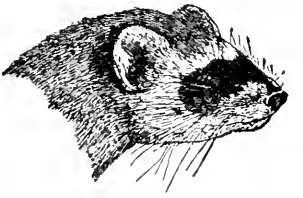
U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
E. W. NELSON, *Chief*

NORTH AMERICAN FAUNA

No. 41

[Actual date of publication, February 9, 1918]



REVIEW OF THE GRIZZLY AND BIG BROWN BEARS OF NORTH AMERICA

(GENUS URSUS)

WITH DESCRIPTION OF A NEW GENUS, VETULARCTOS

BY

C. HART MERRIAM

CONSULTING BIOLOGIST, BIOLOGICAL SURVEY
RESEARCH ASSOCIATE, SMITHSONIAN INSTITUTION

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

NORTH AMERICAN FAUNAS.

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(Continued on page 3 of cover.)

WILD GRIZZLY IN NORTHWESTERN WYOMING.

Photograph made and used by permission of Frederick K. Vreeland.

U. S. DEPARTMENT OF AGRICULTURE
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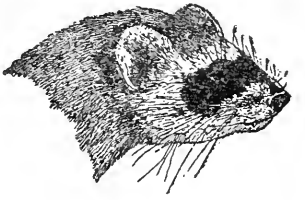

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., July 18, 1917.

SIR: I have the honor to transmit for publication as North American Fauna No. 41 a review of the grizzly and big brown bears of North America, by Dr. C. Hart Merriam, consulting biologist and former chief of the Biological Survey and research associate of the Smithsonian Institution. This review was prepared and originally submitted in September, 1916, but before composition was begun it was recalled from the printer in order that additional information, developed by the discovery of new material, might be included. The work is based largely upon material in the collection of the Biological Survey. Up to 20 years ago only 8 species of grizzly and big brown bears were known, but since then, largely through the investigations of Dr. Merriam, the number of recognizable forms has increased to 86. Additional study and material may solve certain points now in doubt, but it is not deemed advisable to delay further the publication of our present state of knowledge of this group of America's historic big game animals, now vanished from great stretches of their former domain. This review will be of material assistance to students and others interested in our native wild life, past and present.

Respectfully,

E. W. NELSON,
Chief, Biological Survey.

Hon. DAVID F. HOUSTON,
Secretary of Agriculture.

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[The plates of skulls, owing to restriction of space, are limited to the side view, and consequently in some cases are misleading. Skulls having similar profiles often differ surprisingly when viewed from above or below, as would be seen at a glance were it practicable to give two views.]

No. 41. NORTH AMERICAN FAUNA. Feb., 1918.

REVIEW OF THE GRIZZLY AND BIG BROWN BEARS OF NORTH AMERICA

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INTRODUCTION.

When Audubon and Bachman published their great work on the Mammals of North America (1846–1854), and in fact up to the year 1857, it was commonly believed by naturalists as well as by hunters and the public generally that there was only a single species of grizzly bear—the one described by Lewis and Clark in 1804–5, and named *Ursus horribilis* by Ord in 1815. Baird, in 1857, described another species, from Coppermines, New Mexico, which he named *Ursus horriæus.*

Nearly 40 years later, in my "Preliminary Synopsis of the American Bears,"[1] eight grizzlies and big brown bears were recognized, of which five were described as new. It was not then suspected that the number remaining to be discovered was anything like so great as has since proved to be the case. The steady influx of specimens resulting from the labors of the Biological Survey, supplemented by the personal efforts of a number of hunter-naturalists, brought to light many surprises, most of which have been published; and beginning in the spring of 1910, a fund placed at my disposal made it possible to offer hunters and trappers sufficient inducement to tempt them to exert themselves in securing needed specimens. As a result, the national collection of bears has steadily grown until, in number of species represented, in completeness of series, and in number of type specimens, it now far excels all other collections in the world together. Nevertheless there are many gaps in the series.

[1] Proc. Biol. Soc. Washington, X, pp. 65–83, April 13, 1896.

Knowledge of the big bears is by no means complete and many years must pass before the last word on the subject will be written. Many bears now roaming the wilds will have to be killed and their skulls and skins sent to museums before their characters and variations will be fully understood and before it will be possible to construct accurate maps of their ranges. Persons having the means and ambition to hunt big game may be assured that bears are still common in many parts of British Columbia, Yukon Territory, and Alaska, and that much additional material is absolutely required to settle questions still in doubt.

Among the localities from which specimens are greatly needed may be mentioned Lynn Canal and Lituya Bay, Alaska, and in fact the entire coast strip between Cross Sound and Yakutat Bay; the Cook Inlet and Susitna regions; the mountains between the Yukon and Tanana; the Endicott Range and other mountains between the Yukon and the Arctic coast all the way from Seward Peninsula to the Alaska-Yukon boundary; the Rocky Mountains of Canada, from British Columbia northward, including the sources of the Pelly, Macmillan, Stewart, and Porcupine Rivers; the Mackenzie River and Great Bear Lake region; the southwest corner of Yukon Territory; the western part of Alberta; and the interior of British Columbia. In the United States, skulls of adult males are much needed from all localities inhabited by grizzly bears, particularly in Colorado, Idaho, Montana, and Wyoming—including the Glacier and other National Park regions.

What is most needed to-day in this line is a series of adults collected by absolutely trustworthy persons and labeled on the spot for locality and sex. Many specimens in museums are not labeled for sex; others have the sex wrongly marked; and many either lack localities or the localities given are open to serious doubt. A specimen is of little value unless one can pin his faith on the label.

Some writers have advanced the view that the various species of bears freely interbreed. Let those so minded ask themselves the question, If promiscuous interbreeding were to take place, what would become of the species? From the nature of the case, the stability of species depends on the rarity of crossings with other species, for if interbreeding were to take place frequently the species so interbreeding would of course cease to exist, having merged into a common hybrid. Hybrids now and then occur, particularly in zoological gardens, but among wild animals in their native haunts they are exceedingly rare.

The number of species here given will appear to many as preposterous. To all such I extend a cordial invitation to visit the National

Museum and see for themselves what the bear skulls show. Recognition of species is a matter of interpretation. If the material is adequate there can be little room for difference of opinion; if inadequate, many important points must remain in doubt. It is not the business of the naturalist either to create or to suppress species, but to endeavor to ascertain how many Nature has established, and having discovered this, to point out their characters and learn as much as possible about them.

One of the unlooked-for results of the critical study of the American bears is the discovery that the big bears, like mice and other small mammals, split up into a large number of forms whose ranges in some cases overlap so that three or more species may be found in the same region.

Another surprising result is the discovery that Admiralty Island in Southeastern Alaska appears to be inhabited by no less than five distinct species, each of which is obviously related to and representative of an adjacent mainland species. The recognition of this very remarkable state of affairs makes it possible to understand what before had seemed a most anomalous condition, namely, the extraordinary diversity or variability of the skulls and teeth of the island bears. It was not until material essential for the determination of the mainland forms had been collected that it was possible to recognize and define the island forms.

The varying degrees of divergence of the island bears furnish an interesting index to the relative time when each obtained a foothold on the island. In this connection it is well to remember that the breadth of the strait separating Admiralty Island from the mainland at its narrowest point does not exceed 5 miles.

The mainland big bears with their representatives on Admiralty Island here provisionally recognized are:

Mainland Species.	Admiralty Island Species.
Ursus dalli	*Ursus shirasi.*
Ursus stikeenensis	*Ursus mirabilis.*
Ursus tahltanicus	*Ursus insularis.*
Ursus kwakiutl	*Ursus neglectus.*
Ursus caurinus	*Ursus eulophus.*

GEOGRAPHIC DISTRIBUTION.

In early days grizzly bears were common in most parts of western North America, their range being nearly continuous from northern Mexico northward through the Western States and western Canada to northern Alaska; but now within the United States sev-

eral of the species are extinct, and those still living are confined in the main to remote or inaccessible mountain ranges, where two or more species not infrequently occur together. In many cases the original distribution areas overlapped, as they do to-day in parts of British Columbia, Yukon, and Alaska; in other cases, owing to the settlement of the country, species inhabiting easily accessible areas were either exterminated or forced into mountains where they now occupy the same ground with other species, so that it is impossible to ascertain what the original distribution was. As a rule, in cases where two or more species inhabit the same area, the species occurring together belong to different superspecific groups. Thus in the Yellowstone Park and Stikine River regions representatives of the *horribilis*, *absarokus*, *tahltanicus*, and *chelan* groups occur, so far as known, in the same localities.

SEXUAL DIFFERENCES.

In most species of bears the males are much larger than the females. In some the disparity in size is very remarkable, as in *middendorffi* of Kodiak Island and *magister* of southern California. In a few cases the difference is slight, as in *kidderi* of Alaska Peninsula.

AGE DIFFERENCES.

Bear skulls undergo a series of changes from early life to old age, and in most species do not attain their mature form until seven or more years of age. In species having the frontal shield highly elevated, as in *middendorffi*, *kluane*, *stikeenensis*, and *mirabilis*, the frontals reach their maximum of arching or bulging in early adult life (about the sixth year), after which they gradually become flatter.

MATERIAL EXAMINED.

It is a pleasure to express appreciation of the invaluable assistance rendered by the loan or presentation of skins and skulls of grizzly and brown bears utilized in the preparation of the accompanying descriptions. To Charles Sheldon, G. Frederick Norton, and the late Charles R. Cross, jr., and to J. H. Kidder, Robert P. Blake, Waldo Emerson Forbes, George Mixter, Samuel Mixter, Dr. William Jason Mixter, Charles S. King, and Homer E. Sargent, special thanks are due for their generosity in placing at my disposal the valuable specimens and notes obtained on their private hunting trips. Most of these specimens have been presented to the national collections. And to Miss Annie M. Alexander, of Oakland, California, special acknowledgment should be made for the loan of her collection of

Alaska bears, now in the Museum of Vertebrate Zoology of the University of California, and second only to that of the Biological Survey and National Museum.[1]

In conclusion it is only proper to state that the material on which the present publication is based could not have been brought together during my lifetime, nor the results prepared for publication, but for the generous assistance of Mrs. E. H. Harriman in establishing under the Smithsonian Institution a special research fund for my scientific work.

TECHNICAL TERMS.

In describing the skulls of bears a few terms are used in a special sense which it is desirable to understand.

The *frontal shield* is that part of the top of the skull extending from the base of the rostrum backward to the meeting point of the temporal impressions. It is elevated above the surrounding parts and is sharply defined. Its posterior point, confined between the temporal impressions, is longer in female than in male skulls, and up to a certain limit becomes shorter with age.

The *postorbital processes* stand out from the sides of the frontal shield, limiting the orbits posteriorly.

The term *sulcate* is applied to skulls having a longitudinal median depression or groove in the frontal shield, usually shallow and rather broad and without definite lateral limits.

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[1] Others who have helped by the presentation or loan of material are: C. E. Aiken, Dr. J. A. Allen, Dr. R. M. Anderson, Edward F. Ball, Dr. Arthur H. Bannon, Dr. William Bebb, H. C. Beggs, Mrs. C. C. Beggs, John P. Bird, W. C. Bradbury, J. Stanley-Brown, Fred K. Burnham, Mr. and Mrs. E. S. Cameron, Dr. Frank M. Chapman, R. H. Chapman, Elton Clark, James L. Clark, Charles B. Cory, Prof. Charles R. Cross, Heyward Cutting, Frank S. Daggett, E. W. Deming, Howard Eaton, Charles Farwell Edson, Lincoln Ellsworth, Lieut. G. T. Emmons, J. D. Figgins, J. Stanley Foster, Charles A. Gianini, Dr. J. B. Girard, Dr. Joseph Grinnell, Samuel Henshaw, Charles J. Hittell, Dr. W. J. Holland, Dr. R. Houston, James T. Jardine, Remington Kellogg, Francis Kermode, Charles S. King, Paul Kleineidam, Prof. S. H. Knight, Frederick Lambart, Edward H. Litchfield, Col. J. A. McGuire, John Murgatroyd, Prof. C. C. Nutting, Wilfred H. Osgood, John M. Phillips, the late W. Hallett Phillips, the late Warburton Pike, Wilson Potter, George D. Pratt, Dr. E. P. Richardson, Powhatan Robinson, Archibald Rogers, Carl Rungius, Homer E. Sargent, Prof. W. B. Scott, George Shiras 3d, George Shiras 4th, Dr. H. A. Sifton, Henry A. Stewart, Dr. Walter T. Swingle, P. A. Taverner, Prof. S. D. Thacher, Dr. Charles H. Townsend, Frederick K. Vreeland, E. R. Warren, A. Bryan Williams, and W. W. Wood.

Fullest acknowledgments are due the following institutions for their courtesy in loaning specimens: American Museum of Natural History, New York; Carnegie Museum, Pittsburgh; Colorado Museum of Natural History, Denver; Field Museum of Natural History, Chicago; Museum of Comparative Zoology, Cambridge; Museum of History, Science, and Art, Los Angeles; Museum of Vertebrate Zoology, University of California; Peabody Museum of Salem; Peabody Museum of Yale University; Provincial Museum, Victoria, British Columbia; U. S. National Museum, Washington; Victoria Memorial Museum, Ottawa; Zoological Society of Philadelphia; and the Museums of the Universities of Iowa, Kansas, Nebraska, and Wyoming.

For the frontispiece, showing a wild grizzly in a pine forest near Yellowstone Park, western Wyoming, thanks are due Frederick K. Vreeland, who was so fortunate as to take the photograph.

The term *dished* means that the nasal or fronto-nasal region is depressed, producing a change of angle from the plane of the anterior part of the nasals to the plane (or slope) of the frontal shield. Some skulls are strongly dished, some are flat, while some have the fronto-nasal region elevated and compressed, giving a very different outline from that of the normally dished skull.

The term *braincase* is loosely applied to the whole upper rounded part of the skull between the occiput and postorbital processes, but not including the wedge-shape posterior part of the frontal shield. Used in this way, it covers the parietal bones and posterior part of the frontals on each side of the temporal ridges, including not only the actual bony case inclosing the brain, but also its anterior continuation (the sinus case).

The term *sinus case* is applied more definitely to the smoothly rounded part of the frontals below the shield and in direct continuation of the braincase—the outer shell covering the large sinuses or air cells lying between the nasal chamber and the brain. It is not always discriminated from the braincase.

The term *bellied* is applied to the posterior part of the inferior border of the ramus of the underjaw to indicate a swelling or thickening common in many species.

The term *subangular border* is applied to the posterior part of the inferior border of the underjaw, immediately anterior to the angular process, and usually set off from the rest of the ramus by a step or small tubercle.

The term *keeled* is applied to a not uncommon condition of the upper part of the sinus case, in which the top or arch is compressed, rising rather narrowly into the anterior part of the sagittal crest and posterior part of the frontal shield. The condition is marked in *Ursus eulophus* and occurs in several other species. In most species, however, this part of the braincase is rather broadly rounded, the sagittal crest rising abruptly from the median line.

