remarks.—It is interesting to find the common boreal Shrew of British Columbia and the northern Rocky Mountains ranging southward, in a very slightly modified form, all the way to the mountains of extreme southern Mexico.

The 7 specimens from the type locality (Cerro San Felipe) were collected August 26 to September 1, and are about equally divided between the two pelages. The 9 from the mountains west of Oaxaca were collected September 12 to 18, and all are in the dark pelage.

Sorex obscurus ventralis differs from *S. oreopolus* much as it differs from typical *obscurus*, in having the under parts dull chestnut instead of ashy gray. The skull is broader and much shorter (particularly the brain case) and the second upper molar is broader.

Specimens examined.—Total number, 21, from the following localities, all in the State of Oaxaca, Mexico: Cerro San Felipe (type locality), 7; mountains 15 miles west of Oaxaca City, 9; mountains near Ozolotepec, 3; near Cajones, 2.

Mean measurements of Sorex obscurus ventralis from different localities in Oaxaca, Mexico.

Locality.	Total length.	Tail.	Hind foot.	No. of specimens in average.
	mm.	*mm.*	*mm.*	
Cerro San Felipe, Oaxaca, Mexico	105.4	37.3	12.9	7
Mountains 15 miles west of Oaxaca City, Oaxaca	105.3	41.2	13.7	9
Mountains near Cajones, Oaxaca	106	41	13.5	2
Mountains near Ozolotepec, Oaxaca	112	40	13.3	3

SOREX OBSCURUS ALASCENSIS subsp. nov.

Type from Yakutat Bay, Alaska. Type, No. 73539, ♀ yg. ad., U. S. Nat. Mus., Department of Agriculture collection. Collected July 10, 1895, by C. P. Streator.

General characters.—Size large; tail medium, about equal to body without head; hind foot nearly 15 mm. Similar to *S. obscurus*, but larger; similar to *S. longicauda*, but tail shorter; similar to *S. fumeus* of the northeastern United States, but third unicuspid decidedly smaller than fourth, as in most west American Shrews, and color different.

Color.—Upper parts uniform sepia brown, finely mixed with light-tipped hairs; under parts ash gray, the plumbeous showing through. Tail bicolor: above, dark brown; below, whitish; tip usually dusky all round.

Cranial and dental characters.—Skull similar in size and general characters to that of *S. fumeus*, from which it differs in the following points: Brain case shorter, somewhat more inflated above plane of rostrum, and slightly narrower; palate and postpalatal notch slightly narrower; first and second unicuspids more swollen; third much smaller than fourth; second upper true molar less deeply excavated posteriorly and shorter on lingual side. The rostrum, palate, and teeth are essentially the same as in *fumeus*, except that the third unicuspid is smaller than the fourth, as usual in western Shrews. The skull and molariform teeth of *Sorex alascensis* are decidedly larger than those of *S. obscurus* and smaller than those of *S. longicauda*. Compared with *S. obscurus* the difference in size of cranium is due almost wholly to the great development of the brain case, which in *alascensis* is not only larger in every way but is more highly inflated above the plane of the rostrum.

Measurements.—Type specimen: Total length, 115 mm.; tail vertebræ, 45 mm.; hind foot, 14.5 mm. Average of 10 specimens from type locality (Yakutat, Alaska): Total length, 116 mm.; tail vertebræ, 49 mm.; hind foot, 14.8 mm.

General remarks.—Externally *Sorex alascensis* resembles *S. longicauda* except that its tail is much shorter. This difference is well shown in the table of measurements given under *S. obscurus* (p. 73).

The type locality of *alascensis* is Yakutat, Alaska; the type locality of *longicauda* is Wrangel, Alaska. Juneau is intermediate in geographic position between Yakutat and Wrangel, and its Shrews of the *obscurus* group are, as might be expected, intermediate between *alascensis* and *longicauda*. A series of 16 specimens from Juneau differs from the Yakutat series in having the tail longer (averaging 53.5 mm. instead of 49.2 mm.), the ear slightly longer, the mddle upper molar less emarginate posteriorly, and the color more inclining to rufous (particularly in No. 74386, in which the upper parts are much darker and more rufous and the under parts strongly washed with the same color). But the difference in color is probably seasonal, as a few of the specimens which are still in summer pelage (as No. 74397) are like those

from Yakutat. The Yakutat specimens were collected in July; the Juneau series about the middle of August. It is probable that complete intergradation exists between *alascensis* and *longicauda*.

SOREX OREOPOLUS Merriam.

(Pl. VIII, figs. 4, 4*a*.)

Sorex oreopolus Merriam, Proc. Biol. Soc. Washington, VII, 173, September 29, 1892.

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

General characters.—Size medium; tail and ears short; hind foot, 13 mm. Similar to *S. obscurus*, but tail much shorter; color much darker above and below; skull very much longer and more slender.

Color.—Upper parts finely mixed sepia brown and dusky, without chestnut tinge; under parts drab; tail bicolor: dusky above and all round at tip, soiled whitish beneath.

Cranial and dental characters.—Skull similar to those of *S. obscurus* and *ventralis*, but much longer and more slender, with brain case and constriction between brain case and rostrum especially elongated, and palate narrower. The second upper molar is narrower (inner side shorter) than in *ventralis*.

Measurements.—Average of 3 specimens from type locality: Total length, 104.7 mm.; tail vertebræ, 36.3 mm.; hind foot, 13.7 mm.

General remarks.—*Sorex oreopolus* has apparently the most restricted distribution of any Mexican *Sorex*, being known only from the Sierra Nevada de Colima, Jalisco. It belongs to the *S. obscurus* group, and is represented in the mountains of Oaxaca by a closely related form, *S. obscurus ventralis*, from which it may be distinguished by its much paler under parts, the absence of chestnut tinge from the sides and back, and the very much longer and more slender skull, as already pointed out.

Specimens examined.—Total number, 3; all from the type locality.

SOREX BAIRDI sp. nov.

(Pl. VII, figs. 3, 3*a*.)

Type from Astoria, Oregon. Type, No. $\frac{17414}{21318}$, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected August 2, 1889, by T. S. Palmer. Orig. No. 270.

Geographic distribution.—Coast of Oregon at mouth of Columbia River.

General characters.—Size, rather large; tail long; color dull brownish chestnut; external appearance as in *S. longicauda*, but skull larger and anterior unicuspids much more swollen.

Color.—Upper parts dull, dark chestnut brown; under parts dull chestnut brown (similar to back, but lacking the admixture of black-tipped hairs); tail bicolor: dark brown, almost dusky-above; flesh color, or pale buffy brownish, below.

Cranial and dental characters.—Skull similar to that of *obscurus*, but larger (averaging 20 mm. in length and 9 mm. in breadth); first and second unicuspids very large and broad, differing markedly from any known species.

Measurements.—Average of 9 specimens from type locality: Total length, 129 mm.; tail vertebræ, 57 mm.; hind foot, 15.1 mm.

General remarks.—After *Sorex pacificus*, *S. bairdi* is the largest of the west American Shrews of the restricted genus *Sorex*. Externally it resembles its geographical neighbor, *S. longicauda*, from which it differs strongly in the large size of its anterior unicuspidate teeth.

The species is remarkable in several respects. Geographically it is restricted to the coast of Oregon near Astoria, on the south side of the mouth of the Columbia River. On the north side of the river it is replaced by *S. longicauda*, a closely related species, whose affinities have been already discussed. It seems peculiarly appropriate that this large and handsome Shrew should perpetuate the name of Professor Baird, the pioneer in the study of west American Shrews.

SOREX TROWBRIDGII Baird.

(Pl. VII, figs. 4, 4*a*.)

Sorex trowbridgii Baird, Mamm., N. Am., pp. 13-15, 1857.

Type locality.—Astoria, mouth of Columbia River, Oregon.

Geographic distribution.—Western Washington and Oregon, west of Cascade Range.

General characters.—Size, rather large; tail long; ears conspicuous; color dark slate or sooty plumbeous, with no brownish or chestnut. Resembles *S. montereyensis* of California, but differs in marked cranial and dental characters.

Color.—Upper parts blackish slate or sooty plumbeous; under parts dull plumbeous; tail sharply bicolor: blackish above, whitish beneath; feet flesh color.

Cranial characters.—Contrasted with *S. montereyensis*, the only species with which it requires comparison, the skull of *S. trowbridgii* is thinner and more 'papery,' the brain case more globular, the palate much narrower. The molariform teeth and first and second unicuspids are decidedly smaller and narrower. The large upper premolar in particular is very much smaller than in *montereyensis*.

Measurements.—Average of 3 specimens from Astoria, Oregon (type locality): Total length, 121 mm.; tail vertebræ, 57.7 mm.; hind foot, 13.7 mm. Average of 5 specimens from Olympic Mts., Washington: Total length, 120 mm.; tail vertebræ, 57.8 mm.; hind foot, 13 mm.

General remarks.—*Sorex trowbridgii* may be distinguished at a glance from all other American Shrews, except the related *S. montereyensis*, by its large size, sooty plumbeous color, and long, sharply bicolor tail. The characters that distinguish it from *montereyensis* have been pointed out in the above diagnosis.

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

Washington: Seattle, 1; Steilacoom, 2; Tenino, 1; Olympic Mountains, 5; Aberdeen, 1.

Oregon: Astoria (type locality), 3; Beaverton, 1; Yaquina Bay, 1; Marshfield, 1; Siskiyou, 3.

SOREX MONTEREYENSIS sp. nov.

Type from Monterey, Calif. Type, No. $\frac{32000}{44870}$, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected October 1, 1891, by Vernon Bailey. Original number, 3336.

Geographic distribution.—Coast strip and Sierra Nevada of California; south on the coast at least to Morro and San Luis Obispo; south in the Sierra to Sequoia National Park and East Fork Kaweah River.

General characters.—Size large; tail long; ears prominent; color sooty black, becoming brownish in worn summer pelage. Similar to *S. trowbridgii*, but with slightly larger feet, broader palate, and larger molariform teeth.

Color.—Upper parts slate black, passing insensibly into dull plumbeous brown on the belly. In worn summer pelage the back becomes brownish. Tail sharply bicolor: blackish above, whitish beneath.

Cranial characters.—Skull similar to *S. trowbridgii* but slightly heavier, brain case less globular, palate and interpterygoid notch much broader. Molariform teeth and first and second unicuspids decidedly larger and broader. The large upper premolar alone is diagnostic of the species, contrasted with its small size in *trowbridgii*.

Measurements.—Average of 5 specimens from Monterey, Calif. (type locality): Total length, 120 mm.; tail vertebræ, 52.4 mm.; hind foot, 14.8 mm. Average of 4 specimens from Sequoia National Park, west slope Sierra Nevada: Total length, 120.5 mm.; tail vertebræ, 51.3 mm.; hind foot, 14 mm.

General remarks.—*Sorex montereyensis* is the California representative of *S. trowbridgii* from the coast region of Oregon and Washington, and requires comparison with no other species.

Specimens examined.—Total number, 33, from the following localities in California:

Coast Belt: Crescent City, 2; Eureka, 1; Nicasio, Marin County, 8; Boulder Creek, Santa Cruz County, 4; Monterey, 6; Morro, 2; San Luis Obispo, 1.

Sierra Nevada (west slope): Michigan Bluff, 1; Middle Fork American River, Eldorado County, 2; Sequoia National Park (Halsted Meadows), 5; East Fork Kaweah River, 1.

SOREX ORNATUS sp. nov.

(Pl. VIII, figs. 3, 3*a*.)

Type from head of San Emigdio Canyon, Mount Piños, California. Type, No. $\frac{31333}{43198}$, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected October, 19, 1891, by E. W. Nelson. Original number, 1328.

Geographic distribution.—Mountains of southern California, from head of Ventura River and Mount Piños easterly to San Bernardino Peak, and south through the San Jacinto range to Santa Ysabel.

General characters.—Similar to *S. californicus*, but larger, with much longer tail, larger ears and feet, and a dark rump patch.

Color.—Upper parts ash gray, becoming suddenly darker on the rump, the dark hairs forming a distinct patch or saddle on posterior half of the back, strongly contrasted with the clear gray of the shoulders and anterior part of back; under parts whitish, reaching far up on the sides. Tail indistinctly bicolor: dark above, and all round on distal half; pale below on proximal half.

Cranial and dental characters.—Skull similar to that of *californicus*, but larger and with the brain case narrower and higher. Large upper premolar decidedly larger than in *californicus;* molariform teeth very broadly and deeply excavated posteriorly.

Measurements (of type specimen in flesh).—Total length, 108 mm.; tail vertebræ, 43 mm.; hind foot, 13 mm. Average of 2 from San Bernardino Peak: Total length, 104 mm.; tail vertebræ, 42.5 mm.; hind foot, 12 mm.

General remarks.—The dark rump patch is probably a feature of the winter pelage, as it is hardly apparent in September specimens from the San Bernardino Mountains.

Specimens examined.—Total number, 7, from the following localities in southern California: Mount Piños and head of San Emigdio Canyon, 2; near head of Ventura River, 1; San Bernardino Peak, 2; Santa Ysabel, 2.

SOREX CALIFORNICUS sp. nov.

(Pl. XII, figs. 6, 7.)

Type from Walnut Creek, Contra Costa County, Calif. Type, No. $\frac{82578}{144726}$, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected February 15, 1892, by Clark P. Streator. Original number, 1583.

General characters.—Size small; tail shorter than body without head; hind foot about 11.5 mm.; ears conspicuous; skull small and flat; brain case hardly higher than rostrum.

Color.—Upper parts dark ash gray, with a decided 'pepper and salt' appearance, and sometimes washed with brownish; under parts plumbeous, tipped with whitish.

Cranial and dental characters.—Skull small and flat; brain case depressed, broadly flattened, and hardly higher than rostrum, with which it forms a nearly straight line; palate broad. Third unicuspid very small, hardly half as large as fourth. Molariform teeth similar to those of *S. vagrans*, but smaller.

Measurements.—Average of 4 specimens from Walnut Creek, California (type locality): Total length, 93 mm.; tail vertebræ, 34.5 mm.; hind foot, 11.5 mm.