Measurements are always in millimeters unless otherwise specified.

The museum number of the skull, unless otherwise stated, is understood to be that of the United States National Museum.

CLASSIFICATION OF GRIZZLY AND BIG BROWN BEARS.

The differences formerly supposed to exist between the grizzlies and the big brown bears appear, in the light of the material now available, to distinguish certain groups of species from certain other groups, rather than the grizzlies collectively from the big brown bears collectively. In other words, the differences between the grizzlies on the one hand and the big brown bears on the other are

neither so great nor so constant as at one time believed. And there are species which in the present state of knowledge can not be positively referred to either group. In fact, it seems at least possible that certain species which appear to belong with the grizzlies are closely related to certain other species which clearly belong with the big brown bears. The typical brown bears differ from the typical grizzlies in peculiarities of color, claws, skull, and teeth. The color of the former is more uniform, with less of the surface grizzling due to admixture of pale-tipped hairs; the claws are shorter, more curved, darker, and scurfy instead of smooth; the skull is more massive; the fourth lower premolar is conical, lacking the sulcate heel of the true grizzlies. But these are average differences, not one of which holds true throughout the group. Most of the specimens in museums consist of skulls only, unaccompanied by skins or claws, leaving a doubt as to the external characters; and in old bears the important fourth lower premolar is likely to be so worn that its original form can not be made out. And, worst of all, some of the grizzlies lack the distinctive type of premolar, leaving only the skull as a guide to their affinities. The present classification, therefore, must be regarded as tentative and subject to revision.

RELATIVE VALUES OF CRANIAL AND DENTAL CHARACTERS.

In my judgment cranial characters among the bears of the genus *Ursus* are more permanent and of more significance from the standpoint of classification than minor tooth characters. The teeth are strongly modified by food and consequently in some cases present marked variations in the same group. Thus the skull of adult male *chelidonias* from the coast of southern British Columbia is almost indistinguishable from that of *imperator* from the Yellowstone Park, a member of the *horribilis* group; but *imperator* has very large molars, nearly as big as those of *horribilis* and *bairdi*, while *chelidonias*, being a fish eater, has such small molars that were it not for the skull no one would think of placing it in the *horribilis* group.

Cranial and dental characters among the big bears are very subtle. As a rule comparison of any two skulls of essentially the same size brings to light so many resemblances that one is likely to infer a far closer relationship than actually exists. This is because the big bears of the genus *Ursus* are such a closely interrelated group that the resemblances far outnumber the differences. Hence the greatest caution is necessary to avoid misleading conclusions.

The present paper is merely a review of the existing state of knowledge of the grizzlies and big brown bears of America and does not include either the polar or the black bears. It is not intended as a

monographic revision, but aims to supply a list of the species, together with descriptions and comparisons of adult skulls, chiefly males. Little is said of external characters, for the reason that little is known, only a few skins with claws being available for study.

List of Species and Subspecies of Grizzly and Big Brown Bears, with Type Localities.[1]

(Classification provisional.)

Horribilis group (pp. 17–34):

Ursus horribilis horribilis Ord.....Missouri River, northeastern Montana.
horribilis bairdi Merriam.....Blue River, Summit County, Colorado.
horribilis imperator Merriam.....Yellowstone National Park, Wyoming.
chelidonias nobis.....Jervis Inlet, British Columbia.
atnarko nobis.....Atnarko River, British Columbia.
kwakiutl Merriam.....Jervis Inlet, British Columbia.
nortoni Merriam.....Southeastern side Yakutat Bay, Alaska.
warburtoni Merriam.....Atnarko River, British Columbia.
neglectus Merriam.....Near Hawk Inlet, Admiralty Island, Southeastern Alaska.
californicus Merriam.....Monterey, California.
tularensis Merriam.....Fort Tejon, California.
colusus Merriam.....Sacramento Valley, California.
dusorgus nobis [2].....Jack Pine River, Alberta-British Columbia boundary.

Planiceps group (pp. 34–53):

Ursus nelsoni Merriam.....Colonia Garcia, Chihuahua, Mexico.
texensis texensis Merriam.....Davis Mountains, Texas.
texensis navaho Merriam.....Navajo country near Fort Defiance, Arizona. (Probably Chuska Mountains.)
planiceps nobis.....Colorado (exact locality uncertain).
macrodon nobis.....Twin Lakes, Colorado.
mirus nobis.....Yellowstone National Park, Wyoming.
eltonclarki Merriam.....Near Freshwater Bay, Chichagof Island, Alaska.
tahltanicus Merriam.....Klappan Creek (=Third South Fork Stikine River), British Columbia.
insularis Merriam.....Admiralty Island, Alaska.
orgilos Merriam.....Bartlett Bay, east side Glacier Bay, Southeastern Alaska.
orgiloides nobis.....Italio River, Alaska.
pallasi Merriam.....Donjek River, southwestern Yukon.
rungiusi rungiusi nobis.....Rocky Mountains, headwaters Athabaska River, Alberta.
rungiusi sagittalis nobis.....Champagne Landing, southwestern Yukon.
macfarlani nobis.....Anderson River, 50 miles below Fort Anderson, Mackenzie.
canadensis Merriam [2].....Moose Pass, near Mount Robson, British Columbia.

[1] Nearly 130 years ago Prof. Zauschner proposed the name *Ursus saribur* for an animal "from the region of Canada" (Bestimmung der Hundsart Krokute, und der Bärenart Saribur, p. 8, 1788), but the species appears to be impossible of identification.

[2] Reference to group provisional.

Arizonæ group (pp. 53–76):

Ursus arizonæ Merriam.....Escudilla Mountains, Apache County, Arizona.

idahoensis nobis.....North Fork Teton River, eastern Idaho.

pulchellus pulchellus nobis.....Ross River, Yukon.

pulchellus ereunetes nobis.....Beaverfoot Range, Kootenay District, British Columbia.

oribasus nobis.....Upper Liard River, Yukon.

chelan Merriam.....East slope Cascade Mountains, Chelan County, Washington.

shoshone Merriam.....Estes Park, Colorado.

kennerlyi Merriam.....Mountains of northeastern Sonora, near Los Nogales, Mexico.

utahensis Merriam.....Salina Creek, near Mayfield, Utah.

perturbans nobis.....Mount Taylor, northern New Mexico.

rogersi rogersi nobis.....Upper Greybull River, Absaroka Mountains, Wyoming.

rogersi bisonophagus nobis.....Black Hills (Bear Lodge), northeastern Wyoming.

pervagor Merriam.....Pemberton Lake (now Lillooet Lake), British Columbia.

caurinus Merriam.....Berners Bay, east side Lynn Canal, Southeastern Alaska.

eulophus Merriam.....Admiralty Island, Southeastern Alaska.

klamathensis Merriam [1].....Beswick, near mouth Shovel Creek, Klamath River, northern California.

mendocinensis Merriam [1].....Long Valley, Mendocino County, California.

magister Merriam [1].....Los Biacitos, Santa Ana Mountains, Southern California.

Hylodromus group (pp. 77–84):

Ursus hylodromus Elliot.....Rocky Mountains, western Alberta.

kluane kluane Merriam.....McConnell River, Yukon.

kluane impiger nobis.....Columbia Valley, British Columbia.

pellyensis nobis.....Ketza Divide, Pelly Mountains, Yukon.

andersoni nobis [1].....Dease River, near Great Bear Lake, Mackenzie.

Horriæus group (pp. 84–88):

Ursus apache Merriam.....Whorton Creek, south slope White Mountains, eastern Arizona (a few miles west of Blue).

horriæus Baird.....Coppermines, southwestern New Mexico.

henshawi Merriam.....Southern Sierra Nevada, near Havilah, Kern County, California.

Stikeenensis group (pp. 88–94):

Ursus stikeenensis Merriam.....Tatletuey Lake, tributary to Finlay River, near head Skeena River, British Columbia.

crassodon nobis.....Klappan Creek (=Third South Fork Stikine River), British Columbia.

crassus nobis [1].....Upper Macmillan River, Yukon.

mirabilis Merriam [1].....Admiralty Island, Alaska.

absarokus Merriam [1].....Little Bighorn River, northern Bighorn Mountains, Montana.

[1] Reference to group provisional.

Alascensis group (pp. 94–99):
Ursus alascensis Merriam.....Unalaklik River, Alaska.
t-klat Merriam.....Head of Toklat River, north base Alaska Range, near Mount McKinley, Alaska.
latifrons Merriam.....Jasper House, Alberta.
Richardsoni group (pp. 99–106):
Ursus richardsoni Swainson.....Shore of Arctic Ocean, west side Bathurst Inlet, near mouth of Hood River.
russelli Merriam [1].....West side Mackenzie River delta, Canada.
phæonyx Merriam.....Glacier Mountain, Tanana Mountains, Alaska (about 2 miles below source of Comet Creek, near Fortymile Creek, between Yukon and Tanana Rivers).
internationalis Merriam.....Alaska-Yukon boundary, about 50 miles south of Arctic coast.
ophrus Merriam.....Eastern British Columbia (exact locality unknown).
washake Merriam.....North Fork Shoshone River, Absaroka Mountains, western Wyoming.
Kidderi group (pp. 106–110):
Ursus kidderi kidderi Merriam.....Chinitna Bay, Cook Inlet, Alaska.
kidderi tundrensis Merriam.....Shaktolik River, Norton Sound, Alaska.
eximius Merriam.....Head of Knik Arm, Cook Inlet, Alaska.
Innuitus group (pp. 110–115):
Ursus innuitus Merriam.....Golofnin Bay, south side Seward Peninsula, northwestern Alaska.
cressonus Merriam.....Lakina River, south slope Wrangell Range, Alaska.
alexandræ Merriam [1].....Kusilof Lake, Kenai Peninsula, Alaska.
Townsendi group (pp. 115–116):
Ursus townsendi Merriam.....Mainland of Southeastern Alaska (exact locality uncertain).
Dalli group (pp. 116–124):
Ursus dalli Merriam.....Yakutat Bay (northwest side), Alaska.
hoots Merriam.....Clearwater Creek, a north branch of Stikine River, British Columbia.
sitkensis Merriam.....Sitka Islands, Alaska.
shirasi Merriam.....Pybus Bay, Admiralty Island, Alaska.
nuchek Merriam [1].....Head of Nuchek Bay, Hinchinbrook Island, Prince William Sound, Alaska.
Gyas group (pp. 124–127):
Ursus gyas Merriam.....Pavlof Bay, Alaska Peninsula.
middendorffi Merriam.....Kodiak Island, Alaska.
Kenaiensis group (pp. 127–131):
Ursus kenaiensis Merriam.....Cape Elizabeth, extreme west end Kenai Peninsula, Alaska.
sheldoni Merriam.....Montague Island, Prince William Sound, Alaska.

Vetularctos genus nobis (pp. 131–133):
Vetularctos inopinatus nobis.....Rendezvous Lake, northeast of Fort Anderson, Mackenzie.

[1] Reference to group provisional.

DESCRIPTIONS OF SPECIES AND SUBSPECIES.

Horribilis Group.

URSUS HORRIBILIS HORRIBILIS Ord.

BIG PLAINS GRIZZLY.

(Pl. XIV.)

Ursus horribilis Ord, Guthrie's Geography, 2d Amer. Ed., pp. 291, 300, 1815 (Rhoads' reprint, 1894). Based on the white bear of Lewis and Clark, particularly the one from eastern Montana killed May 5, 1805, on the Missouri River, near the mouth of Poplar River (called by them Porcupine River, but not the same as the Porcupine of to-day, which is about 50 miles farther west).

Ursus ferox Rafinesque, Amer. Monthly Mag., I, p. 437, Oct., 1817 (*nomen nudum*).

"*Ursus ferox* Lewis & Clarck," Desmarest, Mammalogie, p. 164, Paris. 1820 (under *U. cinereus*).

Ursus cinereus Desmarest, Mammalogie, p. 164, Paris, 1820.

Ursus griseus Choris, Voyage Pittoresque autour du Monde, folio colored plate and text (unpaged), Paris, 1822.

Ursus candescens Ham. Smith, in Griffith's Cuvier, II, p. 229 and facing plate, 1827; ibid. V, p. 112, 1827.

Type locality.—Missouri River, a little above mouth of Poplar River, northeastern Montana.

Characters.—Size huge; skull long and massive; claws long, moderately or slightly curved, and smoothly polished; usually streaked lengthwise with whitish or yellowish, which increases with age until in some old individuals the claws are almost wholly white or whitish. Color variable, usually light.

Cranial characters.—Old male (topotype, No. 202739) from Breaks of Missouri River, about 100 miles north of Fort Miles, eastern Montana, April 4, 1890; killed and presented by E. S. Cameron and wife: Skull huge (total length, 400 mm.=15¾ inches); vault of cranium moderately arched; zygomata rather squarely spreading posteriorly, moderately outbowed, the squamosal part rather broadly expanded vertically; frontal shield rather broad, flattish, sloping gradually upward to apex, the posterior part broader than usual (not cut away on sides by incurving temporal ridges); sagittal crest long, straight on top, high posteriorly, reaching forward over posterior fourth of frontals; postorbital processes large, flat, and horizontally outstanding; rostrum high, ascending posteriorly; fronto-nasal region rather high but *distinctly dished* and somewhat sulcate; palate long, concave in cross section; postpalatal shelf broad and flat, well rounded on sides; underjaw large and rather massive; coronoid blade high, its apex not strongly produced posteriorly; ramus rather flat; diastema long.

Teeth large, especially lower canine and last upper and middle lower molar. *Skull of female* (No. 13245, from head of Big Porcupine Creek [not Porcupine River] between Musselshell and Yellowstone Rivers, eastern Montana): Of generalized grizzly type; large and rather massive; vault of cranium rather flat; braincase rather broad; frontal shield of moderate breadth, slightly convex, slightly depressed or sulcate between orbits, elongate-lyrate posteriorly; postorbital processes weak and slightly decurved; sagittal crest not yet reaching fronto-parietal suture; muzzle moderate or rather short; zygomata moderately spreading and rather angular; palate rather narrow. Teeth large; M^2 large and subrectangular.

Cranial comparisons.—Adult male (No. 202739, topotype) compared with two adult males of *bairdi*, one from near Cheyenne, southeastern Wyoming (Yountz), the other from Blue River, Summit County, Colorado (No. 203805): Size slightly larger; fronto-nasal region (interorbitally) *dished* instead of *elevated*, not compressed in front of orbits; frontal shield slightly broader, rising from plane of nasals (in *bairdi* continuing plane of nasals); palate longer and broader; postpalatal shelf much broader and more rounded on sides; mastoids short, appressed, vertical (in *bairdi* longer and divergent); meatus tube compressed between mastoid and glenoid (in *bairdi* not compressed); underjaw longer; ramus longer and flatter (much less swollen on outer side); coronoid blade less falcate (notch shallower); lower canine and last upper molar larger.

Male adult compared with male adult *absarokus* (type): Size decidedly larger; vault of cranium less arched; frontal shield rising more gradually; rostrum longer; palate broader and much longer; ramus much longer; meatus tube compressed between mastoid and glenoid (in *absarokus* not compressed). Teeth much larger, especially lower canine, last upper molar, and middle lower molar.

Remarks.—Until recently the absence of authentic specimens from the neighborhood of the type locality, in connection with the presence of several species of grizzly in Montana, caused an embarrassing uncertainty as to which species was entitled to the name *horribilis*. But the slow accumulation of material during the long period in which I have been engaged in a study of the group made it possible to map the ranges of some of the species with some degree of confidence; and finally, through the generosity of Mr. and Mrs. E. S. Cameron, of Marsh, Montana, I have been presented with a splendid skull of an old male *horribilis* from the Breaks of the Missouri, about 100 miles north of Fort Miles, Montana (practically the type locality). This skull proves that the huge buffalo-killing grizzly of the Great Plains bordering the Missouri in eastern Montana and the Dakotas—the "White Bear" of Lewis and Clark—is really the species to which Ord in 1815 gave the name *Ursus horribilis*.

Skull measurements.—Old male (No. 202739, from Missouri Breaks, eastern Montana): Basal length, 351; occipito-nasal length, 350; palatal length, 192; zygomatic breadth, 247; interorbital breadth, 86.

URSUS HORRIBILIS BAIRDI MERRIAM.[1]

BAIRD GRIZZLY.

Ursus bairdi Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 192–193, August 13, 1914.

Type locality.—Blue River, Summit County, Colorado.

Type specimen.—No. 203805, ♂ old, U. S. National Museum, Biological Survey collection (=3147, Warren collection).

Range.—Southern Rocky Mountain region from San Juan Mountains, southwestern Colorado, northward through Wyoming to Montana, and perhaps to southeastern British Columbia. Probably a mountain animal, while its neighbor *horribilis* was a plains species.

Characters.—Size large—in the Rocky Mountain region exceeded only, if at all, by *horribilis;* skull long, with narrow elevated fronto-nasal region; claws of moderate length, smooth.

Cranial characters.—Old male (type) from Blue River, Colorado, and a closely similar old male from Sabille Hole, Laramie County, southeastern Wyoming, a little north of Cheyenne: Size large; fronto-nasal region high and rather narrow; rostrum rather long, narrow, and strongly compressed in front of orbits; face long sloping; frontal shield flat, short pointed, faintly depressed medially; shield and nasals in essentially same plane except that anterior third of nasals is slightly upturned; postorbital processes large, outstanding, flat, and blunt; orbital rims prominent; sagittal crest moderately high posteriorly; temporal impressions short, incurved, beaded; zygomata strongly outbowed, squarely spreading posteriorly; lachrymal duct notching orbital rim; squamosal shelf short, arched over meatus, the free edge thickened; palate and postpalatal shelf of moderate breadth; mastoids rather long, divergent. Molars large, especially M^2.

Immature males, up to at least the fifth or sixth year, have rather narrow convex frontal shields with weak decurved postorbital processes, and may be recognized at once by the form of the fronto-nasal region, which is *high, narrow, and strongly pinched in* immediately in front of the orbits.

Cranial comparisons.—Old male compared with old male *horribilis* (No. 202739, from Missouri Breaks, eastern Montana): Size essentially the same; frontal shield slightly lower posteriorly, higher anteriorly, the point lyrate and more slender; fronto-nasal region elevated (never dished or sulcate between orbits); base of rostrum much more com-

[1] Named for S. F. Baird, former Secretary of the Smithsonian Institution and founder of the U. S. National Museum.

pressed laterally in front of orbits; palate narrower; mastoids longer and more divergent; meatus tube broadly rounded and free (not compressed between mastoid and glenoid); underjaw shorter; ramus more swollen on outer side; inferior border of ramus shorter and less upturned; coronoid blade more recurved, the apex narrower and reaching farther backward. Teeth similar but slightly smaller; M^1 and M^2 smaller and less massive.

Skull measurements.—Old male (type): Basal length, 348; occipito-nasal length, 325; palatal length, 157; zygomatic breadth, 235; interorbital breadth, 81.

URSUS HORRIBILIS IMPERATOR Merriam.

Yellowstone Park Big Grizzly.

Ursus imperator Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 180–181, August 13, 1914.

Type locality.—Lake Hotel, Yellowstone National Park, Wyoming.

Type specimen.—No. 176297, ♂ old, U. S. National Museum. Died in National Zoological Park.

Range.—Yellowstone National Park, Wyoming; limits unknown.

Characters.—Size large; skull massive, with large horizontally outstanding postorbitals; closely similar to *horribilis*.

Cranial characters.—Old male (type) and a much finer male (No. 216205): Size large (only slightly smaller than *horribilis*); skull massive; vault of cranium rather high; fronto-nasal region moderately dished; sagittal crest long, high, and straight; frontal shield exceedingly short, flattish, shallowly sulcate medially, slightly swollen over orbits, ending in short obtuse point about 30 millimeters behind plane of postorbitals; postorbitals long, peglike, horizontally outstanding; lachrymal duct opening on orbital rim; zygomata moderately outstanding and outbowed, the squamosal base broadly expanded; squamosal shelves broad, arched over meatus; palate moderate; postpalatal shelf rather long; occipito-sphenoid 91 mm.; mastoids short; underjaw large, long, and massive, with high vertical coronoid blade. Teeth large: M^2 with long heel.

Cranial comparisons.—Two old males (Nos. 176297 and 216205) from near northern boundary of Yellowstone National Park[1] compared with an old male topotype of *horribilis* (No. 202739) from Missouri Breaks, eastern Montana: Size only slightly less, general appearance essentially same; frontal shield slightly broader interorbitally and decidedly broader across postorbital processes; postor-

[1] While both are old males, the type is the older of the two and the recessive changes incidental to senility have already begun. It differs from the other in having the frontal shield shorter pointed posteriorly (with consequent lengthening of sagittal crest), the rostrum narrower, the fronto-nasal region more strongly dished.

bital processes more widely outstanding horizontally; palate and postpalatal shelf narrower; mastoids less appressed (apex farther from glenoid surface, leaving broader space for tube of auditory meatus). Last upper molar somewhat smaller, heel equally long but narrower posteriorly; middle lower molar narrower.

Old males (type and topotype) compared with old male *bairdi:* Size essentially same; frontal shield broader throughout; distance between tips of postorbital processes much greater; fronto-nasal region more dished (in *bairdi* elevated) and less compressed; inion more strongly developed.

Old male (type) compared with adult male *absarokus* (type): Size slightly larger; frontal shield broader and flatter; postorbital processes longer and more widely outstanding; rostrum higher and more nearly horizontal (in *absarokus* lower anteriorly and more sloping); sagittal crest longer; squamosal root of zygoma very much more expanded vertically; palate much longer.

Skull measurements.—Old male (type): Basal length, 336; occipito-nasal length, 317; palatal length, 191; zygomatic breadth, 232; interorbital breadth, 90. Another and more perfect old male from Yellowstone Park (No. 216205): Basal length, 340;[1] occipito-nasal length, 332; palatal length, 186; zygomatic breadth, 230; interorbital breadth, 90.

URSUS CHELIDONIAS sp. nov.

Jervis Inlet Grizzly.

Type No. 223133, ♂ old, U. S. National Museum, Biological Survey collection. Collected on river at head of Jervis Inlet, British Columbia, in 1916, by Forrest and Fred Johnstone.

Characters.—Size very large; external characters unknown; skull of male strikingly like that of *imperator* but teeth, especially upper molars, very much smaller, resembling those of *kwakiutl.*

Cranial characters.—*Adult male* (type): Skull very large, massive, flat on top, with horizontally outstanding or slightly uplifted postorbital processes; shield moderately broad, flat, the point long, reaching back to fronto-parietal suture; rostrum elevated in same plane with shield; sagittal crest short, confined to parietals; zygomata moderately outstanding and outbowed; nares small; postpalatal shelf rather broad; occipito-sphenoid unusually long (102); basicranial axis flat; mastoids long and spreading; meatus tubes large and free; underjaw large and massive; coronoid blade high and nearly vertical; ramus rather broad posteriorly, its inferior border concave under anterior molar, convex behind plane of last molar; subangular

[1] In part restored.

border short; canines moderate, rather small for size of skull; upper and lower molars small; heel of M^2 short and rather broadly rounded; last lower premolar of grizzly type.

Cranial comparisons.—*Ursus chelidonias* requires comparison with only two species, *imperator* and *warburtoni*. Adult male (type) compared with equally old male *imperator* from Hell Roaring Creek near northern boundary of Yellowstone National Park: Size slightly greater; general form and proportions almost identical; point of shield somewhat longer; rostrum more completely in frontal plane; zygomata more outbowed anteriorly; basicranial axis flatter (in *imperator* somewhat arched); mastoids longer and more divergent; meatus tube longer; postpalatal shelf broader; coronoid blade higher; canines about same size; molars (both upper and lower) smaller, the difference most marked in M^1, M^2, and M_1.

Compared with two adult males of *warburtoni*, one (No. 223946) from Iskut River near its junction with the Stikine; the other (No. 210142) from Chilkat River valley, Southeastern Alaska: Skull as a whole slightly larger; frontal shield more nearly horizontal, somewhat broader, and completely flat (in *warburtoni* slightly convex); zygomata more outbowed anteriorly; postpalatal shelf broader; basicranial axis flatter; occipito-sphenoid longer (102 mm., contrasted with 95); palate longer; postpalatal shelf broader; underjaw more massive; coronoid blade higher (posterior part of jaw more uplifted, raising condyle and coronoid); upper canines conspicuously more slender; lower canines much smaller; upper and lower molars smaller; middle lower molar not only shorter but differing markedly in proportions, the posterior moiety small and narrow (14.5) in comparison with the anterior (17); PM_4 more distinctly of grizzly type; M_1 with saddle open (cusplet on inner side nearly obsolete).

Skull measurements.—Old male (type): Basal length, 346; occipito-nasal length, 337; palatal length, 191; zygomatic breadth, 240; interorbital breadth, 91.

URSUS ATNARKO SP. NOV.

ATNARKO GRIZZLY.

Type No. 211452, ♂ ad., U. S. National Museum, Biological Survey collection. From Lonesome Lake,[1] Atnarko River, one of the upper forks of the Bella Coola, British Columbia. Collected in September, 1915, by E. H. Edwards.

[1] Lonesome Lake is about 30 miles from the junction of the Whitewater, or Talchawko, and the Atnarko, which two rivers unite to form the Bella Coola. The Bella Coola is about 45 miles long. Lonesome Lake is nearly on the fifty-second parallel, and by the river about 75 miles from the head of Burke Channel.

Characters.—Size large; external characters unknown; skull of male long and narrow, similar in general to that of *kwakiutl* but much narrower; skull of female surprisingly different from that of *kwakiutl*, being long, low, and very narrow, while *kwakiutl* is exceptionally high and broad.

Cranial characters.—Adult male (type): Skull long, low, and narrow, highest in posterior frontal region; braincase anteriorly keeling into sagittal crest; shield narrow and rather sharp pointed posteriorly; postorbitals moderate, horizontally outstanding; rostrum long and slender, rising gradually into plane of shield; zygomata not widely outstanding; sagittal crest long; palate and postpalatal shelf long and narrow; lower jaw long; coronoid blade moderate; subangular border short. Dentition weak: canines small for size of skull (as in *kwakiutl*); molars even smaller than in *kwakiutl*. *Adult female* (based on 3 adult and old females, Nos. 223177, 223182, and 223183) from Atnarko River: Skull long, low, slender, nearly flat on top; shield long and narrow, not rising above plane of rostrum; postorbitals weak, outstanding; rostrum long and slender, passing insensibly into frontal plane; zygomata appressed; palate long and narrow; coronoid blade moderate; subangular border short. Dentition weak.

Cranial comparisons.—Compared with *kwakiutl* the skull as a whole is longer and narrower; frontal shield much narrower and more evenly sloping (rising less abruptly from rostrum); postorbitals much less widely outstanding; posterior frontal region higher, keeling into sagittal crest; palate and postpalatal shelf notably longer and narrower.

Adult and old female compared with old female *kwakiutl* of slightly greater basal length: Breadth very much less (across postorbitals 105 or less, contrasted with 130); shield low, narrow, and flat instead of broad, high, and rising abruptly from rostrum; postorbitals much smaller and weaker; zygomata appressed instead of outstanding; palate, postpalatal shelf, and palatal notch very much narrower; sagittal crest much weaker.

Remarks.—The males of *kwakiutl* and *atnarko* are so much alike that their differences would naturally be regarded as of only subspecific weight; but the females are so strikingly different that it seems necessary to give them independent specific rank. Their specific distinctness is the more certain by reason of the geographic contiguity of the localities where they were killed, the type localities being on the same watercourse and not more than 75 miles apart.

Skull measurements.—Adult male (type): Basal length, 345;[1] occipito-nasal length, 325; palatal length, 199; zygomatic breadth, 214; interorbital breadth, 75.

[1] Partly restored.

URSUS KWAKIUTL MERRIAM.

KWAKIUTL GRIZZLY.

Ursus kwakiutl Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 143–144, September 6, 1916.

Type locality.—Jervis Inlet, coast of southern British Columbia.

Type specimen.—No. 211748, ♂ ad., U. S. National Museum, Biological Survey collection. Collected May 17, 1916, by Fred Mansell.

Range.—Coast region of British Columbia from southwestern corner (Burrard Inlet, Howe Sound, Jervis Inlet) northwesterly to or beyond the lower Bella Coola.

Characters.—Size large; color dark; ears densely furred; claws unknown; skull long, but little arched.

Color.—Skin of head of adult male (type): Nose brown; head and face from front of eyes posteriorly very dark brown, darkest on ears, slightly grizzled on occiput by golden-tipped hairs.

Cranial characters.—Adult male (type): Size large; skull long, rather low and narrow, with long high rostrum, gradually ascending frontal shield, rather low fronto-parietal region, and strongly outstanding postorbitals. Frontal shield of moderate breadth, shallowly sulcate medially, swollen over orbits, short pointed posteriorly; rostrum long, high, and rather narrow; nasals flattened, nearly horizontal; fronto-nasal region sloping gently in plane of shield; braincase long, its anterior part keeling into elongate sagittal crest; zygomata moderately spreading (becoming, of course, more strongly outbowed in old age); palate long, concave, slightly arched anteroposteriorly; postpalatal shelf large and broad, nearly square; dentition rather light for size of skull; underjaw long, its inferior border slightly sinuous (slightly bellied under last molars); coronoid blade broad at base, not very high, the apex slightly produced posteriorly but falling far short of plane of condyle.