General remarks.—Sorex californicus is the type of a new group of Shrews, previously overlooked, and easily distinguished by the flatness of the brain case. Three members of the group are here described, all of small size, namely, *S. californicus*, *S. tenellus*, and *S. nanus*.

Specimens examined.—Total number, 7, from the following localities in California: Glen Ellen, Sonoma County, 1; Walnut Creek, Contra Costa County (type locality), 4; Berkeley, Alameda County, 2.

SOREX TENELLUS sp. nov.

(Pl. XII, figs. 8, 9.)

Type from summit of Alabama Hills near Lone Pine, Owens Valley, Calif. Type, No. $\frac{25083}{32495}$, ad., U. S. Nat. Mus., Department of Agriculture collection. Collected December 22, 1890, by E. W. Nelson. Original number, 131.

General characters.—Size small; coloration pale; skull flat, as in *S. californicus*, but smaller and much narrower.

Color.—Upper parts pale ash gray, under parts and feet white; tail bicolor: dark above, white beneath.

Cranial and dental characters.—Skull small, slender, and very flat; brain case depressed to plane of rostrum, which is nearly horizontal; palate narrow. Teeth much as in *S. californicus*.

Measurements (in flesh).—Type specimen: Total length, 103 mm.; tail vertebræ, 42 mm.; hind foot, 12.5 mm. Average of 2 specimens from White Mountains, California: Total length, 98 mm.; tail vertebræ, 41 mm.; hind foot, 12.2 mm.

General remarks.—*Sorex tenellus* is a third member of the group of flat-skulled Shrews comprising *S. californicus* and *S. nanus*. It differs strikingly from *californicus* in the narrowness of its skull.

Specimens examined.—Total number, 3, from the following localities in southeastern California: Alabama Hills, near Lone Pine, Owens Valley, 1; White Mountains, 2.

SOREX TENELLUS NANUS subsp. nov.

(Pl. VIII, figs. 5, 5*a*.)

Type from Estes Park, Colorado. Type, No. 73773, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected August 3, 1895, by E. A. Preble.

General characters.—One of the smallest of the American Shrews (hind foot, 10 mm.). Similar to *S. tenellus*, but smaller and darker; skull more slender and teeth smaller.

Color.—Upper parts sepia brown, darkest on the back, under parts and feet grayish ash; tail bicolor: upper side concolor with back, except at tip, which is decidedly darker, under side whitish.

Cranial and dental characters.—Skull similar to that of *tenellus*, but even smaller and more slender; anterior part of rostrum narrower and more attenuate; constriction less swollen; palate narrower; molariform teeth smaller (especially m^1). Compared with *S. longirostris*, the whole skull is much flatter and more slender.

Measurements.—Type specimen: Total length, 105 mm.; tail vertebræ, 42 mm.; hind foot, 10 mm.

General remarks.—The discovery in Colorado of a representative of the tiny California *Sorex tenellus* is as interesting as it was unexpected. True *tenellus* inhabits the mountains of Owens Valley and the White Mountains on the border between California and Nevada. The closely related form here described as *nanus* was collected at Estes Park, Colorado, by Mr. E. A. Preble.

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

Colorado: Estes Park (type locality), 2; West Cliff (Custer County), 1.
Montana: Fort Custer, 1.

SOREX MACRODON sp. nov.

(Pl. VII, figs. 2, 2*a*; Pl. XII, figs. 12, 13.)

Type from Orizaba, Vera Cruz, Mexico (altitude, 4,200 feet). Type, No. 58272, ♂ yg. ad., U. S. Nat. Mus., Department of Agriculture collection. Collected January 26, 1894, by E. W. Nelson and E. A. Goldman. Original number, 5759.

General characters.—Size rather large; ears large; tail long; coloration dusky. Almost indistinguishable externally from *S. caudatus*, but with skull and teeth much larger and more massive.

Color.—Upper parts finely mixed sepia and black, the black usually predominating, particularly on the posterior half of the back; under parts seal brown; tail blackish above, paler beneath, without line of demarcation; feet blackish.

Cranial and dental characters.—Skull large and heavy (20 by 9.5 mm.) with large brain case; rostrum high; anterior nares remarkably large, and with thickened borders; palate and interpterygoid fossa broad. Third unicuspid small, hardly half as large as fourth. Molariform teeth very large and massive.

Measurements.—Type specimen: Total length, 128 mm.; tail vertebræ, 52 mm.; hind foot, 15.5 mm. Average of 5 specimens from type locality: Total length, 125 mm.; tail vertebræ, 50.2 mm.; hind foot, 15.3 mm.

General remarks.—*Sorex macrodon*, while hardly distinguishable externally from *S. caudatus*, may be told at a glance by the heavy skull and teeth. The skull suggests that of *Blarina*, particularly in the large size and thickened borders of the anterior nares.

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

State of Vera Cruz: Orizaba (type locality), 5; Jico, 3.
State of Oaxaca: Totontepec, 2.

SOREX VERÆPACIS Alston.

Sorex veræ-pacis Alston, Proc. Zool. Soc. London, 1877, 445-446; Biologia Centrali-Americana, p. 55, Pl. col. V, fig. 1, 1880.

Sorex pacificus Dobson, Monog. Insectivora, Part III, Pl. XXIII, fig. 8 (not *S. pacificus* Baird).

Type locality.—Coban, Guatemala.

General characters.—Size rather large; tail long; color very dark; third unicuspid smaller than fourth.

Color.—"Nearly uniform dark dusky brown, hardly lighter beneath; feet and tail dusky."

Cranial and dental characters.—The skull of *S. veræpacis* I have not seen, but judging from Alston's rather poor figures it presents no unusual characters, except that the molariform series converge posteriorly, leaving the roof of the mouth broadest on the plane of the first true molar. Alston states that the first upper incisor has a well-marked internal cusp and that the canine (fourth unicuspid) is slightly smaller than the fourth incisor (third unicuspid); but Mr. Oldfield Thomas, curator of mammals in the British Museum, who has kindly reexamined the type at my request, writes me that the contrary is true. Mr. Thomas says: "*Sorex veræpacis* has the fourth unicuspid distinctly higher than the third, so Alston's description is wrong." The relations of these teeth are correctly shown in Dobson's Monograph of the Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 8.

Measurements.—The measurements recorded by Alston from the mounted specimens are, approximately: Total length, 137 mm.; tail vertebræ, 51 mm.; hind foot, 13.5 mm. The measurement of the hind foot is erroneous. Mr. Oldfield Thomas finds that it measures 15.7 mm.

General remarks.—The two original specimens of *Sorex veræpacis* were brought to England from Coban, Guatemala, more than half a century ago, and are still unique.[1] The species finds its nearest relative in *S. macrodon*, of Orizaba, Mexico. Mr. Thomas, who has compared *S. macrodon* with the type of *veræpacis*, writes me that the latter is much the darker and that the third and fourth unicuspids are very different in shape.

SOREX SAUSSUREI Merriam.

Sorex saussurei Merriam, Proc. Biol. Soc. Washington, VII, 173-174, September 29, 1892.

Type locality.—North slope Sierra Nevada de Colima, Jalisco, Mexico (altitude, 8,000 feet).

General characters.—Size rather large; tail rather short (shorter than body without head); ears large; hind foot, 14.5 mm.

Color.—Upper parts finely mixed sepia brown and dusky, the dark hairs predominating over the rump; under parts drab gray on throat and breast, more or less clouded over the belly; tail dark, paler below proximally.

Cranial and dental characters.—Skull large; rostrum high and swollen; constriction broad; brain case not abruptly elevated; palate rather narrow; postpalatal notch broad; third unicuspid slightly smaller than fourth. The skull of *Sorex saussurei* hardly needs comparison with any other species. It is very much larger than any member of the *obscurus* group, and is nearly as large as *S. macrodon*. It may be known from the latter at a glance by the smaller molariform teeth and more slender anterior part of rostrum, with much smaller anterior nares.

Measurements.—Average of 2 specimens from type locality: Total length, 118.5 mm.; tail vertebræ, 47 mm.; hind foot, 14.5 mm.

[1] Since the above was printed 5 specimens have been received from Tumbala, Chiapas, Mexico.

General remarks.—The only Shrews that resemble *S. saussurei* externally are its subspecies *caudatus* and *S. macrodon*, from both of which it differs in greater length of tail and paler color of under parts.

Sorex saussurei is an exceedingly interesting type, inhabiting, either in its typical form or as subspecies *caudatus*, most of the higher mountains of southern Mexico, from the volcano of Colima on the west to Mount Orizaba on the east. On mapping the distribution of the typical form and the subspecies separately, it is found that the former inhabits the mountains whose watershed finds its way to the Pacific, while the latter is confined to those on the Atlantic slope. Specimens from Cerro San Felipe, Oaxaca, on the border land between the two, are intermediate in characters.

Specimens examined.—Total number, 24, from the following localities:

State of Jalisco: North slope of Sierra Nevada de Colima, 2.

State of Michoacan: Nahuatzin, 5.

State of Mexico: Mount Popocatepetl, 2; Salazar, 2; North slope of volcano of Toluca, 1.

State of Morelos: Tetela del Volcan, 1.

State of Oaxaca: Mountains 15 miles west of Oaxaca City, 1; mountains near Ozolotepec, 4; Tlapancingo, 2; Tamazulapam, 2.

State of Guerrero: Mountains near Chilpancingo, 2 (not typical).

SOREX SAUSSUREI CAUDATUS subsp. nov.

Type from Reyes, Oaxaca, Mexico (altitude 10,200 feet). Type, No. 69600, ♀ yg. ad., U. S. Nat. Mus., Department of Agriculture collection. Collected October 21, 1894, by E. W. Nelson. Original number, 6963.

General characters.—Similar to *S. saussurei*, but tail much longer (averaging 57 instead of 47 mm.); hind foot slightly longer; color of under parts darker.

Color.—Upper parts finely mixed sepia and blackish; under parts seal brown, passing insensibly into the color of the back; feet and tail blackish, the latter fading to brownish underneath.

Cranial and dental characters.—Skull and teeth similar to those of *saussurei*, but averaging slightly larger, with brain case somewhat higher. Third unicuspidate tooth slightly smaller than fourth.

When good series of skulls are available from single localities (as from Reyes and Mount Zempoaltepec) it is found that two types exist in each: (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). I incline to look upon these differences as sexual, though they do not uniformly correspond to the sex marks on the labels. But in the *Soricidæ*, as in the *Geomyidæ*, it is not safe to pin one's faith too closely on the collector's sexing.

Measurements.—Type specimen: Total length, 126 mm.; tail vertebræ, 57 mm.; hind foot, 14.5 mm. Average of 11 specimens from type

locality (Reyes, Oaxaca): Total length, 125 mm.; tail vertebræ, 56.6 mm.; hind foot, 14.8 mm.

General remarks.—*Sorex saussurei caudatus* is simply a long-tailed form of *saussurei*, differing slightly in coloration. Its distribution is complemental to that of *saussurei*, as it inhabits mountain slopes of southeastern Mexico, while typical *saussurei* occupies the mountains of southwestern Mexico. On Mount Zempoaltepec it presents greater range of variation than elsewhere.

Specimens examined.—Total number, 41, from the following localities in southern Mexico:

Oaxaca: Reyes (type locality), 11; Totontepec, 5; Mount Zempoaltepec, 11; Cerro San Felipe, 4.

Vera Cruz: Jico, 5; Mount Orizaba, 4; Las Vigas, 1.

SOREX LONGIROSTRIS Bach.

(Pl. IX, figs. 6, 6*a*.)

Sorex longirostris Bachman, Jour. Acad. Nat. Sci. Phila., III, Part. II, 370-373, Pl. XXIII, fig. 2, 1837.

Type locality.—Swamps of Santee River, South Carolina.

Geographic distribution.—Austroriparian fauna of North and South Carolina, and probably Georgia and Florida also.

General characters.—Size small (hind foot, 11 mm. or less); tail shorter than body without head; ears large and conspicuous; third unicuspid smaller than fourth, as in the west American Shrews.

Color.—Upper parts chestnut brown, changing rather abruptly to color of under parts, which is ashy tinged with drab; upper side of tail dark, under side pale brownish.

Cranial and dental characters.—Skull smallest of the American species except *S. nanus*, from Colorado, with which it agrees in size and many important characters. It differs from all the other species of the genus in eastern America, and agrees with most of those from the West, in having the third unicuspid decidedly smaller than the fourth. Compared with *S. nanus* of Colorado, the whole cranium is higher; constriction broader and more swollen; palate broader and more arched; anterior part of rostrum broader, shorter, and less attenuate. Molariform teeth small and moderately excavated posteriorly; unicuspids broad and crowded; first and second subequal; third about half as large as second and decidedly smaller than fourth; fifth relatively large.

Measurements.—Average of 6 specimens from Raleigh, N. C.: Total length, 85.6 mm.; tail vertebræ, 31.9 mm.; hind foot, 10.7 mm.[1]

General remarks.—So far as I am aware, the only specimens extant of Bachman's *Sorex longirostris* are the half dozen collected at Raleigh, N. C., by H. H. and C. S. Brimley. These specimens, I am informed,

[1] For these measurements, taken in the flesh, I am indebted to H. H. and C. S. Brimley, of Raleigh, N. C.

were captured on high ground, while the type came from a swamp on the Santee River. The question might be raised whether the form from Dismal Swamp here described as new (*S. fisheri*) may not be the true *longirostris* instead of the one from Raleigh. The only facts at hand bearing on this point are the measurements originally recorded by Bachman; these indicate an animal even smaller than the Raleigh form, while the Dismal Swamp form is very much larger. The name *longirostris* is unfortunate, since the rostrum in this species is shorter and broader than in the common small Shrew of the Eastern States (*S. personatus*).

SOREX FISHERI sp. nov.

(Pl. IV, fig. 4.)

Type from Lake Drummond, Dismal Swamp, Virginia. Type, No. 75166 ♂ ad., U. S. Nat. Mus., Dept. Agriculture coll. Collected Oct. 11, 1895, by A. K. Fisher. Orig. No. 1800.

General characters.—Similar to *S. longirostris*, but larger; hind foot decidedly longer (12 mm. instead of 10.7 mm.); ears larger; coloration duller, that of under parts less different from upper parts; nose and ears darker; skull much larger and heavier.