Old female (No. 215432): The skull of an old female from Kwatna, on the lower Bella Coola, is obviously of this species. It is large and rugged for a female, with strongly dished fronto-nasal region and broad massive frontal shield rising abruptly from a very small rostrum; shield sulcate, swollen between sulcus and orbits, lyrate pointed, ending at fronto-parietal suture; postorbitals large and outstanding; zygomata outstanding; sagittal crest strongly developed for a female; palate and postpalatal shelf very broad; teeth small; PM^4 badly worn but apparently subconical, as in a male (No. 215433) from the same locality.

Cranial comparisons.—The only species requiring comparison with *kwakiutl* are the much larger *nortoni* and the very different *pervagor*. Adult male (type) compared with adult male *nortoni* (No. 213705) from southeast side Yakutat Bay: Similar in general but much

shorter; rostrum slightly longer; *braincase materially shorter;* shield much less elevated; fronto-nasal region much less dished; *postpalatal length much less.* Compared with male *pervagor:* Skull longer and less highly arched; braincase and rostrum materially longer; frontal shield shorter pointed posteriorly; rostrum more elevated anteriorly; nasals more nearly horizontal, shorter posteriorly, longer anteriorly; postpalatal notch longer; underjaw decidedly longer and more massive, but inferior border of ramus from symphysis to tubercle of essentially same length; subangular border much longer. Dentition heavier (both upper and lower canines, incisors, and molars larger).

Skull measurements.—Adult male (type): Basal length, 340; occipito-nasal length, 330; palatal length, 184; zygomatic breadth, 212; interorbital breadth, 85.

URSUS NORTONI[1] MERRIAM.

YAKUTAT GRIZZLY.

(Pl. XIII.)

Ursus nortoni Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 179–180, April 13, 1914.

Type locality.—Near Yakutat village, southeastern side Yakutat Bay, Alaska.

Type specimen.—No. 178763, ♀ ad., U. S. National Museum, Biological Survey collection. (Mother of ♂ cub of second year, No. 178764.) Collected May 15, 1910, by G. Frederick Norton.

Range.—Limited apparently to coastal plain on southeastern side of Yakutat Bay.

Characters.—A true grizzly, apparently of the *californicus-kwakiutl* group; of large size, with smoothly polished horny claws. Fourth lower premolar large and of ultra-grizzly type (long heel with continuous sulcus and complete lateral ridges ending in upturned posterior cusplets); molars, especially M^2, small for size of skull. Coloration normal for a grizzly; skull large, massive, and very broad.

Color.—Of pale grizzly type; head grizzled yellowish or golden brown; muzzle pale brown; neck and shoulders to middle of back pale buffy from the long whitish buff-tipped hairs, giving the skin viewed from behind a decidedly whitish appearance; hinder back and rump dark, well washed with pale brown tips; lower part of legs and feet dark brown; back of fore feet browner and not so dark; underchin and throat pale soiled buffy whitish.

[1] Named for G. Frederick Norton, who collected and presented the type specimen.

Cranial characters.—Adult male (No. 213705, from southeast side of Yakutat Bay, northeast of Yakutat village): Skull large, long, massive, and strongly dished; braincase exceptionally long; facial part of skull relatively short; frontal shield rather broad, moderately convex transversely and sulcate medially (swollen between sulcus and postorbitals), rising strongly and abruptly from rostrum; postorbital processes well developed, slightly arched; rostrum rather short, horizontal; zygomata moderately spreading, outbowed; sagittal crest highly developed; squamosal shelves broad and long; palate and postpalatal shelf rather long and of moderate breadth; palate troughed between molar series; mastoids moderate; underjaw massive; coronoid blade high, broad, and not recurved; ramus long and straight. Teeth small for size of skull; M^2 rather short, the heel evenly emarginate and broadly rounded posteriorly.

Adult female (type): Rather massive, moderately dished, broad, with large broadly rounded braincase, bowed (but not widely outbowed and not angular), moderately spreading zygomata; short weak sagittal crest confined to posterior half of parietals; rather broad lambdoid crest defining a rather broadly open groove or sulcus continuous with that of the deeply sulcate and broadly expanded horizontal shelf of the squamosal; squamosal base of zygoma moderately expanded; frontal shield broad and long, its lyrate point reaching back to middle of parietals, broadly sulcate between orbits; frontonasal region moderately dished; postorbital processes large and broadly outstanding, infraorbital process of jugal and infrajugal process of maxillary well developed (probably not constant); rostrum broad, short, and rather depressed; lachrymal opening within orbit; palate and postpalatal shelf broad, the palate rather deeply concave from incisive foramina to plane of hind molars; postpalatal notch broad and rather squarely truncate; occipito-sphenoid length 90 (about equal to distance from posterior rim of alveolus of outer incisor to front of last upper molar); basioccipital considerably longer than basisphenoid; occiput broad, rather low, truncate; coronoid blade rather high. Basicranial axis nearly straight and horizontal, parallel to palatal axis. Dentition light in both sexes; canines and molars rather small for size of skull; $PM_{\frac{4}{4}}$ of ultra grizzly type, with slender cone, well-developed completely sulcate heel ending posteriorly in pair of upturned cusplets; PM^4 large and broad; heel of M^2 rather short, not strongly narrowed posteriorly, third cusp small; incisors rather large.

Cranial comparisons.—Male adult (type) compared with male adult *kwakiutl* (type): Similar in general *but very much longer* both basally and on top; rostrum slightly shorter; braincase *materially longer;* frontal shield rising higher and more abruptly from ros-

trum; fronto-nasal region more conspicuously dished; *postpalatal length very much greater;* underjaw longer and more massive; ramus longer; subangular border shorter; coronoid blade much larger and higher; teeth closely similar, but upper canines and upper molars slightly larger.

Specimens examined.—About a dozen specimens have been examined, mainly females and young, all from the coastal plain southeast of Yakutat Bay. Three (including type) were collected by G. Frederick Norton, and by him presented to the Biological Survey; others were collected by Miss Annie M. Alexander, and are in the Museum of Vertebrate Zoology, University of California; still others (including a splendid adult male) were obtained from Yakutat Indians by E. M. Axelson and purchased by me. The localities are: Peninsula between Yakutat and Disenchantment Bays (northeast of Yakutat village); near Yakutat village; front of Yakutat Glacier; Ankow River; Setuk River; and Anklin River.

Skull measurements.—Adult male (No. 213705): Basal length, 353; occipito-nasal length, 346; palatal length, 185; zygomatic breadth, 241; interorbital breadth, 91. Adult female (type): Basal length, 306; occipito-nasal length, 284; palatal length, 165; zygomatic breadth, 210; interorbital breadth, 80.5.

URSUS WARBURTONI[1] MERRIAM.

WARBURTON PIKE GRIZZLY.

Ursus kwakiutl warburtoni Merriam, Proc. Biol. Soc. Washington, XXIX, p. 145, September 6, 1916.

Type locality.—Atnarko River, British Columbia.

Type specimen.—No. 210576, ♂ old, U. S. National Museum, Biological Survey collection. Collected July 15, 1915, by E. H. Edwards.

Range.—Coast region (but perhaps not the immediate coast strip) of Southeastern Alaska and adjacent parts of British Columbia from Chilkat River southeasterly to Atnarko River, one of the upper forks of the Bella Coola (skulls of adult males examined from Atnarko River, Stikine River, Iskut River near junction with Stikine, and Chilkat River valley).

Cranial characters.—Adult males: Skull large and massive, rather long and flattish on top, not arched. Similar to male *kwakiutl* but with much broader (less peglike) and flatter postorbitals, flatter frontal shield (not deeply concave in old age), much shorter sagittal crest, somewhat heavier dentition, especially broader and more massive

[1] Named in honor of the late Warburton Pike, author of The Barren Grounds of Northern Canada, and The Subarctic Forest, who obtained a fine large typical skull (No. 223946) on the Iskut a few miles from its junction with the Stikine.

M^2. Easily distinguished from *stikeenensis* of the same region by the much greater length of skull and underjaw and lesser elevation of frontal region.

Skull measurements.—Old male (type): Basal length, 340; occipito-nasal length, 324; palatal length, 185; zygomatic breadth, 233; interorbital breadth, 85. Old male (No. 223946) from Iskut River, a branch of the Stikine: Basal length, 326; occipito-nasal length, 340; palatal length, 176; zygomatic breadth, 230; interorbital breadth, 86.5.

URSUS NEGLECTUS Merriam.

Admiralty Island Grizzly.

Ursus kwakiutl neglectus Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 144–145, September 6, 1916.

Type locality.—Near Hawk Inlet, Admiralty Island, Southeastern Alaska.

Type specimen.—No. 209889, ♂ old, U. S. National Museum, Biological Survey collection. Collected April, 1914, by W. H. Spaulding.

Cranial characters.—Skull rather large and massive, flat topped, with rather broad outstanding postorbitals. Frontal shield moderate, flattish, shallowly sulcate, rather short pointed; fronto-nasal region elevated in plane of shield and slightly compressed; rostrum moderate, high; zygomata moderately outstanding and somewhat bowed; postpalatal shelf short and broad; notch rather broad. Underjaw rather short, ramus rather flat and broad vertically, especially posteriorly, strongly bellied posteriorly; coronoid blade high and narrow, its apex not reaching plane of condyle. Teeth moderate.

Cranial comparisons.—*Ursus neglectus* requires comparison with both *kwakiutl* and *warburtoni*. Old male (type) compared with adult male *kwakiutl* (type from Jervis Inlet): Size similar; shield flatter, more nearly horizontal and less sloping anteriorly; postorbitals broader and flatter on top; fronto-nasal region elevated instead of depressed; rostrum larger and more elevated; zygomata less outbowed; nasals more produced anteriorly, projecting broadly over nares (about 7 mm. beyond premaxillæ at point of contact); nares more truncate; underjaw and subangular border much shorter; coronoid blade narrower. Upper canines and crown of last upper molar longer.

Old male (type) compared with three old males of *warburtoni* (from Atnarko and Iskut Rivers and Chilkat Valley): Size slightly smaller but occipito-sphenoid length same; top of skull more nearly horizontal (shield anteriorly and rostrum more elevated); zygomata

less outbowed; nasals more projecting anteriorly; palate shorter; postpalatal shelf broader, flatter, and much shorter; mastoids shorter; underjaw slightly smaller; subangular border much shorter; coronoid blade narrower and more nearly vertical. Canines (especially upper) more slender; M^2 narrower and less massive but difference not great.

Skull measurements.—Old male (type): Basal length, 322; occipito-nasal length, 325; palatal length, 177; zygomatic breadth, 229; interorbital breadth, 83.

URSUS CALIFORNICUS Merriam.

CALIFORNIA COAST GRIZZLY.

[*Ursus horriæus*] subspecies *californicus* Merriam, Proc. Biol. Soc. Washington, X, pp. 76–77, April 13, 1896.

Ursus californicus Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 186, 188, August 13, 1914.

Type locality.—Monterey, California.

Type specimen.—Skull No. 3630, ♂ old, U. S. National Museum.

Range.—Humid coast region of California from San Francisco Bay south about to San Luis Obispo (apparently passing into *tularensis* in the dryer interior).

Characters.—Size large; claws long and smooth; pelage variable. Dentition heavy; last upper molar large, its heel long and broad.

Cranial characters.—Adult male: Skull long and narrow; vault of cranium flat—not arched; frontal shield flat (or concave medially), short pointed posteriorly, gradually sloping almost in same plane with rostrum (dishing slight); temporal impressions beaded; postorbitals massive and moderately spreading; zygomata slightly bowed; rostrum long, slightly compressed in front of orbits; nasals nearly horizontal, slightly rising posteriorly in plane of shield; frontal shield moderately broad, slightly swollen over orbits, the point lost in sagittal crest 25 to 50 mm. anterior to fronto-parietal suture; postorbital processes strongly developed, subtriangular, rather massive, outstanding, and slightly decurved over orbits; sagittal crest strongly developed and nearly straight; squamosal shelf broad; squamosal base of zygoma vertically expanded in aged skulls; frontal part of braincase in young-adult skulls somewhat elevated and tending to "keel" into crest; mastoid processes long; interpterygoid fossa long and usually narrow; underjaw long and massive, ramus broad vertically. Teeth large and heavy; M^2 subrectangular, heel long, broad posteriorly. *Skull of female:* Similar to that of male, but smaller.

Cranial comparisons.—Adult and old male compared with adult male *klamathensis* (type): Skull longer; zygomatic breadth essen-

tially the same; face and rostrum longer; rostrum more compressed in front of orbits; fronto-nasal region more dished; frontal shield more concave medially and more swollen at orbital rims; postorbital processes much more massive, slightly arched, the tips slightly decurved; temporal beads more strongly incurved; sagittal crest shorter posteriorly; lambdoid crest more outstanding laterally; occipital overhang much less; squamosal shelf behind zygoma much shorter; occipito-sphenoid and palate longer; mastoids much longer and more strongly outstanding. Underjaw much longer. Dentition heavier, the last upper and middle lower molar in particular much larger; heel of M^2 very broad and broadly rounded posteriorly.

Old male from Monterey, compared with old male *colusus* (type, from Sacramento River): Fronto-nasal region slightly higher and less depressed; rostrum higher, less depressed, and less horizontal; postorbitals much larger and more swollen; orbital rims more swollen; orbits more nearly vertical, squamosal base of zygoma more expanded; palate narrower anteriorly; ramus much broader vertically, its inferior border less convex in middle part and more bellied posteriorly; apex of coronoid more produced posteriorly; angular process larger and longer; mastoids longer and directed less anteriorly, not reaching so near glenoid process. Dentition stronger and strikingly different: canines larger; upper incisors and both upper and lower molars very much larger; heel of M^2 large and not normally emarginate.

Skull measurements.—Old male (type): Basal length, 361; occipito-nasal length, 346; palatal length, 196; zygomatic breadth, 224; interorbital breadth, 82.

URSUS TULARENSIS Merriam.

Tejon Grizzly.

Ursus californicus tularensis Merriam, Proc. Biol. Soc. Washington, XXVII, p. 188, August 13, 1914.

Type locality.—Fort Tejon, Cañada de las Uvas, Tehachapi Mountains, California.

Type specimen.—No. 3536, ♂ old, U. S. National Museum. Collected by John Xantus.

Range.—Dry chaparral hills of interior coast ranges between the San Joaquin Valley and Los Angeles plain, comprising the Tehachapi, Tejon, Sierra Madre, and San Gabriel Ranges, and probably San Bernardino Mountains also, and ranging northward an unknown distance, doubtless covering the San Rafael and Gabilan Ranges, and southern part of the Diablo Range; limits unknown.

Characters.—Size large, but smaller than *californicus;* claws of grizzly type, but those of a female dark, thick, and broad for a fe-

male, rather straight (tips worn off), straighter and broader than in female *magister*.