Color.—Dull chestnut brown, fading to drab brown on under parts; nose, ears, and upper side of tail very dark; under side of tail pale brownish except at tip, which is dark all round.

Cranial and dental characters.—Skull and teeth similar to those of *S. longirostris*, but very much larger; whole cranium higher; palate broader; molariform teeth larger throughout.

Measurements.—Type specimen: Total length, 108 mm.; tail vertebræ, 39 mm.; hind foot, 12 mm. Average of 4 specimens from type locality: Total length, 103 mm.; tail vertebræ, 38.2 mm; hind foot, 12.2 mm.

General remarks.—Unfortunately, no specimens of *S. longirostris* from the type locality (swamps of Santee River) are at hand. The above comparison has been made with specimens from Raleigh, N. C., which are assumed to be typical.

SOREX PACIFICUS Baird.

(Pl. VII, figs. 1, 1*a*.)

Sorex pacificus Baird, in Coues' Precursory Notes on American Insectivorous Mammals, Bull. U. S. Geol. and Geog. Surv., III, 3, p. 650, May 15, 1877. Type from Fort Umpqua, Oregon.

Type locality.—Fort Umpqua, mouth of Umpqua River, Oregon.

Geographic distribution.—A narrow belt along the Pacific Coast from Point Reyes, California, to Yaquina Bay, Oregon.

General characters.—Size, largest of the American Long-tailed Shrews of the restricted genus *Sorex;* color unique, cinnamon rufous; ears conspicuous; hind foot large; tail about equal to body without head.

Color.—In summer pelage, uniform cinnamon rufous above and below; in winter pelage, everywhere darker, the upper parts darkened by dark-tipped hairs. (This pelage is sometimes assumed early.)

Cranial and dental characters.—Skull large and massive, suggesting that of *Blarina*. Brain case broad and flattened, rounded laterally. Zygomatic ridge of squamosal strongly developed, forming a horizontal shelf. First and second unicuspids subequal; third about half as large as second; fourth abruptly larger than third, but not so large as second; fifth variable, usually only slightly smaller than third, and tipped with orange.

Measurements.—Average of 10 specimens from coast of northern California and southern Oregon: Total length, 150 mm.; tail vertebræ, 63 mm.; hind foot, 17 mm.

General remarks.—*Sorex pacificus* stands alone and does not require comparison with any other species, its great size and peculiar cinnamon-rufous color serving to distinguish it at sight. Externally, when in the dark pelage, it resembles the subgenus *Atophyrax* perhaps more closely than any species of true *Sorex*.

Specimens examined.—Total number, 13, from the following localities on the Pacific Coast.

Oregon: Yaquina Bay, 1; mouth of Umpqua River (type locality), 3; Marshfield, 1; Myrtle Point, 1.

California: Crescent City, 3; Eureka (Humboldt Bay), 2; Point Reyes (Marin County), 2.

SOREX PRIBILOFENSIS sp. nov.

(Pl. IX, figs. 3, 3*a*.)

Type from St. Paul Island, Pribilof Islands, Bering Sea. Type, No. 30911, ♀ ad. Collected July 29, 1891, by C. Hart Merriam. (Alcoholic.)

General characters.—Size rather small; tail short, thick, and remarkably hairy; ears conspicuous; hind foot, 13 mm. Unicuspids greatly swollen, diminishing from before backward as in *S. personatus;* third larger than fourth. Body distinctly tricolor.

Color.—Head and a band down the back chocolate brown; sides dull ochereous buff, fading into the soiled whitish of under parts; chin, throat, and feet white; tail sharply bicolor: narrowly brown above, broadly white beneath.

Cranial and dental characters.—Skull short and thick; constriction between brain case and rostrum greatly swollen; palatopterygoids very broad. Anterior unicuspids (first, second, and third) much swollen (very broad transversely). The skull of *Sorex pribilofensis* does not require comparison with any American Shrew. Contrasted with *S. personatus*, with which it agrees in length, it is everywhere broader and heavier, the constriction between brain case and rostrum very much broader; the brain case more truncate posteriorly; the rostrum and palatopterygoids broader, and the unicuspidate teeth very much broader.

Measurements.—Type (♀ ad.): Total length, 107 mm.; tail vertebræ, 35 mm.; hind foot, 13.5 mm. Average of 5 specimens from type locality: Total length, 105 mm.; tail vertebræ, 34.5 mm.; hind foot, 13.2 mm.

SOREX MERRIAMI Dobson.

(Pl. IX, figs. 4, 4*a*; Pl. XII, figs. 10, 11.)

Sorex merriami Dobson, Monog. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 6 (type). May, 1890.

Type locality.—Fort Custer, Montana. (Type, No. $\frac{1001}{48061}$, ♀ ad., Merriam collection.) Collected December 26, 1884, by Maj. Charles E. Bendire. Original number, 635.

General characters.—Size medium (hind foot, 12 mm.); tail hardly as long as body without head; ears very large (4 mm. from crown and 5 mm. from upper base); coloration peculiar: upper parts pale; under parts, sides, and tail white or nearly white.

Color (of type specimen dried from alcohol).—Head and back ash gray or drab with a buffy tinge; sides and under parts pure white; feet and tail whitish; the latter white below and buffy white above.[1]

Cranial and dental characters.—Skull short, broad, and swollen, unlike any known American shrew. Brain case rather flat, not elevated above plane of rostrum; constriction broad and swollen; rostrum and palate remarkably broad and short. The palate is broad for the entire length of the molariform series and then contracts rather abruptly. The unicuspidate and molariform teeth are in the same plane, the usual angle being nearly obsolete. The unicuspidate series are short and slope strongly inward. The unicuspid teeth are crowded, nearly vertical, and but slightly imbricating; the second is decidedly the largest tooth; first and third subequal; fourth decidedly smaller than third; fifth minute as usual. The large upper premolar and first true molar are broadly and deeply excavated posteriorly. The middle incisor has no secondary cusp on its inner side. The mandible is short and heavy.

In some respects the skull resembles that of *S. pribilofensis*, particularly in the great breadth of the constriction; but the two hardly need comparison, the unusual breadth of the palate, flatter brain case, smaller anterior nares, larger molars, and more crowded unicuspids of *S. merriami* serving to distinguish it at a glance.

Measurements (of type specimen, a well-preserved alcoholic).—Total length, 90 mm.; tail vertebræ, 36 mm.; hind foot, 11 mm.

General remarks.—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 of my other Shrews, to Dr. George E. Dobson, who was then engaged on a monographic revision of the Soricidæ. 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

[1] In a note accompanying the specimen the collector, Major Bendire, states that the original color was different from that of the other Shrews (*S. personatus*), being "much more bluish."

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.

Subgenus MICROSOREX Baird, 1877.

Microsorex Baird, in Coues Precursory Notes on American Insectivorous Mammals, Bull. U. S. Geol. and Geog. Surv., III, 646, May 15, 1877. Type, *Sorex hoyi* Baird.

Geographic distribution.—Boreal zone from northern New England and the Maritime Provinces of Canada (on both sides of the St. Lawrence) westward to British Columbia. Not known to range southward on any of the mountain systems.

Diagnosis.—Teeth 32, as in *Sorex*, but third unicuspid minute, transversely elongated, and wedged in between second and fourth so as to be hardly visible (and often not visible) from outer side (see Pl. IX, figs. 5*a*, 5*c*). The ridge on inner side of first and second unicuspids tends to develop a small accessory cusp at base, just above the cingulum.[1] Brain case narrow, depressed, and much elongated (Pl. XII, figs. 4, 5). Mandible relatively short and heavy (Pl. IX, fig. 5*b*). The mandible, compared with that of *Sorex personatus*, is shorter and heavier, with the coronoid process upturned more nearly at right angles to the ramus. The anterior lower incisor reaches posteriorly completely under the first and second and partly under the third lateral tooth.

The subgenus is represented, so far as known, by a single species of very small size.

SOREX (MICROSOREX) HOYI Baird.

(Pl. IX, figs. 5–5*c*; Pl. XII, figs. 4, 5.)

Sorex hoyi Baird, Mammals N. Am., 32–33, Pl. XXVIII, 1857. (From Racine, Wis.)
Sorex thompsoni Baird, Mammals N. Am., 34–35, Pl. XXVII. (From Burlington, Vt.)

Type locality.—Racine, Wisconsin.

General characters.—Size small (hind foot 10.5 mm.); tail considerably shorter than body without head; third unicuspidate tooth minute, scarcely visible between second and fourth.

[1] This cusplet may be seen also in *Sorex personatus*, though commonly less developed. It is figured by Miller on page 42 of this number of N. Am. Fauna (fig. 1*c*).

Color.—Upper parts sepia brown; under parts ashy gray, washed with buffy on throat and breast, and sometimes on belly also; tail bicolor: dark brown above, whitish beneath.

Cranial and dental characters.—Skull smallest of the known American Shrews except *S. zanus* (15.5 by 6.5 mm.[1]), and differing from all in the subgeneric characters already described. The brain case is low, long, and rather narrow, the constriction relatively broad, and the rostrum medium. Viewed from below, the sides of the rostrum converge gradually, without apparent angle between the molariform and unicuspidate series. The lower jaw is relatively large and heavy, and the styliform angular process is very long. The molars do not present any marked peculiarities. The unicuspids, viewed from the outer side, seem to be three in number, the third and fifth being so minute and internal as to escape notice; in fact, in some skulls they can not be seen at all from the outer side. The middle incisors have a large inner lobe.

General remarks.—*Sorex hoyi* has been supposed to have a very restricted distribution, but the specimens secured in recent years show it to range from British Columbia on the west almost to Labrador on the east. It is the type, and, so far as known, the sole representative, of Baird's subgenus *Microsorex*, a division which in the future is likely to be raised to full generic rank.

The material now available is insufficient to determine whether or not the British Columbia form is entitled to subspecific separation.

Measurements.—Average of 3 alcoholic specimens (in good condition) from Elk River, Minn.: Total length, 81.7 mm.; tail vertebræ, 30.7 mm.; hind foot, 10.7 mm. Average of 5 alcoholic specimens from Godbout, Quebec, Canada: Total length, 83 mm.; tail vertebræ, 32 mm.; hind foot, 10.5 mm. A single alcoholic specimen from Fort St. James, Stuart Lake, British Columbia, measures: Total length, 88 mm.; tail vertebræ, 31 mm.; hind foot, 9.5 mm.

Specimens examined.—Total number, 23, from the following localities:

Canada: Godbout, Quebec, 5; Digby, Nova Scotia, 1; Red River Settlement, Manitoba, 1; Fort St. James (Stuart Lake), British Columbia, 1.
Minnesota: Elk River, 11.
North Dakota: Devils Lake, 1.
New York: Locust Grove, Lewis County, 3.

Subgenus NEOSOREX Baird, 1857.

Neosorex Baird, Mammals N. Am. p. 11, Pl. XXVI, 1857. Type, *Neosorex navigator* Baird.

Geographic distribution.—The Sierra Nevada of California, the Rocky Mountains from Colorado northward, and boreal parts of eastern North America from plains of North Saskatchewan to Minnesota, the Adiron-

[1] A very old skull from Locust Grove, N. Y., measures only 14 by 5.8 mm., and is the smallest Shrew skull I have ever seen. A young adult from the same locality measures 15 by 6.5. mm.

dacks of New York, northern New England, and eastern Canada on both sides of the St. Lawrence.

Diagnosis.—Feet large; hind foot very long, broad, somewhat oblique, and fimbriate for swimming; toes all fimbriate, the third and fourth united at base and slightly webbed.

The known members of the subgenus are of large size (much larger than any species of true *Sorex*), have long tails, and are white underneath at least part of the year. I am not aware of any cranial or dental characters by which *Neosorex* may be distinguished from *Sorex*, although the brain case is unusually broad and broadens abruptly from the rostrum, as in *Atophyrax*.

Number of representatives.—Three members of the subgenus *Neosorex* have been described: (1) *palustris*, from the region between the Rocky Mountains and Hudson Bay; (2) *navigator*, from the Rocky Mountains and Sierra Nevada; and (3) *albibarbis*, from the mountains of northern New England and northern New York. Still another species, *Sorex hydrodromus* Dobson, from Unalaska Island, is here referred to *Neosorex*, though I have not seen specimens, and its exact affinities are uncertain.

SOREX (NEOSOREX) PALUSTRIS Rich.

(Pl. X, figs. 5-7.)

Sorex palustris Richardson, Zool. Jour., III, No. 12, p. 517, January to April, 1828.

Type locality.—Marshy places from Hudson Bay to the Rocky Mts.

Geographic distribution.—Parts of the Boreal zone from Minnesota to the east base of the Rocky Mountains.

Habitat.—Streams, lakes, and marshes.

General characters.—Size very large (total length, 155 mm. or more; hind foot, 19 to 20 mm.); tail long; coloration of body and tail sharply bicolor; unicuspids broad.

Color.—Upper parts dusky, finely mixed with hoary; under parts dull white, sometimes clouded across breast and in anal region; tail sharply bicolor: blackish above and all round near tip, white below, the white narrower than the black; feet dark on outer side, whitish on inner side.

Cranial and dental characters.—(Specimen No. 69177, ♂ ad., from South Edmonton, Alberta). Skull large (22.5 by 10.2 mm.); brain case elevated decidedly above plane of rostrum; palate and postpalatal notch rather broad. Molariform teeth large and heavy, deeply excavated posteriorly. Unicuspidate teeth only slightly imbricating, the first and second subequal and very broad (transverse diameter equal to or greater than antero-posterior); third abruptly very much smaller; fourth much larger than third and about two-thirds size of second.

Measurements.—Richardson's measurements of the species are: Total length, 155 mm.; tail vertebræ, 65.5 mm.; hind foot, 19 mm. A specimen from Edmonton, Alberta, collected by J. Alden Loring, measured

in the flesh: Total length, 157 mm.; tail vertebræ, 68 mm.; hind foot, 20 mm.—a remarkably close agreement.

General remarks.—*Sorex palustris* requires comparison with two closely related forms which it separates geographically, and with both of which it probably intergrades—*S. albibarbis* of the mountains of northern New England and New York (and probably Ontario also), and *S. navigator* of the Rocky Mountains and Sierra Nevada. From the former it may be distinguished by its white belly and sharply bicolor tail at all seasons; from the latter by larger size, darker color of upper parts, and much broader unicuspids.

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

Alberta: South Edmonton, 1.
Minnesota: Tower (Vermilion Lake), 1; Elk River, 7.

SOREX (NEOSOREX) PALUSTRIS NAVIGATOR Baird.

(Pl. XI, figs. 1-6.)

Neosorex navigator (Cooper MS.) Baird, Mam. N. Am., pp. 11-12, Pl. XXVI, 1857.
Sorex palustris Merriam, N. Am. Fauna No. 5, p. 35, August, 1891. (Idaho.)

Type locality.—Unknown; probably northern Idaho.[1]

Geographic distribution.—The Rocky Mountains and outlying ranges from British Columbia to southern Colorado, and the Sierra Nevada of California south to the Sequoia National Park.

Habitat.—Mountain streams.

General characters.—Similar to *N. palustris*, but decidedly smaller; coloration more plumbeous.

Color.—Upper parts plumbeous, finely mixed with hoary; under parts varying from silvery white to dull white, often clouded across the breast and on anal region; tail sharply bicolor: dusky above and all round near tip, white below.

Cranial characters.—Skull and teeth similar to those of *palustris*, but decidedly smaller (skull of type 20.5 by 9.6 mm.); brain case flatter; palate and interpterygoid fossa narrower. Unicuspidate teeth narrow (transverse diameter much less than antero-posterior instead of greater).

[1]Baird gave the locality of the type specimen as Fort Vancouver, Wash. But Dr. Cooper, who collected it, states: "According to the label now attached [this specimen] 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." 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 probably 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.

Measurements.—Baird's measurements of the alcoholic type specimen are, approximately: Total length, 127 mm.; tail vertebræ, 72 mm.; hind foot, 20 mm. The total length is much too small, due to the contraction of the body in alcohol. Average of 8 specimens from Pryor Mountains, Montana: Total length, 148.4 mm.; tail vertebræ, 71.5 mm.; hind foot, 20.4 mm. Average of 12 specimens from Cottonwood Meadows, Mount Whitney, California: Total length, 159.2 mm.; tail vertebræ, 76 mm.; hind foot, 20.2 mm.

General remarks.—*Neosorex navigator* fluctuates considerably in size in the various mountain ranges it inhabits, and seems to intergrade completely with *S. palustris*. Specimens from the Bighorn and Wind River mountains in Wyoming are fairly intermediate, and it is probable that intergrades will be found along the east base of the Rocky Mountains in Alberta. Typical *palustris* occurs on the plains at Edmonton, Alberta, while unmistakable *navigator* is found in the Rocky Mountains at Banff and Henry House, Alberta.

The palate is relatively narrower in the type specimen; broader in specimens from most parts of the Rocky Mts. and the Sierra Nevada.

Specimens examined.—Total number, 77, from the following localities:

British Columbia: Nelson, 3.

Alberta: Banff, 2; Henry House, Rocky Mountains, 1.

Montana: Pryor Mountains, 8; Upper Stillwater Lake, 1; Flathead Lake, 5; Paola (Great Northern Railroad), 1; St. Marys Lakes, 1; Bear Tooth Mountains, 1; Red Lodge, 3.

Idaho: Head of Crow Creek, 1; Head of Wood River, 1; Salmon River Mountains, 5; Birch Creek, 6; Saw Tooth Lake, 3.

Wyoming: Bighorn Mountains, 1; Wind River Mountains, 2.

Utah: Wasatch Mountains, 6; Park City, 1.

Colorado: Gold Hill, Boulder County, 2; Cochetope Pass, 1.

California (Sierra Nevada): Upper Cottonwood Meadows (near Mount Whitney), 12; Independence Creek, 2; Sequoia National Park, 3; Lone Pine, 5.

SOREX (NEOSOREX) ALBIBARBIS (Cope).

Neosorex albibarbis Cope, Proc. Acad. Nat. Sci. Phila., 188–189, 1862.
Sorex albibarbis Merriam, Proc. Biol. Soc. Wash., VII, 25, April, 1892.
Miller, Proc. Bost. Soc. Nat. Hist., XXVII, March 24, 1894.

Type locality.—Profile Lake, Franconia Mountains, New Hampshire.

Geographic distribution.—Boreal parts of eastern North America from mountains of Pennsylvania and New York northward to Labrador.

General characters.—Similar to *S. palustris* in size and general appearance, but with under parts strongly clouded with dusky.

Color.—Upper parts blackish slate very sparingly mixed with light-tipped hairs; chin whitish or grayish, rest of under parts heavily clouded with dusky, the intensity varying with the season. Tail bicolor: blackish above and all round near tip, whitish below on basal half or two-thirds.

Cranial and dental characters.—Skull and teeth similar to those of *S. palustris*, but slightly smaller. The anterior unicuspids are narrower,

and the molariform teeth less deeply excavated posteriorly. In size the skull and teeth are intermediate between *palustris* and *navigator*.

Measurements.—Average of 2 specimens from type locality (Profile Lake, New Hampshire): Total length, 153 mm.; tail vertebræ, 66.6 mm.; hind foot, 19 mm. Average of 7 specimens from Elizabethtown, N. Y.: Total length, 154.7 mm.; tail vertebræ, 71.3 mm.; hind foot, 19.3 mm.

General remarks.—In winter pelage the under parts are less clouded than in summer and the resemblance to *S. palustris* is correspondingly closer. The two may be found to intergrade in the region north of Lakes Huron and Superior.

Specimens examined.—Total number, 5, from the following localities:

New Hampshire: Profile Lake (type locality), 1.
New York: Elizabethtown (east side of Adirondacks), 2.
Pennsylvania: Bushkill Creek, Monroe County, 1.
Canada: Godbout, Province of Quebec (north shore of St. Lawrence), 1.

SOREX HYDRODROMUS Dobson.

Sorex hydrodromus Dobson, Annals and Magazine Nat. Hist., 6th ser. IV, 372-374, fig., November, 1889.

Type locality.—Unalaska Island, Aleutian Islands, Alaska.

General characters.—Size small (hind foot, 13 mm.); third incisor larger than fourth; both fore and hind feet fringed on both sides. "A thick comb-like fringe of stiff hairs extends along the outer and inner margins of both manus and pes, being especially dense and well developed along the outer margins."

Color.—"Fur reddish brown above, yellowish brown beneath; chin, throat, and chest with grayish-tipped hairs; the base of the hairs both above and beneath dark bluish gray."[1]

Dental characters.—"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 sides of the fourth maxillary tooth. The mandibular teeth closely resemble those of *S. vulgaris*."*

Measurements.—"Length: Head and body, 53 mm.; tail, 46 mm.; eye, from end of muzzle, 9½ mm.; ear, length, 6½ mm.; elbow, to end of middle digit, without claw, 13 mm.; manus, 6 mm.; pes, 13 mm.; distance between tips of first upper incisor and last premolar, 3½ mm."*

General remarks.—This interesting aquatic Shrew was described by Dr. Dobson from a specimen in the Museum of the Imperial Academy

[1] Dobson, Annals and Magazine Nat. Hist., 6th ser., IV, 373, November, 1889.

of Sciences at St. Petersburg. It is the only American species of the family *Soricidæ* (except *Sorex veraepacis*, from Guatemala) that I have not seen. Its position in the series is uncertain.

Subgenus ATOPHYRAX Merriam, 1884.

Atophyrax Merriam, Trans. Linn. Soc. New York, Vol. II, pp. 217-222, pl. August, 1884. Type, *Atophyrax bendirii* Merriam, from Klamath Basin, Oregon.

Geographic distribution.—The subgenus *Atophyrax* inhabits the northwest coast region from western British Columbia southward to Sonoma County, Calif. In Oregon and Washington it reaches the east base of the Cascade range; in California it is confined, so far as known, to the coast strip north of Point Reyes.

Diagnosis.—Feet large and fimbriate, with third and fourth toes of hind foot webbed at base, as in *Neosorex*. Anterior part of rostrum narrowed, much produced and decurved, forming, with the under jaw, a toothed forceps for seizing living prey. Brain case expanded laterally, as in *Neosorex*. The unicuspidate series are parallel, or nearly parallel, and in the known forms the teeth are narrow and arranged in pairs of approximately equal size—first and second subequal and largest, third and fourth subequal and smaller, the third slightly smaller than fourth. The fifth is large for a Shrew, and when unworn bears a colored cusp, which is sometimes double or bifid. The large anterointernal cusp of m^1 and m^2 rises posteriorly to form a distinct secondary cusp, not present in the other subgenera. This secondary cusp, which is diagnostic of *Atophyrax*, is separated by a sulcus from the large triangular cusp developed on the cingulum of the posterior half of the inner side of the tooth. The extreme of differentiation of the group is exhibited by *A. palmeri*, from the mouth of the Columbia River.

Number of representatives.—Three well-marked forms of *Atophyrax* are contained in the Department collection: (1) *A. bendirii*, ranging from Burrard Inlet, British Columbia, southward along the Cascade range to southern Oregon, and thence southwesterly to and along the coast of northern California; (2) *palmeri*, from the coast of Oregon at the mouth of the Columbia River; and (3) *albiventer*, from the Olympic Mountains of Washington. Still another may require subspecific recognition, namely, a form from the coast of California in Mendocino County. Additional material is necessary to determine the interrelations of the several forms.

SOREX (ATOPHYRAX) BENDIRII (Merriam).

(Pl. X, figs. 1-4.)

Atophyrax bendirii Merriam, Trans. Linn. Soc. New York, II, 217-225, Aug., 1884.

Sorex bendirii Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 17, and explanation (type specimen).

Type locality.—Klamath Basin, Oregon (near Williamson River, 18 miles southeast of Fort Klamath).

Geographic distribution.—Klamath Basin, Oregon, and thence northward along east side of Cascade range to Puget Sound (Port Moody, British Columbia); westward (probably through Klamath River Valley) to coast of California, and southward to Sonoma County.

General characters.—Size, large (total length, 150 mm.; head and body, 82 mm.; hind foot, 20 mm.); tail long; coloration uniform sooty or sooty brown, sometimes paler below.

Color.—Dull sooty plumbeous, changing in worn pelage to sooty brown, faintly paler on under parts; tail dusky all round. Some of the specimens from Easton and Port Moody have the under parts decidedly pale, suggesting a seasonal difference.

Cranial and dental characters.—The characters by which *Atophyrax* differs from *Sorex* and *Neosorex* have been given in the subgeneric diagnosis and need not be repeated here. The skull of *S. bendirii* differs from those of *palmeri* and *albiventer*, the only other members of the subgenus now known, in the following particulars: Size smaller (total length, 22.5 mm.); anterior narrow part of rostrum shorter; brain case shorter; interpterygoid notch broader; unicuspidate series slightly more divergent posteriorly; molars narrower.

Measurements.—Type specimen (measured from alcohol, in good condition): Total length, 150 mm.; tail vertebræ, 68 mm.; hind foot, 20 mm. Average of 3 specimens from Mendocino County, Calif. (measured in flesh): Total length, 150.3 mm; tail vertebræ, 69.7 mm.; hind foot, 19.7 mm.

General remarks.—The type of *Atophyrax bendirii* was collected in Klamath Basin, Oregon, by Capt. (now Major) C. E. Bendire, and was described by me eleven years ago. The next specimens examined were from Chilliwack, British Columbia, collected by Mr. A. C. Brooks. Subsequently the field naturalists of the division extended the range of the species southward along the coast of California to Gualala, and northward along the Cascade range to Port Moody, on Burrard Inlet, British Columbia. Two additional forms, believed to intergrade with *bendirii*, and hence treated as subspecies, have been discovered and are here described: *palmeri*, a large black form from the coast of Oregon at Astoria; and *albiventer*, a white-bellied form from the Olympic Mountains of Washington. In addition to these, the form from Gualala, Calif., differs somewhat from typical *bendirii*, and if the characters shown by the only two specimens at hand prove constant, will also merit subspecific separation. The two specimens referred to differ from all other American Shrews in having the fifth unicuspidate tooth unusually large and with a double cusp. The peculiarity would seem to be abnormal, but is constant in the two specimens examined. The unicuspidate teeth are more crowded, so that the series as a whole is shorter and the cingulum does not reach so far backward. The large upper premolar and first true molar are more deeply excavated posteriorly, and the third and fourth unicuspids larger.

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

British Columbia: Port Moody, 7; Chilliwack, 2.
Washington: Easton (Cascade range), 8.
Oregon: Klamath Basin, 1 (type).
California: Mendocino County, 1; Gualala, 2.

SOREX (ATOPHYRAX) BENDIRII PALMERI subsp. nov.

(Pl. XII, figs. 1-3.)

Type from Astoria, Oregon. Type No. $\frac{17338}{24263}$, ♀ old, U. S. Nat. Mus., Department of Agriculture collection. Collected July 29, 1889, by T. S. Palmer. Orig. No. 256.

Geographic distribution.—Coast of Oregon and Willamette Valley; limits of range unknown.

General characters.—Similar to *S. bendirii*, but larger (total length, 165 mm.; head and body, 92 mm.); blacker; skull heavier.

Color.—Upper parts glossy black, changing gradually to sooty plumbeous on under parts; tail dusky all round. The black of the upper parts is less pure on the head and shoulders, where the brownish subapical part of the fur shows through.

Cranial and dental characters.—Contrasted with *S. bendirii* the skull of *palmeri* is larger and heavier (type measures 24.5 by 11.5 mm.), with narrower interpterygoid fossa, and larger and heavier teeth. The unicuspids and molars are relatively as well as actually broader. The first unicuspid is appreciably larger than second; third and fourth subequal, but third slightly the smaller. Unicuspid series with middle incisor longer than molariform series.

Measurements.—Type specimen: Total length, 165 mm.; tail vertebræ, 73 mm.; hind foot, 20 mm.

General remarks.—A specimen from Beaverton, in the Willamette Valley, is practically indistinguishable from the type, but one from Oregon City (collected October 21) is more dark slate color without pure black.

Specimens examined.—Total number, 3, from the following localities in Oregon: Astoria (type locality), 1; Beaverton, 1; Oregon City, 1.