Color.—Nearly full-grown male killed by Walter Richardson, near head of Tejunga Canyon, San Gabriel Mountains, Southern California, in 1897: General color very dark brown, almost dusky; grizzled on upperparts by admixture of pale-tipped hairs; muzzle reddish brown.

Cranial characters.—Old male: Skull large, rather broad and flat frontally, moderately dished, moderately high, with large outstanding postorbitals and beaded temporal ridges. Frontal shield rather broad, swollen, and somewhat elevated on orbital rims and base of postorbitals, depressed interorbitally, sloping gradually into rostrum; rostrum large and rather high; fronto-nasal region not depressed; sagittal crest rather short, elevated and produced posteriorly; occipital overhang marked; zygomata moderately spreading, subtriangular; palate and postpalatal shelf broad and flat, mastoids rather long and inclined strongly forward. Underjaw large and rather massive; ramus broad vertically, strongly bellied posteriorly; coronoid rather high, its apex not strongly recurved. Teeth large; M^2 subrectangular, the long heel only slightly emarginate on outer side. *Adult and old females:* Skulls more easily distinguished than in males from their nearest relative, *californicus*. The skull of the female is much more like the normal female grizzly type, not resembling the males as does the female of *californicus*.

Cranial comparisons.—Adult and old females compared with female *californicus:* Skull decidedly smaller; frontal shield behind plane of postorbital processes more elevated and convex—not depressed and concave as in *californicus;* point of shield longer and broader; orbital rims more swollen; sagittal crest shorter and lower; palate at least 10 mm. shorter; occipito-sphenoid about 10 mm. shorter; underjaw smaller and lighter; last upper molar decidedly smaller. Normal M^2 subrectangular as in *californicus* (in *henshawi* subtriangular and small).

Adult and old males compared with male *californicus:* Similar but smaller; base of cranium shorter; palate slightly shorter; occipito-nasal length decidedly less; braincase decidedly shorter; zygomatic breadth same or slightly greater—the skull as a whole relatively broader than in *californicus;* postpalatal shelf broader; underjaw materially shorter; M^1 decidedly smaller (both shorter and narrower); lower series of teeth smaller, M_1 and M_2 particularly smaller, much narrower and less massive; heel of last upper molar less broad than in *californicus*.

Adult male compared with *henshawi* (type): Skull larger and more massive; fronto-nasal region much higher and much less dished; rostrum larger, higher, and not depressed; zygomata more

broadly spreading; postpalatal shelf broader; coronoid larger and less falcate; ramus broader vertically; last upper molar much larger, the heel long and broad posteriorly, contrasted with the short subtriangular heel of *henshawi*.

Skull measurements.—Average of two old males from Fort Tejon, California: Basal length, 329; occipito-nasal length, 320.5; palatal length, 179.5; zygomatic breadth, 228; interorbital breadth, 78. Old female from Fort Tejon: Basal length, 296; occipito-nasal length, 287; palatal length, 162; zygomatic breadth, 187; interorbital breadth, 75.

URSUS COLUSUS MERRIAM.

SACRAMENTO VALLEY GRIZZLY.

Ursus colusus Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 187–188, August 13, 1914.

Type locality.—Sacramento River valley, California (probably between Colusa and Sacramento).

Type specimen.—No. 3837, ♂ old, U. S. National Museum. Collected by the Wilkes U. S. Exploring Expedition and marked "C. P. Ex. Ex. 6.16" (the numerals uncertain, there being indication of a figure in front of the first 6). The words "Grizzly Bear, Sacramento" are written on the right parietal in pencil.

Range.—Sacramento (and perhaps also San Joaquin) Valley and adjacent foothills; westerly in the hot inner coast mountains to Dobbins Creek canyon on the boundary between southeastern Humboldt and southwestern Trinity Counties.

Characters.—Size large, external characters unknown. Skull large and long, resembling that of *californicus*, but teeth smaller and last upper molar very different.

Cranial characters.—Old male: Skull large, long, and low, the frontal shield flat, postorbital processes moderate or small, fronto-nasal region moderately dished, palate long, sagittal crest high, temporal ridges beaded, and occipital overhang pronounced. In general resembling largest skulls of *californicus* but having very much smaller teeth and differing in numerous minor cranial characters. *Young-adult female:* One from San Jose Mission (No. 1143, Yale Museum) appears to be a not quite grown female *colusus*. The last upper molar is short and subtriangular, the heel emarginate on outer side.

Cranial comparisons.—Old male (type) compared with old male *californicus* (from Monterey): Fronto-nasal region slightly lower and more depressed; rostrum lower, more depressed and more nearly horizontal; postorbitals much smaller and less swollen; orbital rims less swollen; orbits less nearly vertical; squamosal base of zygoma less ex-

panded; palate broader anteriorly; ramus much less broad vertically, its inferior border more convex in middle part and less bellied posteriorly; apex of coronoid less produced posteriorly; angular process smaller and shorter; mastoids shorter and directed more anteriorly, reaching nearer to glenoid process. Dentition weaker and strikingly different: canines too badly broken to admit of satisfactory comparison, but obviously smaller; upper incisors and both upper and lower molars very much smaller; heel of M^2 small and strongly emarginate on outer side, of same size and approximately same form as in *klamathensis* but even more strongly constricted on outer side immediately behind second cusp; lower molars of same size as in *klamathensis* though the jaw is much longer.

Old male (type) compared with *klamathensis:* Postorbitals, length of sagittal crest, form of zygomata, and dentition essentially the same, but skull longer; vault of cranium *much lower;* frontal shield narrower and much shorter; temporal beads much more strongly incurved; fronto-nasal region dished instead of elevated; rostrum much lower, more depressed, and more nearly horizontal; ramus longer, less broad vertically; diastema much longer.

Skull measurements.—Old male (type): Basal length, 352; occipito-nasal length, 337; palatal length, 185; zygomatic breadth, 228; interorbital breadth, 82.5.

URSUS DUSORGUS sp. nov.[1]

Rindsfoos Grizzly.

Type No. 217426, ♂ old, U. S. National Museum. From head of Jack Pine River near Mount Bess, Alberta (close to British Columbia boundary). Collected September 4, 1916, and presented to the National Museum by William Rindsfoos.

Cranial characters.—Skull large, broad, and massive, with flat gradually sloping frontal shield and high sagittal crest; shield broad, short pointed, slightly thickened at orbits, with horizontally outstanding slightly elevated postorbitals; fronto-nasal region faintly dished, the broad slightly depressed rostrum rising imperceptibly into shield; sinus case keeling into anterior part of sagittal crest, the crest rising above plane of top of skull and point of frontals and reaching forward nearly half way from fronto-parietal suture to postorbitals; temporal impressions strongly beaded; zygomata broadly outstanding; palate and postpalatal shelf rather broad; underjaw massive; ramus strongly bellied posteriorly; coronoid rather high. Teeth moderate; last upper molar long.

[1] Tentatively included in *horribilis* group. (See Introduction, pp. 12–13.)

Cranial comparisons.—So far as known *dusorgus* requires comparison with only a single species—*imperator* of western Montana and the Yellowstone Park region. Old male (type) compared with old male *imperator* (No. 216205): Similar in general but size somewhat less; vault of cranium, frontal region, and rostrum lower; shield flatter, more strongly sloping, and shorter pointed; rostrum more depressed; sagittal crest much higher anteriorly, rising well above point of shield; palate shorter; meatus tube longer; ramus of jaw shorter. Teeth similar but M^1 smaller.

Skull measurements.—Old male (type): Basal length, 324; occipito-nasal length, 322.5; palatal length, 180; zygomatic breadth, 227; interorbital breadth, 86.

Planiceps Group.

URSUS NELSONI[1] MERRIAM.

NELSON GRIZZLY.

Ursus nelsoni Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 190–191, August 13, 1914.

Type locality.—Colonia Garcia, Chihuahua, Mexico.

Type specimen.—No. 99657, ♀ ad., U. S. National Museum Biological Survey collection. Collected November 13, 1899, by H. A. Cluff.

Range.—Sierra Madre of Mexico from northwestern Chihuahua and northeastern Sonora south to southern Durango.

Characters.—Smallest of the grizzly bears. General color, pale buffy yellowish, varying to grayish white, grizzled from darker color of underfur. Specimens in worn pelage vary to yellowish brown and even rusty. Hairs of throat and flanks longer than elsewhere; belly sparsely haired, lacking the thick underfur of upperparts. Claws long, smooth, and moderately curved; brownish horn color streaked with yellowish. Longest claw 56 mm. from upper base to tip (tip worn off).

Color.—Type specimen in fresh fall pelage: Muzzle pale brown, much darker around eyes; top of head yellowish buff; back grayish brown, heavily overlaid with pale buffy gray tips (color more buffy across shoulders, more whitish gray on back); hump dark brown, small; rump grizzled grayish and brown, the light-tipped hairs failing posteriorly and on the sides, the dark brown ground color passing into blackish brown on thighs, legs, feet, and tail; forelegs also blackish brown; lips and point of chin yellowish buff, followed by area of dark brown; underneck and underparts generally long haired and grizzled, the prevailing color yellowish buff.

[1] Named for E. W. Nelson, who collected the original series in the type region.

Cranial characters.—Adult male: Skull small and wolflike. Similar in general to *texensis*, but smaller and more wolflike; rostrum strikingly narrow; frontal shield flat, narrow, and only faintly sulcate medially; temporal impressions not beaded; occipito-sphenoid length 82 mm. (in ♂ *texensis*, 86); palate very short (149 mm. contrasted with 171 in *texensis*); posterior root of zygoma slender; postorbital process slender, peglike, and outstanding horizontally. Teeth small.

Skull measurements.—Old male (No. 16025, Field Mus. Nat. Hist., Chicago, from Casas Grandes, Chihuahua): Basal length, 284; occipito-nasal length, 264; palatal length, 149; zygomatic breadth, 199; interorbital breadth, 65. Average of three adult females from Colonia Garcia, Chihuahua: Basal length, 260; occipito-nasal length, 243; palatal length, 138; zygomatic breadth, 168; interorbital breadth, 61.

URSUS TEXENSIS TEXENSIS Merriam.

Texas Grizzly.

Ursus horriæus texensis Merriam, Proc. Biol. Soc. Washington, XXVII, p. 191, August 13, 1914.

Type locality.—Davis Mountains, Texas.

Type specimen.—No. 203198, ♂ old, U. S. National Museum, Biological Survey collection. Killed November 2, 1890, by C. O. Finley and John Z. Means.

Range.—Restricted, so far as known, to Davis Mountains, Texas, and mountains of southern Colorado.

Characters.—Size small; external characters unknown. Affinities with *shoshone* rather than with *horriæus*.

Cranial characters.—Old male (type): Size small; frontal shield low, narrow, flat (slightly depressed medially), short pointed posteriorly, gently sloping in same plane with rostrum; postorbital processes small, peglike, horizontally outstanding; fronto-nasal region elevated in fronto-facial plane; rostrum narrow; zygomata rather broadly outbowed, moderately expanded vertically, lachrymal duct wholly anterior to orbit; sagittal crest long and nearly straight; occipital overhang marked; palate broad, deeply excavated between molars (may be abnormal); postpalatal shelf broad and flat; postpalatal notch broad and short; meatus tube slightly recurved and markedly upturned. Underjaw light; inferior border of ramus long, slightly bellied posteriorly; subangular border rather short; coronoid blade high, its recurved apex falling short of plane of condyle. Teeth rather small; M^2 small, with small heel obliquely narrowed on outer side.

Old female (No. 213002, from Navajo Range, near Cromo, Colorado): Skull short, dished, the braincase broad; frontal shield nar-

row; zygomata broadly spreading, slightly bowed; occiput truncate; and postorbitals slender, widely outstanding. Rostrum small, slender, tapering, rising posteriorly into flat lyrate shield; postorbital processes long, slender, and directed forward as well as outward; braincase rather broad and depressed; palate rather short; postpalatal shelf broad and flat. Teeth moderate; canines small and slender; molars nearly as large as in male, and M^2 of same form.

Cranial comparisons.—Adult male (type) compared with adult male *planiceps* (type): Size smaller throughout; shield much narrower, less flat, and less nearly horizontal; fronto-nasal region dished (in *planiceps* not dished); rostrum much smaller and narrower; palate deeply concave between posterior molars (in *planiceps* flat); ramus of underjaw more tapering anteriorly; angular processes not bellied (in *planiceps* bellied); teeth smaller.

Old male (type) compared with male *shoshone:* Size smaller; vault of cranium lower and more nearly horizontal; frontal shield less sloping; anterior part of braincase broadly depressed (not compressed or keeling into crest); palate broader. Teeth smaller.

Old male (type) compared with old male *horriæus* (type): Skull similar in basal length, but materially smaller, lower, flatter, narrower, more smoothly rounded, broader across squamosals, much less massive, and with wholly different postorbitals. Postorbitals small, slender, peglike, and horizontally outstanding instead of large, broad, massive, and decurved; frontal shield narrower and flatter; orbital rims less swollen; rostrum smaller (shorter and more slender); fronto-nasal region even less dished; palate somewhat broader between molars and deeply excavated between last molars (slightly depressed in *horriæus*); interpterygoid canal shorter; zygomata more widely outstanding posteriorly and bowed (in *horriæus* more angular and more outstanding anteriorly); inferior border of jaw (symphysis to subangular tubercle) much longer. Canines and molars smaller.

Old female (from Navajo Mountains) compared with old female *horriæus* (from mountains north of Silver City, N. Mex.): Skull as a whole and rostrum shorter; occiput doubtless more truncate (that of *horriæus* sawed off) frontal shield shorter and more dished; postorbitals longer, more slender, and directed anteriorly as well as outward; zygomata much more broadly spreading, more swollen at anterior base, and distinctly bowed instead of angular; palate broader, flat instead of concave; lower jaw thicker and heavier.

Skull measurements.—Old male (type): Basal length, 308; occipito-nasal length, 301; palatal length, 171; zygomatic breadth, 218; interorbital breadth, 71.

URSUS TEXENSIS NAVAHO MERRIAM.

NAVAHO GRIZZLY.

Ursus navaho Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 191–192, August 13, 1914.

Type locality.—Navajo country near Fort Defiance, Arizona (Mollhausen); type probably killed in 1856 in Chuska Mountains, on boundary between northeastern Arizona and northwestern New Mexico.

Type specimen.—No. 3500, ♂ old, U. S. National Museum.

Range.—Probably restricted to the isolated Chuska Mountains (including the so-called Lukachukki and Tunitcha elevations, and perhaps also the neighboring Carriso Mountains on the north).

Characters.—Size small; external characters unknown; skull short, broad and slightly dished.