SOREX (ATOPHYRAX) BENDIRII ALBIVENTER subsp. nov.

Type from Lake Cushman, Olympic Mountains, Washington. Type, No. 66198, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected July 7, 1894, by C. P. Streator. Original number, 4021.

General characters.—Similar to *S. bendirii*, but larger, with tail decidedly longer, and under parts abruptly whitish; skull and teeth larger.

Color.—Upper parts sooty plumbeous; under parts abruptly white or whitish (as in *Neosorex*), clouded with dusky on breast and middle of belly. In one pelage the clouding below spreads over nearly the whole of the under parts. Tail blackish, indistinctly and narrowly paler below basally.

Cranial and dental characters.—Skull decidedly larger than *bendirii* (23.5 by 10.5. mm.); molariform teeth about the same size; unicuspidate teeth less crowded and series longer; second unicuspid smaller than first. The skull is intermediate in size between *bendirii* and *palmeri*.

Measurements.—Type specimen: Total length, 166 mm.; tail vertebræ, 78 mm.; hind foot, 20.5 mm. Average of 3 specimens from type locality (Lake Cushman, Washington): Total length, 160.3 mm.; tail vertebræ, 73.3 mm.; hind foot, 20.5 mm. One of these has a short tail. The average of the other 2 is: Total length, 165 mm.; tail vertebræ, 78 mm.; hind foot, 21 mm.

General remarks.—So far as known *albiventer* is restricted to the Olympic Mountains. Its large feet indicate that it is more aquatic than the other members of the group. The white of the under parts is much more marked than in the Easton and Port Moody specimens of *bendirii*, and the tail is considerably longer.

ADDENDUM.

While this paper is passing through the press, a remarkable new species of *Sorex* proper has been received from southern Mexico, and is here described.

SOREX STIZODON sp. nov.

Type from San Cristobal, Chiapas, Mexico, No. 75885, ♀ ad. U. S. Nat. Museum, Dept. of Agriculture Coll. Collected Sept. 25, 1895, by E. W. Nelson and E. A. Goldman. Orig. No. 8473.

General characters.—Similar to *S. saussurei* in external appearance, but slightly smaller, and rump not decidedly darker than rest of back.

Color.—Upper parts finely mixed sepia brown and dusky; under parts seal brown, passing insensibly into color of sides and back; tail indistinctly bicolor, dusky above, pale below.

Cranial and dental characters.—Skull similar to that of *saussurei* in general form, great breadth of constriction and breadth of palate; but shorter and broader, with brain case more inflated and rostrum shorter. First and second unicuspids large, the second much larger than first and relatively larger than in any other member of the genus known to me. Contrasted with *saussurei* the molariform teeth are decidedly smaller and less emarginate posteriorly. The chestnut tips to all the teeth are reduced to a minimum and very pale.

Measurements.—The flesh measurements have not been received from the collector. The skin measures as follows: Total length, 105; tail vertebræ, 38; hind foot, 12.

INDEX.

[Names of synonyms are in italics.]

PLATE I.

[All double natural size.]

FIG. 1. *Blarina carolinensis* (Bach). Columbia, S. C.
(No. 71471, U. S. Nat. Mus.)

2–4. *Blarina brevicauda* (Say). Blair, Nebr. (type locality).
(No. 48830, U. S. Nat. Mus.)

5–6. *Blarina parva* (Say). Blair, Nebr.
(No. 48025, U. S. Nat. Mus.)

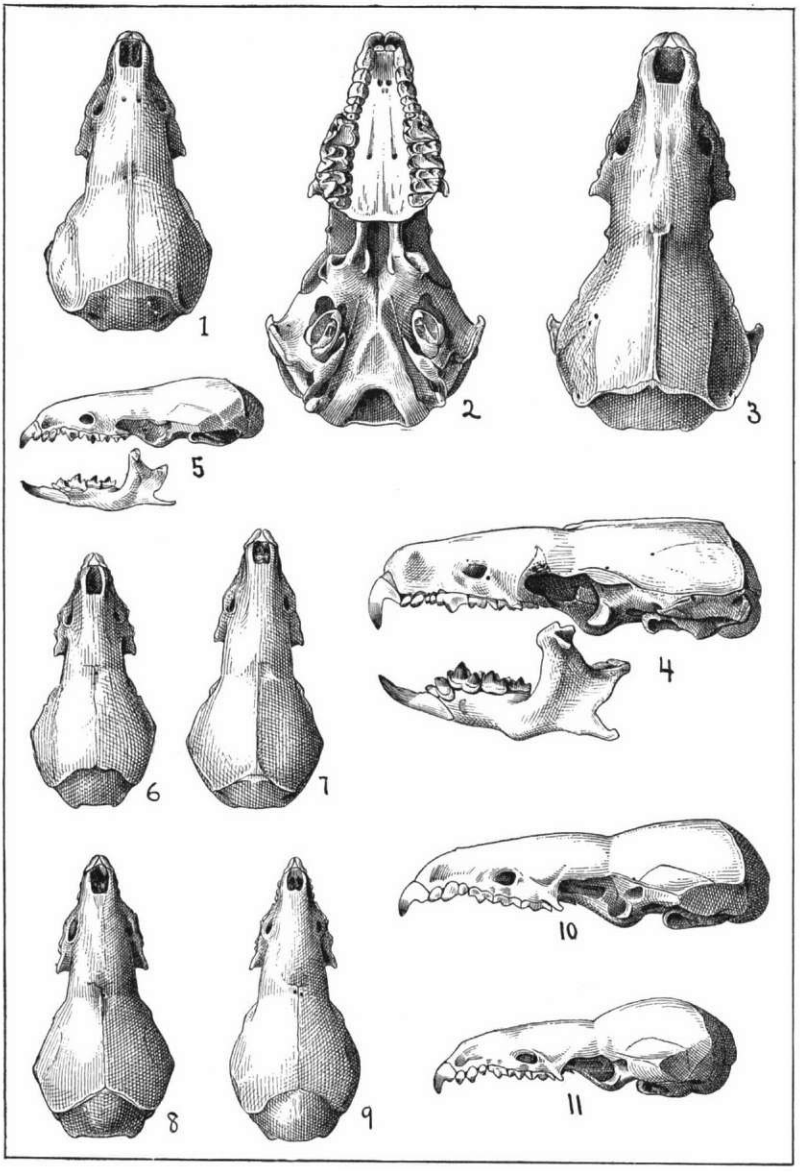
7. *Blarina floridana* nob. Canaveral, Fla.
(No. 23937, U. S. Nat. Mus.)

8. *Blarina tropicalis*. Pluma, Oaxaca, Mexico.
(No. 71452, U. S. Nat. Mus.)

9. *Blarina soricina* nob. Tlalpam, Valley of Mexico.
(No. 50761, U. S. Nat. Mus.)

10. *Blarina magna* nob. Totontepec, Oaxaca, Mexico.
(No. 68575, U. S. Nat. Mus.)

11. *Blarina mexicana* Baird. Jico, Vera Cruz, Mexico.
(No. 55083, U. S. Nat. Mus.)



1. *Blarina carolinensis.*
2–4. *B. brevicauda.*
5, 6. *B. parva.*
7. *B. floridana.*
8. *B. tropicalis.*
9. *B. soricina.*
10. *B. magna.*
11. *B. mexicana.*

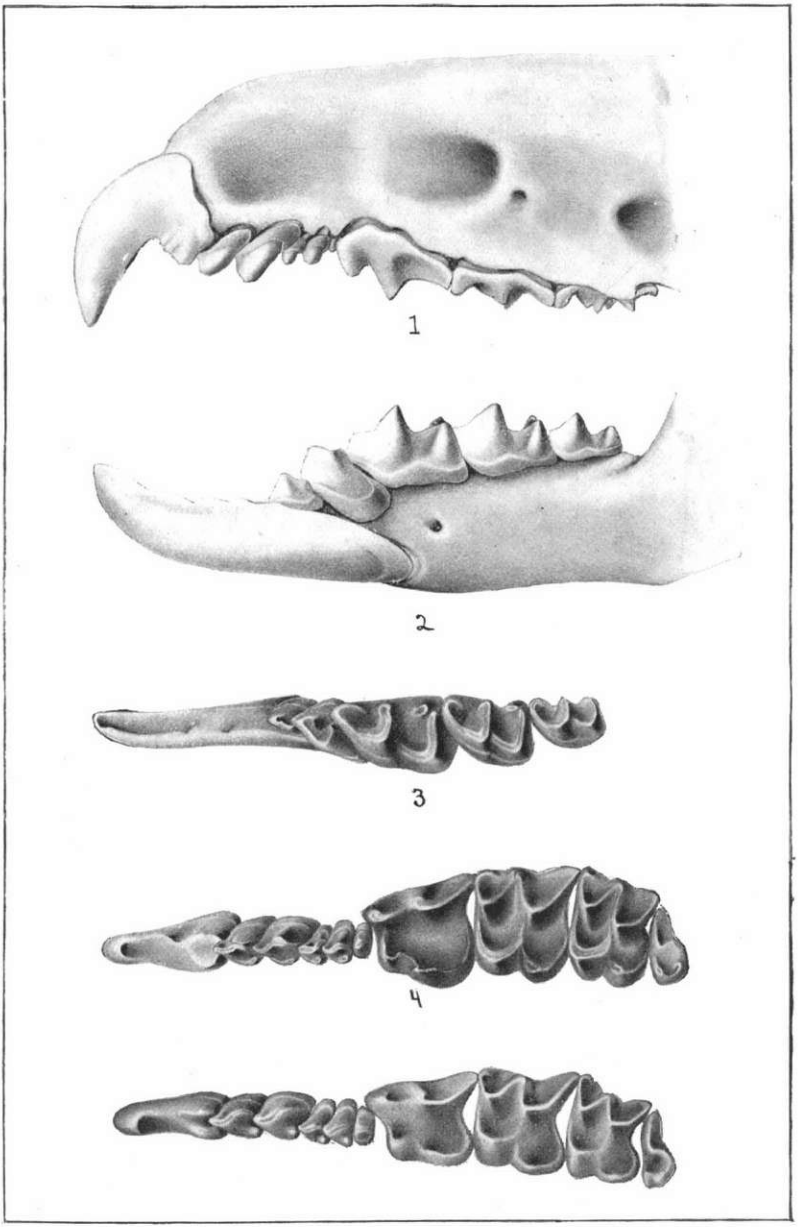
PLATE II.

[Enlarged about seven times.]

FIG. 1–4. *Blarina brevicauda* (Say). Council Bluffs, Iowa (near type locality). (No. 43765, ♀ ad., U. S. Nat. Mus.)

1. Left side of upper jaw, showing teeth.
2. Left side of under jaw.
3. Lower series of teeth, showing crowns (left side).
4. Upper series of teeth, showing crowns (left side).

5. *Blarina telmalestes* nob. Dismal Swamp, Virginia. Type. (No. 71823, ♀ ad., U. S. Nat. Mus.)
Upper series of teeth, showing crowns (left side).



1-4. *Blarina brevicauda* (Say). Council Bluffs, Iowa.
5. *B. telmalestes* nob. Dismal Swamp, Va.

PLATE III.

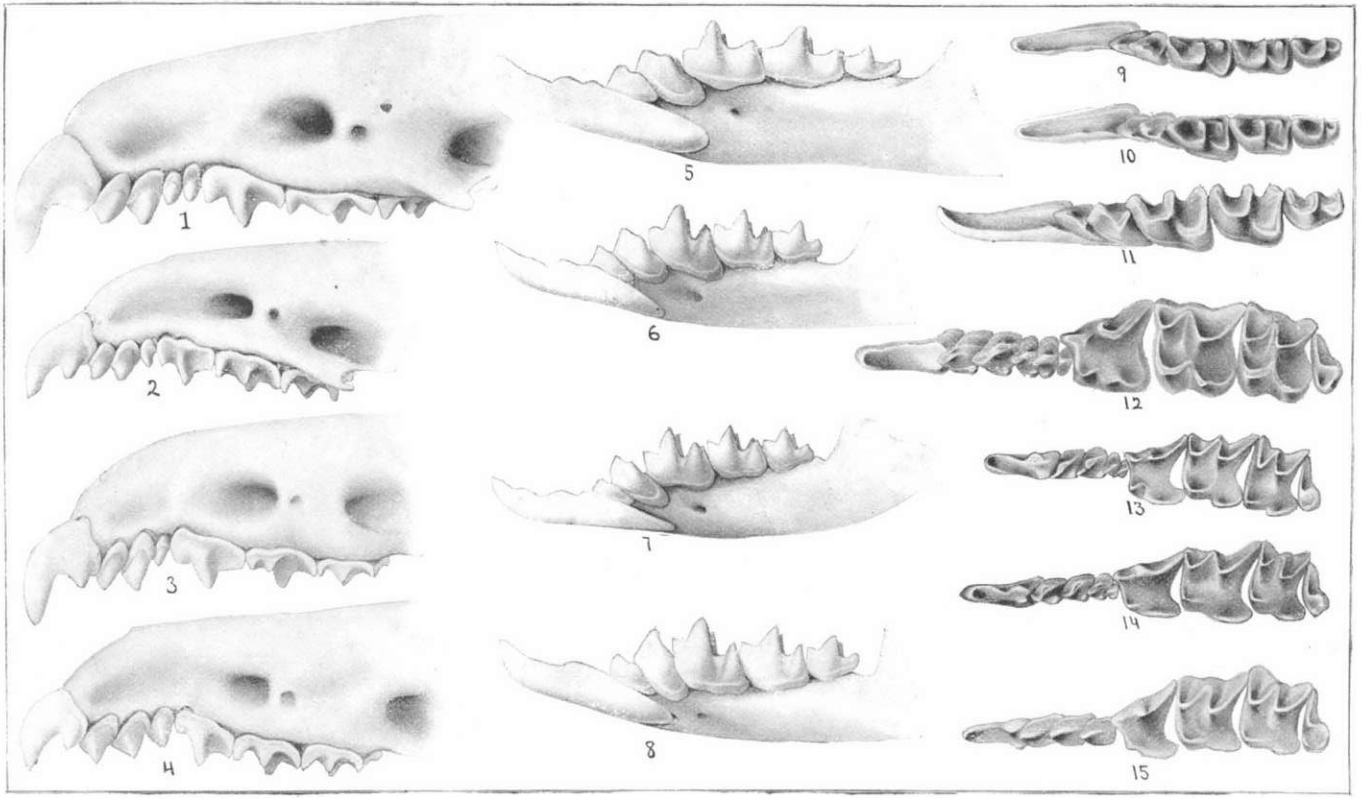
[Enlarged about seven times.]

FIGS. 1, 5, 11, 12. *Blarina carolinensis.* Raleigh, N. C.
(No. 3610, U. S. Nat. Mus.)

2, 6, 9, 13. *Blarina parva.* Blair, Nebr.
(N. 48823, U. S. Nat. Mus.)

3, 7, 10, 14. *Blarina berlandieri.* Brownsville, Tex.
(No. 48810, U. S. Nat. Mus.)

4, 8, 15. *Notiosorex crawfordi.* San Bernardino, Cal.
(No. 2661, Merriam collection.)



1, 5, 11, 12. *Blarina carolinensis.* 2, 6, 9, 13. *B. parva.* 3, 7, 10, 14. *B. berlandieri.* 4, 8, 15. *Notiosorex crawfordi.*

PLATE IV.

[All magnified above ten diameters.]

FIG. 1. *Sorex personatus.* Osler, Saskatchewan, Canada.
(Collection of E. A. and O. Bangs.)

2. *Sorex longirostris.* Raleigh, N. C.
(No. 1280, collection of G. S. Miller, jr.)

3. *Sorex longirostris.* Raleigh, N. C.
(No. 1297, collection of G. S. Miller, jr.)

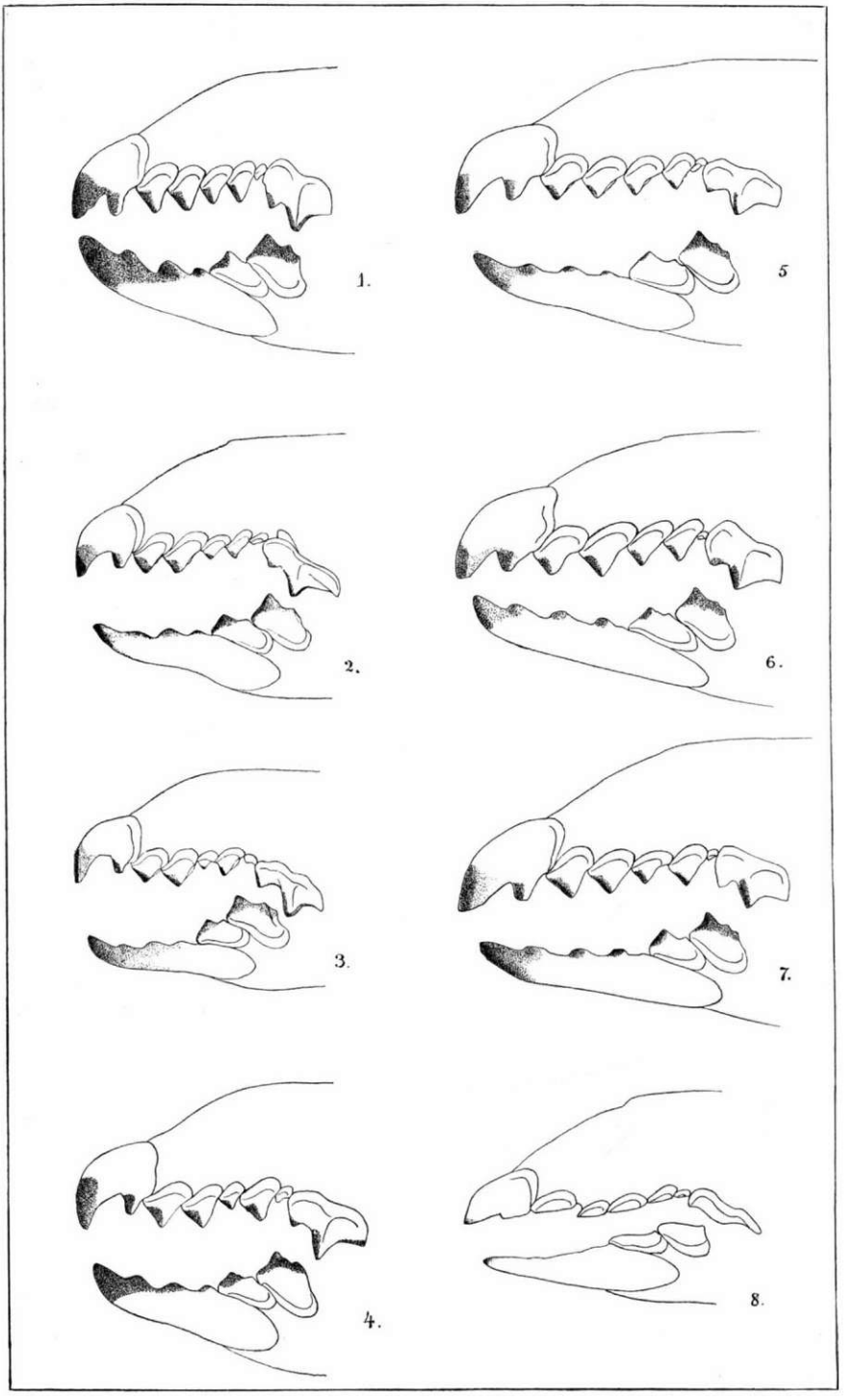
4. *Sorex fisheri.* Dismal Swamp, Virginia.
(No. 71822, U. S. Nat. Mus., Department of Agriculture collection.)

5. *Sorex personatus.* Victoria County, New Brunswick.
(No. 8035, Am. Mus. Nat. Hist.)

6. *Sorex personatus.* Victoria County, New Brunswick.
(No. 7994, Am. Mus. Nat. Hist.)

7. *Sorex personatus.* Victoria County, New Brunswick.
(No. 8022, Am. Mus. Nat. Hist.)

8. *Sorex personatus.* Nantucket, Mass.
(No. 2153, collection of G. S. Miller, jr. Teeth very much worn.)



1, 5, 6, 7, 8. *Sorex personatus.* 2, 3, *S. longirostris.* 4. *S. fisheri.*

PLATE V.

[All magnified about ten diameter

FIG. 1. *Sorex palustris.* Laramie, Wyo.
(No. 54595, U. S. Nat. Mus., Department of Agriculture collection.)

2. *Sorex albibarbis.* Elizabethtown, N. Y.
(No. 2428, collection of G. S. Miller, jr.)

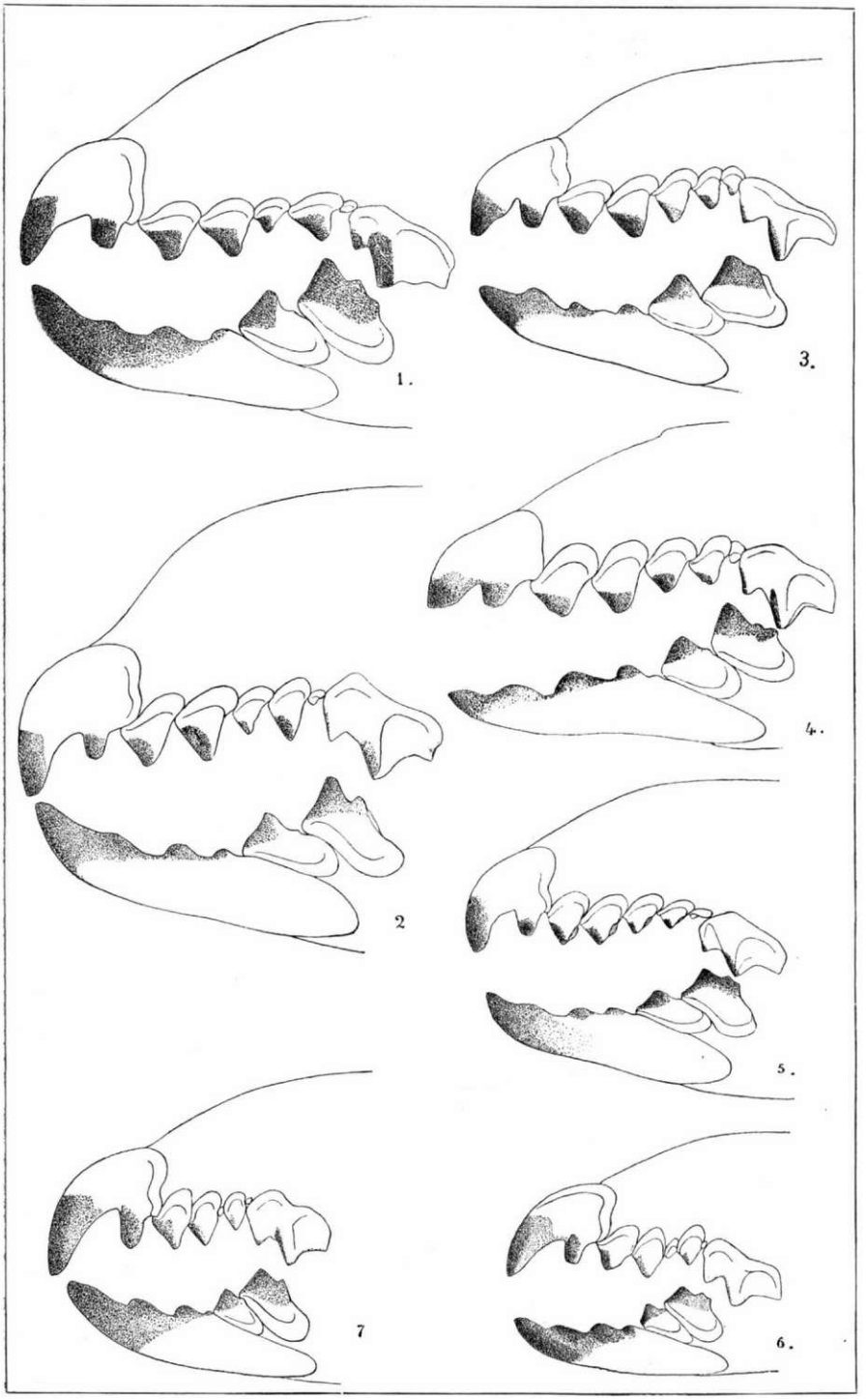
3. *Sorex araneus.* Scotland.
(No. 3598, collection of G. S. Miller, jr.)

4. *Sorex richardsoni.* Elk River, Minnesota.
(No. 2563, collection of Dr. C. Hart Merriam.)

5. *Sorex fumeus* sp. nov. Peterboro, N. Y.
(Type, No. 2582, collection of G. S. Miller, jr.)

6. *Sorex hoyi.* Victoria County, New Brunswick.
(No. 8005, Am. Mus. Nat. Hist.)

7. *Sorex hoyi.* Elk River, Minnesota.
(No. 4353, collection of Dr. C. Hart Merriam.)



1. *Sorex palustris.*
2. *S. albibarbis.*
3. *S. araneus.*
4. *S. richardsoni.*
5. *S. fumeus.*
6, 7. *S. hoyi.*

PLATE VI.

[All double natural size.]

FIG. 1. *Sorex palustris.* Laramie, Wyo.
(No. 54595, U. S. Nat. Mus., Department of Agriculture collection.)

2. *Sorex albibarbis.* Elizabethtown, N. Y.
(No. 2428, collection of G. S. Miller, jr.)

3. *Sorex araneus.* New Forest, England.
(No. 2852, collection of G. S. Miller, jr.)

4. *Sorex richardsoni.* Elk River, Minnesota.
(No. 2547, collection of Dr. C. Hart Merriam.)

5. *Sorex fumeus* sp. nov. Peterboro, N. Y.
(Type, No. 2582, collection of G. S. Miller, jr.)

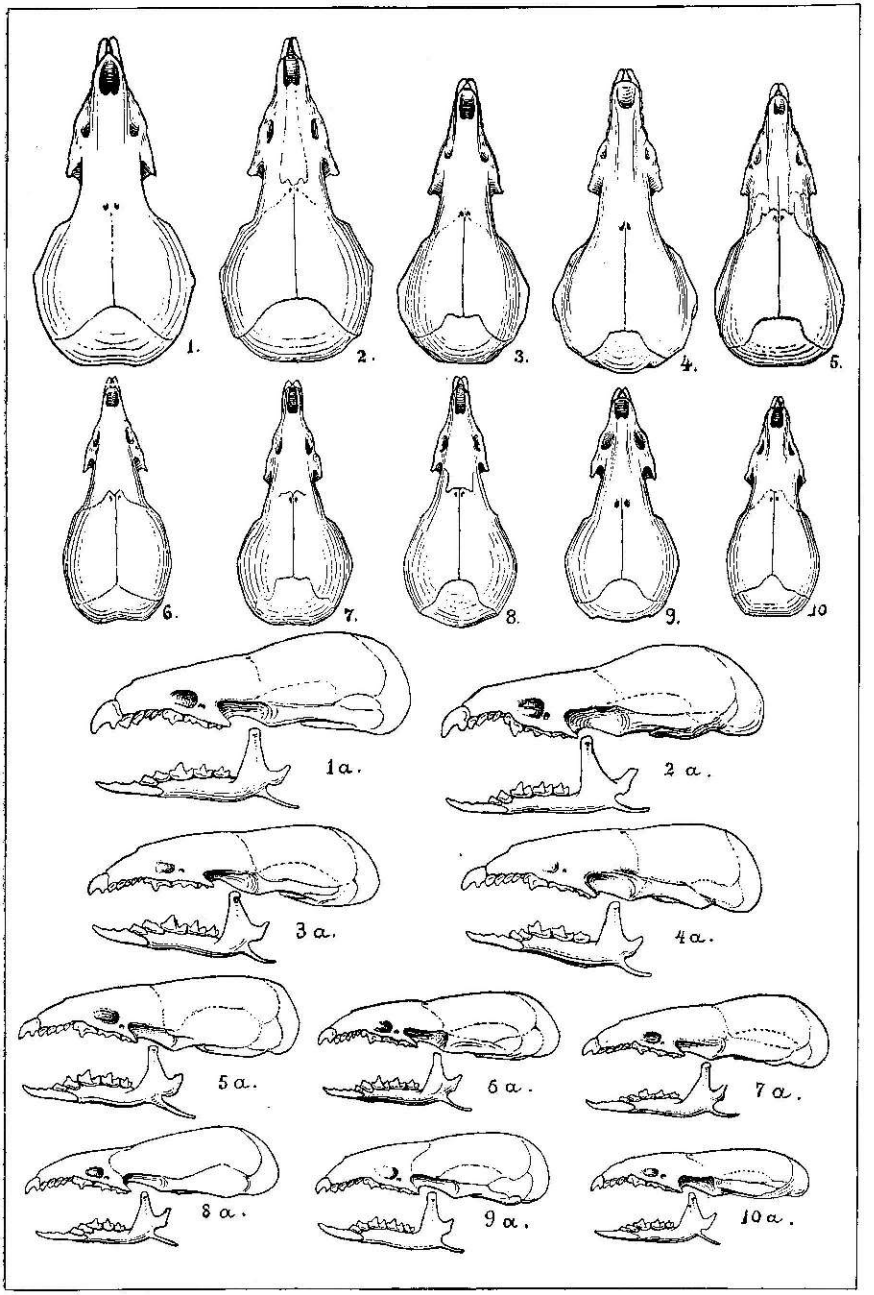
6. *Sorex minutus.* Clifton, England.
(No. 3604, collection of G. S. Miller, jr.)