Cranial characters.—Old male (type; badly damaged, only the front part with zygomata and underjaw remaining): Skull short; zygomata broadly spreading and outbowed, the anterior root much swollen, posterior root not expanded; frontal shield flat, short pointed; postorbital processes peglike and outstanding; temporal impressions finely beaded; rostrum short and small; nares rather small and nearly vertical; lachrymal duct opening on orbital rim, but more in than out; palate broad for so small a skull; postpalatal shelf broad; coronoid blade high. Teeth small: M^1 very small; M^2 short, with broadly rounded heel (tooth nearly as broad posteriorly as in middle and anteriorly).

Cranial comparisons.—Old male (type) compared with old male *texensis* (type): Size somewhat larger; frontal shield and rostrum broader; jugal longer posteriorly. Palate and postpalatal shelf much shorter (157 mm. contrasted with 173), and less deeply concave between posterior molars; postorbital processes slightly larger; anterior root of zygoma much more swollen (in *texensis* hardly swollen); nares much more truncate; underjaw straighter (less upcurved posteriorly); canines about same size; molar series slightly shorter; M^2 of same length but heel broadly rounded posteriorly instead of obliquely truncate, the sides of tooth nearly parallel; M^1, $M_{\overline{1}}$, and PM^4 smaller.

Skull measurements.—Old male (type): Palatal length, 157.5; interorbital breadth, 81. Skull too badly broken to furnish other measurements.

URSUS PLANICEPS SP. NOV.

FLAT-HEADED GRIZZLY.

Type No. 13289, ♂ ad. (rather old), U. S. National Museum, from Colorado (exact locality unknown). Collected by Dr. F. V. Hayden.[1]

[1] Dr. Hayden worked in Colorado in 1869, mainly in the mountains and foothills of the east-central part of the State. Inasmuch as two other grizzlies, *bairdi* and *macrodon*, inhabit the higher mountains of Colorado it seems highly probable that the home of *planiceps* was in the foothills or along the western edge of the plains.

Cranial characters.—Adult male (type): Skull rather large, low, and flat; shield broad, flat, and nearly horizontal; postorbitals horizontally outstanding; rostrum broad, somewhat depressed; zygomata broadly outstanding and outbowed; palate, postpalatal shelf, and postpalatal notch broad; occipito-sphenoid long (95 mm.) Underjaw rather long; ramus flat and rather thin; condyle high, vertical; subangular border short; angular process bellied on underside. Canines moderate; molars rather large but much smaller than in *macrodon.*

Cranial comparisons.—Ursus planiceps requires comparison with its two neighbors, *macrodon* and *texensis*, of which its affinities are closest with *macrodon.* Old male (type) compared with old male *macrodon:* Size and vault of cranium about same; shield slightly broader and flatter; rostrum broader; zygomata very much more broadly outstanding and outbowed; palate, postpalatal shelf, and palatal notch much broader; posterior part of underjaw more upcurved, lifting condyle and coronoid; upper canines about same size; lower canines and upper and lower molars decidedly smaller.

Old male (type) compared with old male *texensis* (type): Size larger throughout; shield much broader, flatter, and more nearly horizontal; fronto-nasal region more elevated in plane of shield (not dished as in *texensis*); rostrum much larger, broader, and more massive; zygomata about the same but squamosal arm longer; palate flat (in *texensis* deeply concave between posterior molars); occipito-sphenoid longer; underjaw much more massive; ramus less tapering anteriorly; angular processes strongly bellied (in *texensis* not bellied); teeth larger.

Skull measurements.—Old male (type): Basal length, 319.5; occipito-nasal length, 305; palatal length, 173; zygomatic breadth, 215; interorbital breadth, 75.

URSUS MACRODON sp. nov.

Twin Lakes Grizzly.

Type skull No. 15707 (skin No. 12678), ♂ old, U. S. National Museum. From Twin Lakes, Colorado, July 28, 1876. Collected by C. W. Derry.

Characters.—Old male (type): Size large; hump evident; claws (worn short) large, broad, mainly yellowish on top, horn color on sides. Skull rather large and flat; last upper molar very large.

Color.—Type specimen: Peculiar for a grizzly, resembling some of the Alaska brown bears; general body color rich brown, almost reddish brown, darker on hump and lightly washed with pale tipped hairs on upper part of back; head rather uniform brown. *Adult female* (No. 203178) from South Branch Williams River, Colorado,

killed September 13, 1895: General color very dark, almost black. Muzzle reddish brown with a golden tinge on top, becoming very dark brown on cheeks, chin, and around eyes; top of head dusky, overlaid by deep rich glossy hazel or between hazel and chestnut; top of neck and upperparts generally blackish, moderately washed with golden-tipped hairs; hump marked and nearly black; legs and feet nearly black; the long hairs below ears and on sides of neck washed with golden. Claws long, slender, and smoothly polished; dark horn color, paler toward tips and on sides. Longest claw from upper base 61 mm. (tip worn off; greatest breadth of claws 8 mm.).

Cranial characters.—Old male (type): Skull long, low, flat, and rather narrow; shield narrow, flat, nearly horizontal, sloping gradually into rostrum without noticeable dishing; zygomata not broadly outstanding; squamosal root long but not vertically expanded; palate long and narrow; postpalatal notch narrow; underjaw long; ramus straight, swollen on outer side below premolars; coronoid blade high; subangular border rather short; angular process bellied; canines and molars large; M^2 40 mm. in length; heel long, slightly emarginate.

Female from South Branch Williams River, Colorado (No. 203178, September 13, 1895, collected and presented by J. P. Bird): Skull similar to that of male but much smaller, with correspondingly narrower shield and rostrum, and slightly more dished fronto-nasal region; shield low, narrow, flat, and gently sloping, the point slender and remarkably short for a female, ending anterior to fronto-parietal suture; sagittal crest proportionately long but low anteriorly; postorbital processes small, slightly elevated, and directed slightly backward; orbital rims somewhat thickened; rostrum small; nasals anteriorly horizontal, posteriorly rising slightly and passing into frontal shield in same plane; zygomata moderately spreading, angular; palate and postpalatal shelf short. Canines very small; molars large; M^2 38 mm., which is materially larger than in males of *texensis* and *planiceps*.

Cranial comparisons.—Skull of old male (type) similar in general to old male *texensis* (type) but slightly larger, with longer, flatter, and more nearly horizontal frontal shield, and somewhat higher fronto-nasal region and rostrum; shield somewhat longer pointed; fronto-nasal region elevated in plane of shield (not dished as in *texensis*); postorbitals more broadly outstanding; rostrum broader and somewhat longer; opening of lachrymal duct within orbital rim (in *texensis* anterior to rim): zygomata less widely outstanding; squamosal root longer; postpalatal shelf narrower; palate flatter; underjaw more massive; ramus less tapering anteriorly; inferior border of angular process strongly bellied or keeled (may be individual); canines and molars very much larger throughout (especially M^2).

Remarks.—In size and general appearance *macrodon* resembles *planiceps*, but the frontal shield is more nearly horizontal; postorbital processes less widely outstanding; *zygomata much less broadly outstanding* and *not bowed;* squamosal arm of zygoma longer; canines and molars, particularly M^2, decidedly larger. It may prove to intergrade with *planiceps.*

Skull measurements.—Old male (type): Basal length, 312; occipito-nasal length, 302; palatal length, 171; zygomatic breadth, 202; interorbital breadth, 72.

URSUS MIRUS sp. nov.

Yellowstone Park Grizzly.

Type No. 206595, ♂ ad. (rather old), U. S. National Museum, Biological Survey collection. From Slough Creek, Yellowstone National Park, March 27, 1915. Collected by Henry Anderson.

Cranial characters.—Old male (type): Size medium; skull long, rather narrow and low arched; shield rather narrow and flat, nearly horizontal postorbitally, anteriorly sloping gently into rostrum; postorbitals long, slender, and horizontally outstanding; rostrum high, subterete above; nares high; zygomata widely outbowed; squamosal root arched and broadly expanded; palate and postpalatal shelf narrow; mastoids vertical; underjaw moderate, swollen on lower part of outer side under diastema; subangular border rather long and sloping upward posteriorly. Teeth of medium size.

Cranial comparisons.—Old male (type) compared with old male *tahltanicus* (type): Basal length and vault of cranium essentially same; occipito-nasal length greater; shield and rostrum flatter; zygomata more outbowed; squamosal arm of zygoma longer and more broadly expanded; underjaw slightly longer; coronoid blade narrower in middle part; inferior border of ramus of same length; subangular border longer.

Old male (type) compared with old male *planiceps* (type): Size essentially same except that the rostrum is decidedly narrower and more elevated anteriorly; point of shield slightly more elevated; shield more sloping; postorbitals longer; rostrum narrower, higher, and subterete instead of flattened above; palate and postpalatal shelf narrower; zygomata even more strongly outbowed; occipito-sphenoid shorter; subangular border of lowerjaw longer; angular processes not bellied; teeth about same size.

Old male (type) compared with old male *texensis* (type): Similar in general characters but somewhat larger; vault of cranium slightly higher; rostrum much higher anteriorly and more nearly horizontal; nares much higher; postorbitals more slender and much more widely outstanding (121 contrasted with 104); posterior frontal region less

elevated; zygomata more outbowed (less triangular); squamosal root of zygoma much more broadly expanded; postpalatal shelf narrower; underjaw larger and longer; ramus less tapering anteriorly; subangular border somewhat longer.

Old male (type) compared with old male *shoshone* (type), with which it agrees in basal length: Vault of cranium lower; shield lower posteriorly and much less strongly sloping; rostrum higher anteriorly and more nearly horizontal; nares higher; sinus case not definitely keeling into sagittal crest; zygomata much more broadly outstanding and outbowed; squamosal root much more broadly expanded; postpalatal length less; canines[1] and molars closely similar.

Compared with old male *idahoensis* (type): Skull, palate, and rostrum longer; basicranium and vault less arched; squamosal arm of zygomata longer and more broadly expanded.

Remarks.—The cranial characters indicate that *mirus* of the Yellowstone Park region is rather closely related to *tahltanicus* of the Stikine region, and also, though apparently less closely, to *planiceps* of Colorado and southern Wyoming. It is so much smaller and has teeth so much smaller than *horribilis* and *imperator* that comparison in detail is unnecessary; and compared with *absarokus* the skull is so much lower, flatter, and narrower and the teeth so much smaller that the two can not be confused.

Skull measurements.—Old male (type): Basal length, 315; occipito-nasal length, 307; palatal length, 174; zygomatic breadth, 220; interorbital breadth, 77.

URSUS ELTONCLARKI[2] MERRIAM.

SITKA GRIZZLY.

Ursus eltonclarki Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 175–176, August 13, 1914.

Type locality.—Near Freshwater Bay, Chichagof Island, the more northern of the Sitka Islands, Alaska.

Type specimen.—No. 179066, ♂ ad., U. S. National Museum, Biological Survey collection. Collected May 19, 1912, by Elton Clark and by him presented to the Biological Survey.

Range.—The Sitka Islands, Baranof and Chichagof.

Characters.—A grizzly of medium or rather small size; skull small, long, narrow, and rather low, with flat frontal shield. Claws of true grizzly type, smoothly polished, strongly curved and rather short; longest claw (in type specimen) from upper base 70 mm.; dark bluish or plumbeous horn color streaked with whitish or yellowish.

[1] In the type specimen of *shoshone* the canines are absent, but they are present in a young male, No. 113410, from Marvine, Colorado, affording the desired comparisons.

[2] Named in honor of Elton Clark, of Boston, who killed and presented the type specimen.

Color.—Color of type very dark and rich. Nose pale brown, darkening just in front of eyes; face, head, and throat rich dark chocolate brown, with golden-brown wash in front of ears; ears and patch under each ear dusky; occiput and neck grizzled golden-brown; back pale, overlaid by buffy tips; legs and feet varying from blackish brown to brownish black.

Cranial characters.—Adult male (type): Skull elongate, narrow; zygomata moderately spreading, outbowed, rounded posteriorly, squamosal part not vertically expanded; frontal shield in same plane with rostrum, narrow, low, flat, or slightly concave, acutely rather short pointed posteriorly, the point entering sagittal crest about one-third the distance from fronto-parietal suture to postorbital process; sagittal crest moderate, reaching more than halfway from occiput to postorbital processes; postorbital processes rather thick, outstanding; fronto-nasal region elevated (not dished); rostrum high and sloping gently upward in plane of frontals; lachrymal opening within orbit; palate long and narrow; postpalatal shelf long; postpalatal notch long and narrow; occipito-sphenoid short, about 80 mm.; basisphenoid deeply concave, without trace of median ridge. Underjaw long. Teeth moderate; canines rather long; $PM_{\frac{4}{4}}$ with moderately sloping heel slightly upturned at tip, sulcus very shallow; $M_{\frac{1}{1}}$ rather short, with cusplet on inner side of saddle posteriorly; $M_{\frac{2}{2}}$ with anterior moiety decidedly longer than posterior and twin cusps of entoconid small and not deeply notched; PM^4 large and rather broad; M^1 broad and rather short; M^2 broad in anterior half, then narrowing strongly, the heel obliquely truncate on outer side; cusps rather weak.

Adult female: Similar, but much smaller, distinctly dished, point of shield lyrate, zygomata more angular.

Cranial comparisons.—Adult male (type) compared with adult *orgilos* (type): Size essentially same; vault of cranium higher; rostrum and fronto-nasal region longer and more elevated; postorbital processes heavier and shorter; occipito-sphenoid much shorter (80 mm. contrasted with 90); mandible more massive. Canines larger and longer; $M_{\frac{1}{1}}$ shorter; M^1 and M^2 shorter and broader (M^2 broader in middle.)

Remarks.—Ursus eltonclarki falls in the *tahltanicus* group. Oddly enough, it resembles *mirus*, a geographically remote member of the group from the Yellowstone Park country, much more closely than it does *tahltanicus*. It agrees with *mirus* essentially in narrowness of skull as a whole, elevation and narrowness of rostrum and narrowness of palate, and even exceeds *mirus* in narrowness of shield and postpalatal notch. Even the underjaw agrees surprisingly with that of *mirus*, and the molar series are of approximately the same length, but the lower canines are materially larger.

Skull measurements.—Adult male (type): Basal length, 316; occipito-nasal length, 322; palatal length, 173; zygomatic breadth, 215; interorbital breadth, 69.

URSUS TAHLTANICUS Merriam.

Tahltan Grizzly.

Ursus tahltanicus Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 181–182, August 13, 1914.

Type locality.—Klappan Creek (=Third South Fork Stikine River), British Columbia.

Type specimen.—No. 179928, ♂ old, U. S. National Museum, Biological Survey collection. Collected in September, 1906, and presented by G. Frederick Norton.

Range.—Middle and upper Stikine-Skeena region, limits uncertain.

Characters.—Size medium; skull of male slightly smaller than male *stikeenensis* and *canadensis;* skull of female about same size as female *stikeenensis*, decidedly larger than female *canadensis.* Color of type very dark.

Color.—Type specimen: Black (head absent, but entire body and legs almost coal black, lightly grizzled on shoulders and anterior part of back by tips of golden brownish).

Cranial characters.—Adult and old males: Rostrum rather narrow (in old age compressed in front of orbits); vault of cranium low, flattish; frontal shield of moderate breadth, flat or depressed (sometimes sulcate medially), rather short pointed, sloping gradually to plane of muzzle, and only slightly dished in fronto-nasal region; postorbital processes peglike, horizontally far outstanding; sagittal crest low, reaching forward a little more than halfway from inion to postorbitals; zygomata broadly spreading and bowed; palate of medium breadth; postpalatal shelf broad and flat; underjaw short—much shorter than in *stikeenensis*, *shoshone*, and *canadensis*—its ramus bellied and upcurved posteriorly, not flattened. Teeth rather small; canines and molars much smaller than in *stikeenensis.*

Female: Skull relatively large (about same length as female *stikeenensis* but much narrower); much larger than female *shoshone* and *canadensis;* vault of cranium moderately elevated, with tendency to a fronto-parietal hump; facial part of skull large and long; frontal shield long, rather narrow, lyre shaped posteriorly, meeting sagittal crest some distance posterior to fronto-parietal suture; fronto-nasal region well dished; palate and postpalatal shelf long; zygomata moderately spreading and conspicuously outbowed; underjaw long. *Young females* are best told by the teeth, especially the lower canines. In *tahltanicus* the lower canines are shorter and

more slender than those of *stikeenensis*. In the latter species they are longer and thicker, especially thick in middle.

Cranial comparisons.—Old male (type) compared with adult male *orgilos* (type): Size essentially same (basal length slightly less); top of skull higher; frontal shield broader and less flat; postorbital processes less slender; palate and postpalatal shelf shorter; zygomata less bowed but more widely outstanding; underjaw shorter, much more massive; inferior border of ramus shorter and more bellied posteriorly; coronoid blade more recurved.

Adult male compared with adult male *stikeenensis* (both inhabiting the same region): Basal length, zygomatic breadth, and frontal breadth essentially the same, but frontal region much lower, frontal shield not rising abruptly at orbits, but sloping gently in plane of rostrum; rostrum narrower, higher, and less nearly horizontal (appearing longer); postorbitals much smaller and more horizontally outstanding; palate shorter; underjaw shorter. Dentition lighter.

Skull measurements.—Old male (type): Basal length, 305;[1] occipito-nasal length, 304; palatal length, 163; zygomatic breadth, 220; interorbital breadth, 84.

URSUS INSULARIS MERRIAM.

ISLAND GRIZZLY.

Ursus eltonclarki insularis Merriam, Proc. Biol. Soc. Washington, XXIX, p. 141, September 6, 1916.

Type locality.—Admiralty Island, Alaska.

Type specimen.—No. 205186, ♂ old, U. S. National Museum, Biological Survey collection, 1914. Purchased from W. H. Case, of Juneau.

Characters.—An island grizzly, apparently related to *tahltanicus* and *orgilos* of the mainland, and to *eltonclarki* of Baranof and Chichagof Islands; in some respects a miniature of *hoots*. $PM\frac{4}{4}$ indistinctly of grizzly type. External characters unknown.

Cranial characters.—Adult male (type): Size medium; frontal shield broad and flattish, with *exceptionally large, broad, and flat postorbitals;* zygomata broadly outstanding; ramus of underjaw strongly upturned posteriorly, elevating coronoid and condyle. Teeth of medium size.

Cranial comparisons.—Adult male (type) compared with old male *tahltanicus* (type): Basal length, zygomatic breadth, breadth and form of frontal shield, breadth across postorbitals, truncation of nasals, and length of jaw essentially same, but postorbitals very much larger, especially broader and more decurved; fronto-nasal

[1] Restored.

region more dished; rostrum slightly longer; palate, postpalatal shelf, and postpalatal notch narrower; underjaw more massive and more upturned posteriorly; ramus longer; coronoid much higher; subangular border shorter. Molar series of approximately same length but more massive; M^1 longer, M^2 shorter.

Adult male (type) compared with adult male *eltonclarki* (type): Similar in general, agreeing essentially in basilar length, zygomatic breadth, length and narrowness of palate and postpalatal shelf, and narrowness of postpalatal notch, but differing widely in other characters. Vault of cranium less highly arched; frontal shield and postorbitals very much broader and more massive (shield interorbitally 82 mm. contrasted with 69), less flat, faintly sulcate medially; postorbital processes very much larger, broader, more widely outstanding (from tip to tip 120 mm. contrasted with 101) and more decurved; rostrum lower, broader, and shorter; nasals shorter (89 contrasted with 105—probably not constant). Underjaw more massive; inferior border of ramus longer, more swollen and more upcurved posteriorly; outer side of ramus not depressed or excavated below anterior base of coronoid; coronoid blade narrower and higher. Canines (both upper and lower) somewhat shorter; molars, especially M^1, M_1, and M_2 decidedly larger.

Compared with *orgilos* and *tahltanicus* of the mainland: Easily distinguished by great size of postorbitals and upturning of posterior part of ramus.

Compared with *kwakiutl:* Quickly told by general shortness of skull, including palate and underjaw, and by large size and breadth of postorbitals.

Skull measurements.—Old male (type): Basal length, 311; occipito-nasal length, 310; palatal length, 171; zygomatic breadth, 216; interorbital breadth, 82.

URSUS ORGILOS Merriam.

Glacier Bay Grizzly.

Ursus orgilos Merriam, Proc. Biol. Soc. Washington, XXVII, p. 176, August 13, 1914.

Type locality.—Bartlett Bay, east side of Glacier Bay, Southeastern Alaska.

Type specimen.—No. 180280, probably ♂, rather old, U. S. National Museum, Biological Survey collection. Collected August 22, 1912, by A. Hasselborg.

Cranial characters.—Size medium; skull long, rather narrow, low, flat on top, slightly dished. Frontal shield rather narrow, flat, concave between orbits, acute pointed posteriorly; postorbital processes long, slender, outstanding, slightly decurved and recurved (posteriorly);

rostrum normal or rather small; nasals nearly horizontal, slightly uplifted and decurved anteriorly; braincase long and low; squamosal shelves long; zygomata moderately spreading and strongly outbowed, the broadest part more anterior than usual; sagittal crest straight and nearly horizontal, reaching only to fronto-parietal suture; palate long and rather narrow; postpalatal shelf long, flat, and rather broad for size of skull; jugal broad anteriorly, rising well above lachrymal duct; lachrymal duct opening within orbit; occipito-sphenoid long (90 mm.); underjaw long; coronoid blade broad at base, moderately high, the apex moderately recurved. Teeth of medium or rather small size.

Cranial comparisons.—*Ursus orgilos* needs to be distinguished from its neighbors, *orgiloides*, *tahltanicus*, and *pallasi*. Compared with *orgiloides*, with which it agrees essentially in size of skull and length of braincase: Shield narrower, gently sloping instead of rising strongly from rostrum; rostrum longer and narrower; palate narrower. Compared with *tahltanicus:* Skull and shield narrower; postorbitals more slender and delicate; zygomata much less outstanding; underjaw more slender and delicate. Compared with *pallasi:* Skull as a whole, braincase, and posterior part of frontal shield much longer; shield less elevated above rostrum; sagittal crest shorter.

Skull measurements—Probably old male (type): Basal length, 316; occipito-nasal length, 304; palatal length, 177; zygomatic breadth, 207; interorbital breadth, 75.

URSUS ORGILOIDES sp. nov.

Alsek Grizzly.

Type No. 223275, probably ♂, U. S. National Museum, Biological Survey collection. From Italio River, Alaska. Collected November, 1916. Purchased from E. M. Axelson, of Yakutat.

Range.—Coast strip southeast of Yakutat Bay. Specimens have been received from near Yakutat village and from Ankow and Anklin Rivers and mouths of Alsek and Italio Rivers.

Cranial characters.—Skull of medium size, long, low, and smoothly rounded, rather narrow, with long braincase, long-pointed shield, rather short rostrum, and large broadly rounded lambdoid crest; shield medium, *rising strongly from horizontal rostrum*, sulcate interorbitally and swollen between sulcus and orbits; point ending at or near fronto-parietal suture; postorbital processes moderate, somewhat decurved; sagittal crest rather short; occipital overhang and inion well developed; rostrum short, broad for size of skull; nares truncate; zygomata not widely outstanding and not bowed; palate long,

of moderate breadth; mastoids appressed; meatus tube large and free; underjaw long; coronoid blade moderate; apex only slightly recurved. Teeth rather small.

Cranial comparisons.—Adult male (type) compared with the type of *orgilos:* Size, length of braincase, and length of postorbital part of frontal shield essentially same; shield broader, *rising strongly from rostrum instead of sloping gradually into rostrum*, sulcate anteriorly and swollen between sulcus and orbits; rostrum shorter and broader; lachrymal duct opening on orbital rim instead of within rim; zygomatic arches more subtriangular (less bowed); palate broader; meatus tube much larger; lambdoid crest more highly developed and more broadly rounded. Teeth about same size; $PM_{\frac{4}{4}}$ distinctly of grizzly type (in *orgilos* subconical).

Compared with the type of *pallasi*, which it strongly resembles: Length about an inch greater (mainly in posterior part of skull); braincase and point of shield much longer; sagittal crest much shorter; occipito-sphenoid and palate longer; mastoids appressed instead of divergent; underjaw much longer, but inferior border of ramus of essentially same length; subangular border slightly longer.

Remarks.—Unfortunately there is possible doubt as to the sex of the type specimens of *orgilos* and *orgiloides*, though both are believed to be males. Both skulls have the appearance of males, except that in *orgiloides* the point of shield is longer than usual in males and the canines are small for males of corresponding size.

Skull measurements.—Adult male (type): Basal length, 316.5; occipito-nasal length, 300; palatal length, 169; zygomatic breadth, 218; interorbital breadth, 81.5.

URSUS PALLASI Merriam.

Pallas Grizzly.

Ursus pallasi Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 149–150, September 6, 1916.

Type locality.—Donjek River, southwestern Yukon.

Type specimen.—No. 205160, ♂ old, U. S. National Museum, Biological Survey collection. Collected August, 1913, by T. A. Dixon.

Range.—Southwest corner of Yukon Territory, east of the St. Elias Range (Kluane Lake, Donjek River, St. Clair River) and adjacent eastern border of Alaska; easterly to McConnell River and Teslin Lake and south into northern British Columbia.

Cranial characters.—Old male (type): Size small, one of the smallest of the grizzlies; skull moderately elevated, flattish on top, with relatively broad frontal shield rising strongly at orbits. Frontal

shield flattish, exceedingly short pointed posteriorly, faintly depressed medially between orbits, slightly swollen on sides of median depression, strongly sloping to rostrum; postorbital processes small, peglike, horizontally outstanding; fronto-nasal region strongly dished; rostrum short, somewhat depressed and pugged; nasals rising anteriorly; nares small and subtruncate; sagittal crest long, reaching to halfway between fronto-parietal suture and plane of postorbitals; zygomatic arches moderately outstanding, narrow, and slender, not expanded vertically; palate and postpalatal shelf short and broad; mastoids long and spreading. Underjaw long for size of skull; coronoid narrow above, the apex not reaching plane of condyle; teeth rather large for size of skull.

Old female (No. 205162) from St. Clair River, Yukon; collected September 6, 1914, by A. Hoyt: Size very small; frontal shield remarkably broad for so small a skull, convex and medially sulcate interorbitally; fronto-nasal region strongly dished; postorbitals small, outstanding; rostrum short and depressed; palate and postpalatal shelf short and broad; zygomata rather strongly outstanding, subtriangular. Underjaw very small and light; coronoid moderate, apex strongly recurved; teeth very small, nearly as small as in *nelsoni*.

Cranial comparisons.—Ursus pallasi, owing to the number of species occurring in or adjacent to its range, should be known from *tahltanicus*, *orgilos*, *orgiloides*, *pulchellus*, and *kluane*. It may be related to *tahltanicus* but is easily distinguished by its low broad rostrum, strongly dished fronto-nasal region, very short shield, less elevated midfrontal region, long and rather high sagittal crest, and larger teeth; while *tahltanicus* has a higher and narrower rostrum, sloping fronto-nasal region, much longer shield, higher midfrontal region, shorter and lower sagittal crest, and smaller teeth. From *orgilos* and *orgiloides* it may be told by the shortness of the skull as a whole, shortness of braincase and point of frontal shield, and greater length of sagittal crest. From *pulchellus* it differs in lower vault of cranium, much broader shield and rostrum, shorter rostrum, broader palate and postpalatal shelf, longer underjaw, and smaller molars. From *kluane* it differs strikingly in much smaller size, much lower arch of cranium, conspicuously shorter braincase and sagittal crest; very much smaller, narrower, and less strongly decurved postorbitals; very much less elevated and more dished fronto-nasal region; much lower rostrum; much shorter palate and much shorter underjaw.

Adult female compared with adult female *kluane:* Size of skull essentially same or slightly smaller; canines smaller; *molars very much smaller.*

Skull measurements.—Old male (type): Basal length, 302.5; occipito-nasal length, 279; palatal length, 159; zygomatic breadth, 209; interorbital breadth, 72.5.

URSUS RUNGIUSI RUNGIUSI[1] SP. NOV.

RUNGIUS GRIZZLY.

Type No. 179893, ♂ young-adult, U. S. National Museum, Biological Survey collection. Collected September, 1910, in Rocky Mountains on headwaters of Athabaska River, Alberta, by Carl Rungius, and by him presented to the Biological Survey.

Characters.—Young-adult male (type): Size small; skull low and flat, with low depressed braincase, very broad depressed sinus case, medium or narrow and exceptionally short frontal shield, long sagittal crest, and long, peglike outstanding postorbital processes. *Fully adult males* differ somewhat. An old male from Fortress Lake, head of Athabaska River (No. 40091, Amer. Mus. Nat. Hist.), killed in May, 1916, by Malcolm S. Mackay; another old male (No. 1919, Ottawa Museum) from Kootenay Pass, Alberta; and a fully adult male (No. 209899) from Indian Point Creek, near Barkerville, B. C., present the following characters: Skull small, low, and nearly flat; shield low, of medium breadth, broadly flat-concave between orbits, sloping gradually into rostrum, very short pointed posteriorly; postorbitals peglike, outstanding, and elevated; orbital rims slightly thickened and everted; rostrum small, narrow, and rather high for so small a skull; zygomata widely outbowed; palate and postpalatal shelf narrow; base of cranium rather narrow; mastoids appressed (not outstanding); underjaw rather light; apex of coronoid recurved. Dentition moderate. PM_4 distinctly of grizzly type. Canines and upper molars rather large for so small a skull.