7. *Sorex personatus.* Mount Graylock, Massachusetts.
(No. 2303, collection of G. S. Miller, jr.)

8. *Sorex personatus.* South Edmonton, Alberta.
(No. 69170, U. S. Nat. Mus., Department of Agriculture collection.)

9. *Sorex longirostris.* Raleigh, N. C.
(No. 1128, collection of G. S. Miller, jr.)

10. *Sorex hoyi.* Locust Grove, N. Y.
(No. 4857, collection of Dr. C. Hart Merriam.)



1. *Sorex palustris.*
2. *S. albibarbis.*
3. *S. araneus.*
4. *S. richardsoni.*
5. *S. fumeus.*
6. *S. minutus.*
7, 8. *S. personatus.*
9. *S. longirostris.*
10. *S. hoyi.*

PLATE VII.

[Enlarged about seven times.]

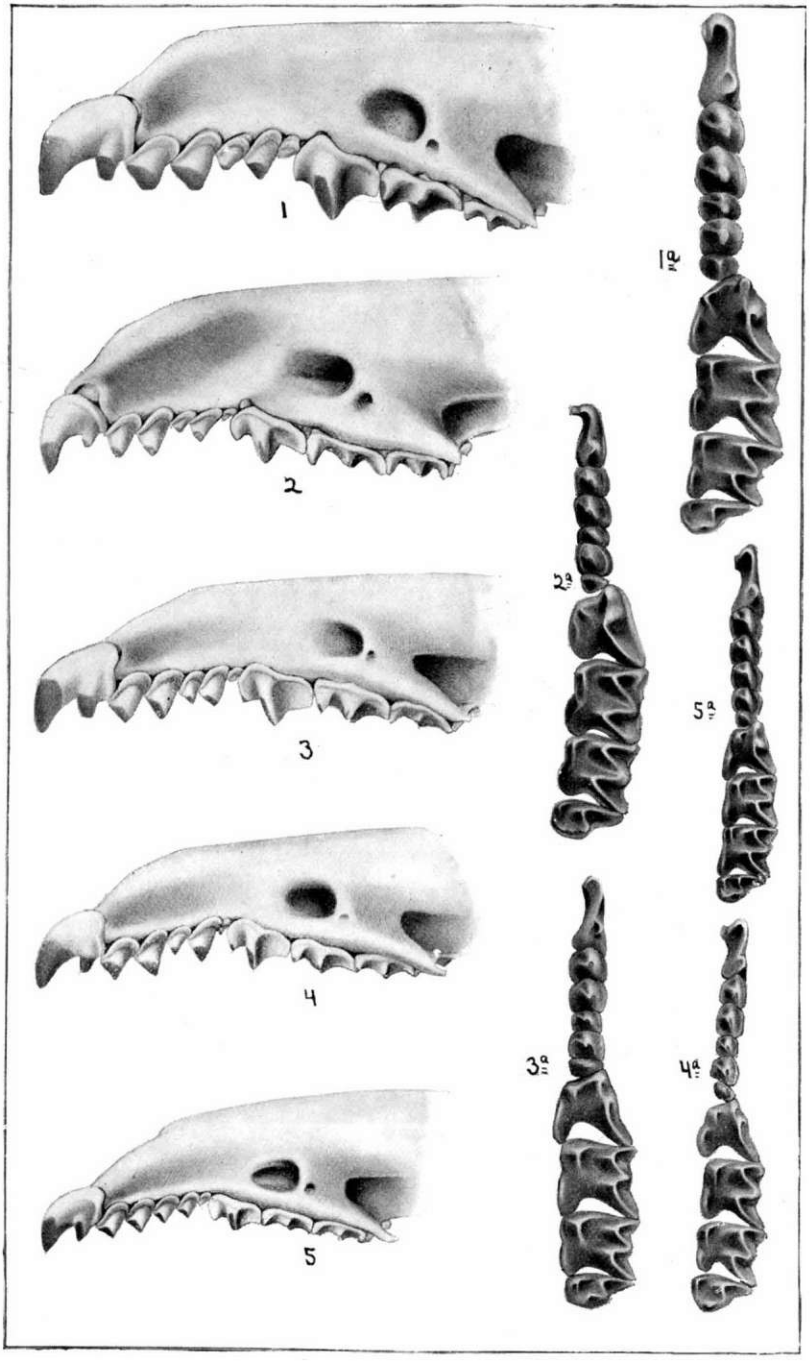
FIG. 1. *Sorex pacificus.* Crescent City, Calif.
(No. 24011, U. S. Nat. Mus.)

2. *Sorex macrodon* nob. Orizaba, Mexico. Type
(No. 58272, U. S. Nat. Mus.)

3. *Sorex bairdi* nob. Astoria, Oreg.
(No. 24318, U. S. Nat. Mus.)

4. *Sorex trowbridgii.* Astoria, Oreg.
(No. 24315, U. S. Nat. Mus.)

5. *Sorex personatus.* South Edmonton, Alberta.
(No. 69169, U. S. Nat. Mus.)



1. *Sorex pacificus.*
2. *S. macrodon.*
3. *S. bairdi.*
4. *S. trowbridgii.*
5. *S. personatus.*

PLATE VIII.

[Enlarged about seven times.]

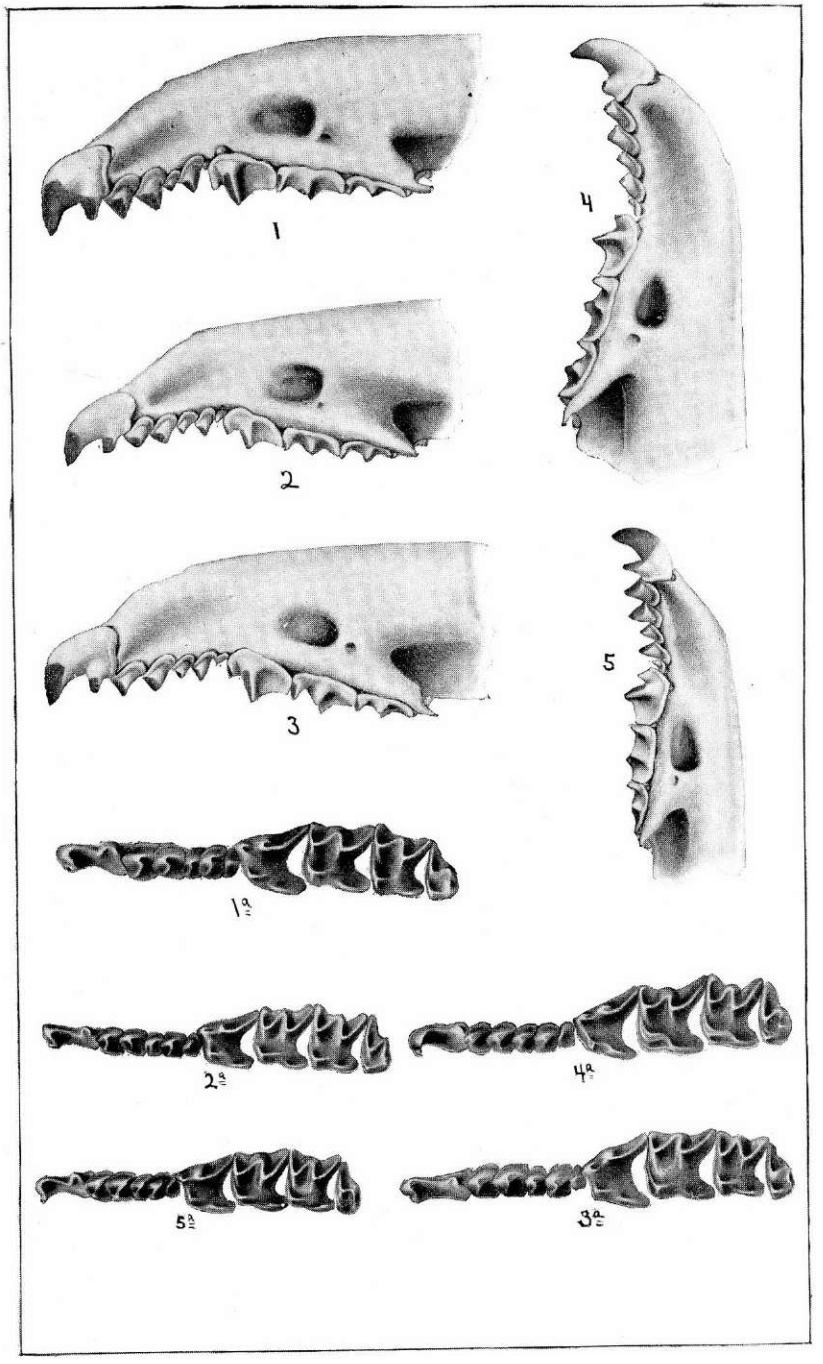
FIG. 1. *Sorex obscurus*. Salmon River Mountains, Idaho. [Type of *S. similis*.]
(No. 23525, ♀, U. S. Nat. Mus.)

2. *Sorex vagrans*. Aberdeen, Wash.
(No. 24322, U. S. Nat. Mus.)

3. *Sorex ornatus* nob. San Emigdio Canyon, California. Type.
(No. 43198, ♂ ad., U. S. Nat. Mus.)

4. *Sorex oreopolus*. Sierra Nevada de Colima, Jalisco, Mexico. Type.
(No. 45698, U. S. Nat. Mus.)

5. *Sorex tenellus nanus* nob. Estes Park, Colorado. Type.
(No. 73772, U. S. Nat. Mus.)



1. *Sorex obscurus.*
2. *S. vagrans.*
3. *S. ornatus.*
4. *S. oreopolus.*
5. *S. nanus.*

PLATE IX.

[Enlarged about seven times.]

FIG. 1. *Sorex richardsoni.* Edmonton, Alberta, Canada.
(No. 69156, U. S. Nat. Mus.)
1. Upper jaw with teeth (profile).
1*a*. Crowns of upper series of teeth.

2. *Sorex fumeus.* Lake George, New York.
(No. 55945, ♂, U. S. Nat. Mus.)
2. Upper jaw with teeth (profile).
2*a*. Crowns of upper series of teeth.

3. *Sorex pribilofensis.* St. Paul Island, Pribilof Islands, Bering Sea.
(No. 74657, U. S. Nat. Mus.)
3. Upper jaw with teeth (profile).
3*a*. Crowns of upper series of teeth.

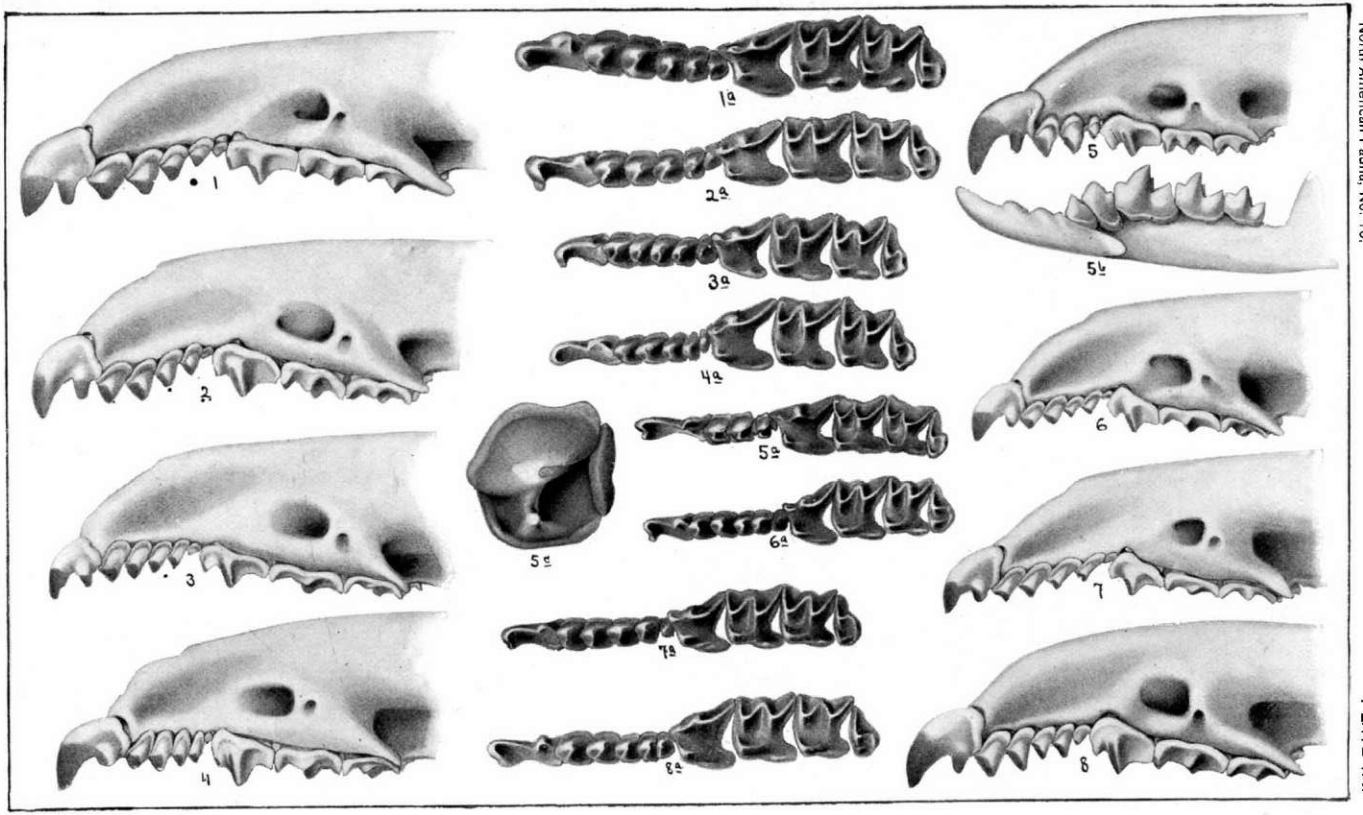
4. *Sorex merriami.* Fort Custer, Mont. Type.
(No. 4861, ♀, Merriam collection.)
4. Upper jaw with teeth (profile).
4*a*. Crowns of upper series of teeth.

5. *Microsorex hoyi.* Devils Lake, N. Dak.
(No. 4353, Merriam collection.)
5. Upper jaw (profile).
5*a*. Crowns of upper series of teeth.
5*b*. Lower jaw (profile).
5*c*. Second and third unicuspids greatly enlarged.

6. *Sorex longirostris.* Raleigh, N. C.
(No. 4635, ♀, Merriam collection.)
6. Upper jaw with teeth (profile).
6*a*. Crowns of upper series of teeth.

7. *Sorex personatus.* Montauk Point, New York.
(No. 56588, U. S. Nat. Mus.)
7. Upper jaw with teeth (profile).
7*a*. Crowns of upper series of teeth.

8. *Sorex dobsoni.* Alturas Lake, Idaho. Type.
(No. 31678, U. S. Nat. Mus.)
8. Upper jaw with teeth.
8*a*. Crowns of upper series of teeth.
NOTE.—In this specimen the third unicuspid is abnormally large.



1. *Sorex richardsoni.* 2. *S. fumeus.* 3. *S. pribilofensis.* 4. *S. merriami.* 5. *S. hoyi.* 6. *S. longirostris.* 7. *S. personatus.* 8. *S. dobsoni.*

PLATE X.

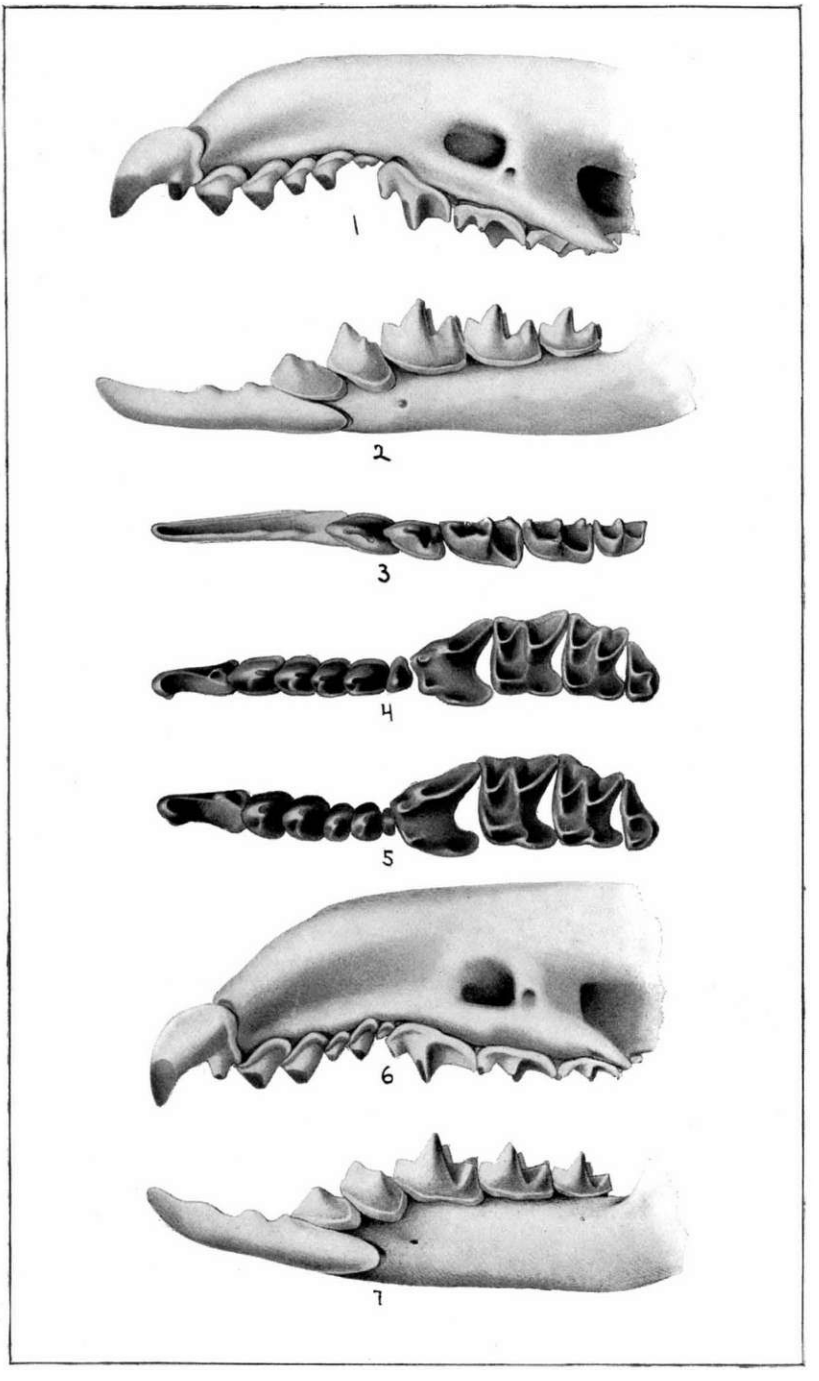
[Enlarged about seven times.]

FIGS. 1–4. *Sorex* (*Atophyrax*) *bendirii*. Easton, Wash.

1. Upper jaw (profile).
2. Lower jaw (profile).
3. Crowns of lower series of teeth.
4. Crowns of upper series of teeth.

5–7. *Sorex* (*Neosorex*) *palustris*. Elk River, Minn.

5. Crowns of upper series of teeth.
6. Upper jaw (profile).
7. Lower jaw (profile).



1–4. *Sorex* (*Atophyrax*) *bendirii*. Easton, Wash.
5–7. *Sorex* (*Neosorex*) *palustris*. Elk River, Minn.

PLATE XI.

[Enlarged about seven times.]

Sorex (*Neosorex*) *navigator*. Mount Whitney, California. Showing changes in teeth resulting from wear.

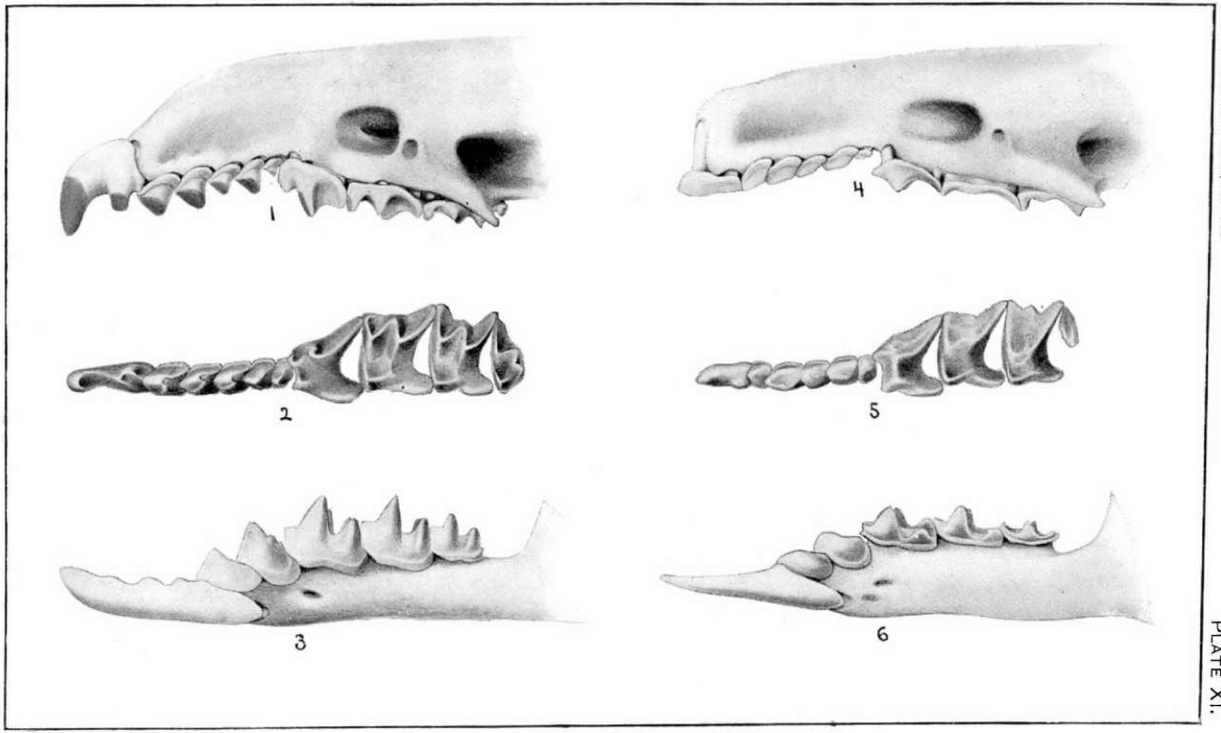
FIGS. 1–3. Young adult (No. 42412).

4–6. Very old (No. 42413).

1 and 4. Upper jaw (profile).

2 and 5. Crowns of upper series of teeth.

3 and 6. Lower jaw (profile)



Sorex palustris navigator, showing changes in teeth resulting from wear. Specimens from Mount Whitney, California.
1–3. Young adult. 4–6. Very old.

PLATE XII.

[All double natural size.]

FIGS. 1– 3. *Sorex* (*Atophyrax*) *bendirii palmeri*. Oregon City, Oregon. Type.
(No. 56898, U. S. Nat. Mus.)

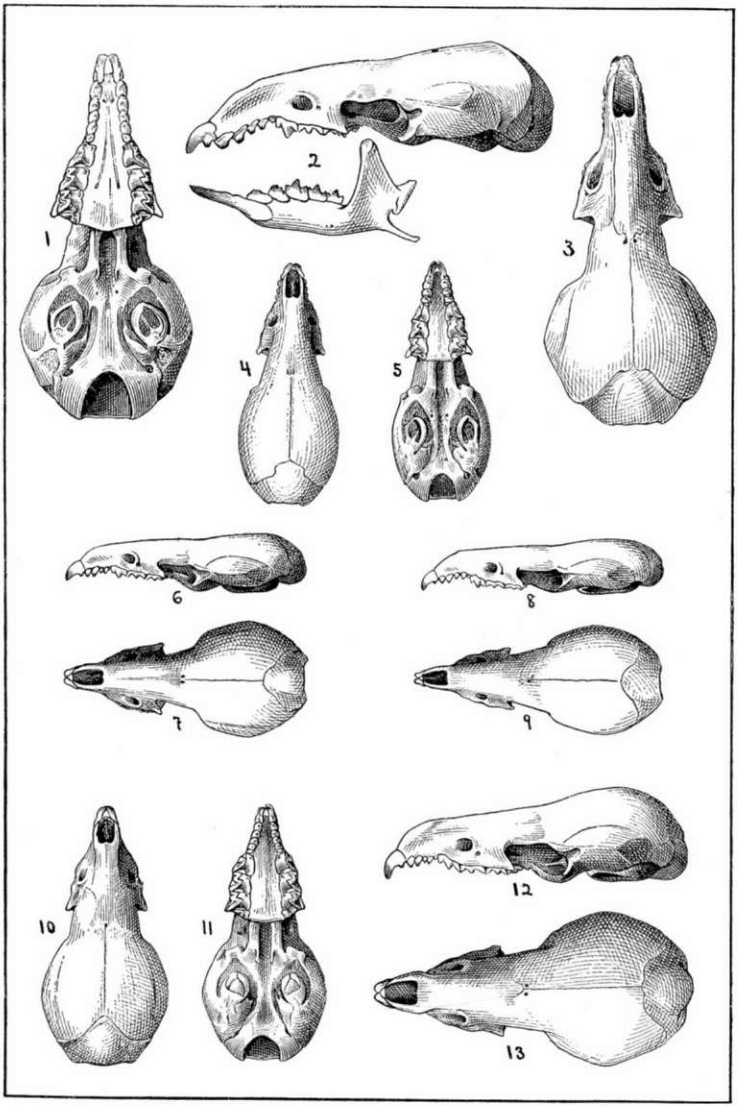
4– 5. *Sorex* (*Microsorex*) *hoyi*. Elk River, Minn.
(No. 2520, Merriam collection.)

6– 7. *Sorex californicus*. Walnut Creek, Contra Costa County, Calif.
(No. 44428, U. S. Nat. Mus.)

8– 9. *Sorex tenellus*. Lone Pine, Owens Valley, California. Type.
(No. 32495, U. S. Nat. Mus.)

10–11. *Sorex merriami*. Fort Custer, Mont. Type.
(No. 4861, ♀, Merriam collection.)

12–13. *Sorex macrodon*. Orizaba, Vera Cruz, Mexico. Type.
(No. 58272, ♂, U. S. Nat. Mus.)



1–3. *Sorex bendirii palmeri.*
4, 5. *S. hoyi.*
6, 7. *S. californicus.*
8, 9. *S. tenellus.*
10, 11. *S. merriami.*
12, 13. *S. macrodon.*