Cranial comparisons.—Adult male (No. 209899), from Indian Point Creek, B. C., compared with adult male *macfarlani* (type): Size slightly less; skull as a whole much lighter; rostrum much smaller and less elevated; fronto-nasal region slightly dished; zygomata much less widely outbowed; palate and postpalatal shelf much narrower; sagittal crest shorter; base of skull narrower; underjaw much less massive; apex of coronoid more recurved. Dentition lighter (except M^2, which is of about same size in both); M_1 less swollen; PM_4 distinctly of grizzly type (not conical as in *macfarlani*).

Adult male (No. 209899, from Indian Point Creek, B. C.) compared with adult male *ophrus* (type): Size smaller; vault of cranium very

[1] Named for the artist, Carl Rungius, of New York, who collected and presented the type specimen.

much lower and flatter; frontal shield broadly concave, not deeply sulcate medially; postorbital processes more slender and horizontal; orbital rims slightly or not swollen; fronto-nasal region not notably dished; rostrum lower; nares smaller; sagittal crest less highly developed and straighter (less convex); zygomata very much less outbowed and only slightly arched (in *ophrus* very highly arched) mastoids much shorter; underjaw much shorter; coronoid about the same size; upper canines and upper and lower molars about the same size; lower canines smaller.

Adult and old males compared with old male *hylodromus* (No. 205170), from Selkirk Mountains, B. C.: Skull shorter; shield flat-concave, rising at orbits and postorbitals (in *hylodromus* decurved laterally); posterior part of shield very much shorter; vault of cranium much lower; braincase more depressed; rostrum smaller, narrower, more nearly horizontal; zygomata more outbowed (less triangular); sagittal crest longer; postpalatal shelf narrower.

Skull measurements.—Young-adult male (type): Basal length, 293; occipito-nasal length, 282; palatal length, 162; zygomatic breadth, 190; interorbital breadth, 73. Adult male (No. 209899) from Indian Point Creek, B. C.: Basal length, 294;[1] occipito-nasal length, 278.5; palatal length, 161; zygomatic breadth, 198; interorbital breadth, 75. Old male (No. 40091 Amer. Mus. Nat. Hist.) from head Athabaska River, B. C.: Basal length, 295; occipito-nasal length, 276; palatal length, 166; zygomatic breadth, 214; interorbital breadth, 75.

URSUS RUNGIUSI SAGITTALIS SUBSP. NOV.

CRESTED GRIZZLY.

Type No. 210705, ♂ ad. (rather old), U. S. National Museum, Biological Survey collection. From Champagne Landing, southwestern Yukon. Collected in the fall of 1915. Purchased from Mackay & Dippie.

Cranial characters.—Adult male (type): Size small; skull low and narrow; shield flat or flat-concave, narrow, short pointed, sloping gradually into rostrum; postorbitals slender, outstanding; rostrum slender; nares large and oblique; zygomata moderately outstanding, subtriangular; sagittal crest long, high, and arcuate; palate narrow; underjaw long and slender; coronoid small and falcate; subangular border short. Dentition moderate.

Cranial comparisons.—Adult male (type) compared with adult male *rungiusi* (No. 209899): Skull similar in general but shield narrower and flatter; postorbitals more slender; orbital rims not thickened or everted; *nares larger and more oblique; sagittal crest very*

[1] Restored.

much higher, rising well above point of shield; squamoso-jugal suture much shorter; underjaw longer; coronoid smaller and more falcate; subangular border shorter. Canines slightly larger; M^2 somewhat smaller.

Adult male (type) compared with *orgilos* (type): Skull about an inch shorter; braincase very much shorter: point of shield much shorter; sagittal crest longer, much higher, and arcuate instead of straight; rostrum much smaller; squamosal arm of zygoma much shorter; underjaw and ramus much shorter; subangular border nearly the same; coronoid blade narrower.

Skull measurements.—Adult male, old: Basal length, 295;[1] occipito-nasal length, 281; palatal length, 160; zygomatic breadth, 200; interorbital breadth, 71.5.

URSUS MACFARLANI[2] SP. NOV.

MacFarlane Bear.

Type No. 6551, ♂ ad., U. S. National Museum. Collected on Anderson River, 50 miles below Fort Anderson, Mackenzie, May 8, 1863, by R. MacFarlane. (Original No. 551.)

Characters.—External characters unknown. Relationship apparently with *rungiusi.*

Cranial characters.—Size medium; skull of adult male (type) massive, low, broad, flat; tip of nose to point of shield in same plane without trace of dishing. Frontal shield low, flat-concave, rather broad, exceptionally short posteriorly, shallowly concave between orbits, not rising above plane of rostrum; postorbitals large, horizontally outstanding and slightly elevated; rostrum broad and high, large for size of skull; zygomata widely outbowed; sagittal crest long and low; palate and postpalatal shelf broad; underjaw massive, coronoid blade high, narrow, nearly vertical, obtusely rounded above; subangular border exceptionally short. Dentition heavy: Canines and molars large for size of skull; PM_4 subconical; M_1 swollen; M^2 moderate, the heel slightly emarginate and rather broadly rounded posteriorly. In immature and young-adult males the frontal shield is less flat, the sides (between sulcus and orbits) strongly swollen (as shown by No. 7146, from Franklin Bay; and 2773, Ottawa Museum, from Stapylton Bay).

Cranial comparisons.—Adult male (type) compared with adult male *rungiusi* (No. 209899) from Indian Point Creek near Barkerville, B. C.: Skull slightly larger and *much more massive*, with higher

[1] Partly restored.

[2] Named in honor of Roderick MacFarlane, who collected the specimen and presented it to the Smithsonian Institution.

and much broader rostrum, and much more widely outbowed zygomata; sagittal crest longer; palate, postpalatal shelf, and base of skull much broader; underjaw much more massive; coronoid blade more nearly vertical and less recurved at apex. Dentition heavier: Canines and molars, upper and lower, larger; M_1 more swollen; PM_4 subconical (not at all of grizzly type).

Skull measurements.—Adult male (type): Basal length, 303; occipito-nasal length, 283; palatal length, 164; zygomatic breadth, 218; interorbital breadth, 79.

URSUS CANADENSIS MERRIAM.[1]

CANADA GRIZZLY.

Ursus shoshone canadensis Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 184–185, August 13, 1914.

Type locality.—Moose Pass, near Mount Robson, British Columbia.

Type specimen.—No. 174511, ♂ ad., U. S. National Museum. Collected by N. Hollister and Charles D. Walcott, jr., July 23, 1911. (Original No. 3792, Hollister catalogue.)

Range.—Eastern British Columbia; limits unknown (type from near Mount Robson; and an adult female from Kootenay Lake).

Characters.—Size medium; color brown, grizzled with buff; claws short for a grizzly, rather thick, moderately curved, pale yellowish on upper surface and tips, brownish horn color on sides.

Color.—Muzzle very pale drab brown, changing to darker brown on head, face, and chin, darkest around ears; top of head, cheeks posteriorly,[2] ears, back, and thighs washed with buffy whitish from abundance of buffy-tipped hairs; foreleg and lower part of hind leg and feet very dark (almost blackish brown); long hairs of throat and axillary region pale yellowish, of rest of underparts dark brown.

Cranial characters.—Adult male (type): Skull of medium size, rather long, low, and narrow, flat in frontal region, with long, high sagittal crest rising above general level of top of cranium. Frontal shield small, flat, narrow, faintly depressed medially, short pointed posteriorly, gently sloping; postorbitals slender, peglike, horizontally outstanding; rostrum relatively high, tapering anteriorly; sagittal crest remarkably long, arcuate, and high, reaching nearly to midway between fronto-parietal suture and plane of postorbitals; zygomata moderate, slightly outbowed, and only slightly expanded vertically; palate excavated between molar series; postpalatal shelf rather long and broad; notch medium or narrow. Underjaw rather massive;

[1] Tentatively included in *planiceps* group. (See Introduction, pp. 12–13.)

[2] The old whitish-tipped hairs of the old coat have fallen out on the cheeks and anterior part of head nearly to ears.

ramus moderately bellied posteriorly; coronoid blade broad and rather short, the apex cutting plane of condyle. Dentition rather heavy; canines thick and short; molars broad.

Adult female (No. 209902 from Kootenay Lake, British Columbia): Skull rather small, long, narrow, low, and slightly dished. Frontal shield *narrow*, flattish, slightly depressed medially between orbits, long pointed, the point reaching to midparietal region; postorbitals moderate; rostrum long and slender, tapering; zygomata moderately spreading. Underjaw similar to that of male but much smaller; coronoid blade relatively narrower and higher. Dentition heavy; teeth similar to those of male and only slightly smaller; canines large and swollen; molars broad.

Cranial comparisons.—Adult male (type) compared with adult male *macrodon* (type): Size essentially same; shield more strongly sloping; postorbitals more slender; rostrum lower and more tapering; sagittal crest higher; inion much more strongly produced; subangular border of ramus shorter; angular process not bellied; canines smaller; M^2 and $M_{\overline{2}}$ decidedly smaller.

Skull measurements.—Adult male (type): Basal length, 313; occipito-nasal length, 312; palatal length, 171; zygomatic breadth, 208; interorbital breadth, 74.

Arizonæ Group.

URSUS ARIZONÆ Merriam.

Arizona Grizzly.

(Pl. XVI.)

Ursus arizonæ Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 135–136, September 6, 1916.

Type locality.—Escudilla Mountains, Apache County, Arizona.

Type specimen.—No. 177332, ♂ ad., U. S. National Museum, Biological Survey collection. Collected September 3, 1911, by C. H. Shinn.

Cranial characters.—Size rather large; skull as a whole rather long and narrow, with broad rostrum; vault of cranium moderately elevated but not arched, highest about two-thirds distance from plane of postorbitals to fronto-parietal suture; frontal shield rather narrow, nearly flat, gently sloping in plane of rostrum, the posterior point in type specimen reaching to about 25 mm. in front of parietals (in older specimens shorter); postorbitals broad and broadly rounded, nearly horizontal, but not widely projecting; fronto-nasal region and rostrum elevated and swollen, continuing plane of frontal shield without trace of dishing, tapering anteriorly; zygomata not

widely outstanding, bowed, anterior roots swollen; palate rather short and broad; postpalatal shelf broad; meatus tube long; coronoid blade rather broad above, its recurved apex cutting plane of condyles. Teeth rather small for size of skull; canines of good size; molars rather small for size of skull, especially last upper molar.

Cranial comparisons.—Adult male (type) compared with old male *apache* (type): Basilar length, occipito-nasal length, length of palate, interorbital breadth, and occipito-sphenoid length essentially the same; zygomata very much less outstanding and subtriangular instead of bowed; frontal shield flatter, of essentially the same breadth interorbitally, but very much narrower across postorbital processes; postorbital processes much less broadly outstanding; orbital rims less swollen; fronto-nasal region much more elevated and swollen; rostrum much larger, broader, more swollen, and tapering instead of depressed basally, narrow, and horizontal; palate and postpalatal shelf much broader. Underjaw weaker; ramus less broad vertically; coronoid blade less high; molars slightly larger; heel of M^2 longer, more distinctly emarginate on outer side (less tapering).

Skull measurements.—Adult male (type): Basal length, 326; occipito-nasal length, 323; palatal length, 175; zygomatic breadth, 208; interorbital breadth, 82.

URSUS IDAHOENSIS sp. nov.

IDAHO GRIZZLY.

Type No. 93, ♂ old, Merriam collection (=187888 U. S. National Museum), from North Fork Teton River, eastern Idaho, September 23, 1874. Killed by the late Richard Leigh (better known as "Beaver Dick").

Characters.—Size rather large, about equaling *arizonæ* (much smaller than *horribilis* and subspecies, and shorter than *rogersi*, *bisonophagus*, and *perturbans*); frontal shield convex both longitudinally and transversely; fronto-nasal region elevated and somewhat compressed (much as in *rogersi*, but rostrum much shorter); postorbital processes rather weak and decurved as in *rogersi* and *arizonæ;* sagittal crest rather short and not strongly developed; zygomata moderately outbowed; coronoid blade rather high, but less high than in *bisonophagus* and *rogersi;* ramus flattish, broad vertically, but much less broad and massive then in *rogersi;* dentition rather heavy; M^2 large, its heel elongate, emarginate, but not narrowed posteriorly, slightly everted; canines rather small, about as in *rogersi* and *arizonæ*.

An old female (No. 160153) from Wallowa Mountains, Oregon, is assumed to be typical of *idahoensis*. It has a long, low, slender, smoothly rounded skull with narrow zygomatic arches, narrow palate, rather broad postpalatal shelf, and very small teeth.

Skull measurements.—Old male (type): Basal length, 317; occipito-nasal length, 318; palatal length, 177; zygomatic breadth, 206; interorbital breadth, 81.

URSUS PULCHELLUS PULCHELLUS SP. NOV.

UPPER YUKON GRIZZLY.

Type No. 221599, ♂ ad., U. S. National Museum, Biological Survey collection, from Ross River, Yukon Territory, Canada. Collected July 20, 1916, by Fred E. Enevoldsen.

Characters.—Size small; frontal shield and rostrum narrow; vault of cranium well arched; base of cranium moderately arched; shield rising rather strongly from plane of rostrum, convex transversely but shallowly sulcate medially, short pointed posteriorly (point ending about halfway between plane of postorbitals and fronto-parietal suture); rostrum slender and high; fronto-nasal region dished; nasals nearly horizontal; sagittal crest only slightly developed, not high posteriorly, somewhat decurved; occiput rather low and shortly truncate; palate and postpalatal shelf rather narrow; zygomata subtriangular; squamosal root expanded vertically; occipito-sphenoid short (80 mm.); underjaw short, its inferior border straight; coronoid rather low, broad basally, apex strongly recurved; subangular border short. Teeth, particularly molars, large for so small a skull; last upper molar broadly quadrate anteriorly, the heel abruptly and strongly emarginate, narrowly rounded posteriorly; M^1 large, broad, and massive.

Cranial comparisons.—*Ursus pulchellus* requires comparison with its near relative *ereunetes*, and also with *pallasi* and *kluane*. Adult male (type) compared with adult male *ereunetes* (type): Size slightly smaller; fronto-nasal region more dished; shield less flat; zygomata broad (in *ereunetes* slender); occipito-sphenoid shorter; M^1 larger and more massive.

Compared with old male *pallasi* (type): Basal length slightly less; occipito-nasal length same; zygomatic breadth less; cranium higher and more arched; frontal shield and rostrum conspicuously narrower; palate and postpalatal shelf narrower; rostrum longer, higher, and more slender; squamosal root of zygoma more broadly expanded vertically; mastoids less elongate; underjaw shorter and less massive. Upper molars larger and more massive.

Compared with adult male *kluane:* Similar in general appearance but skull as a whole, braincase, palate, and underjaw *very much shorter;* frontal shield *very much narrower;* inferior border of ramus more abruptly upcurved; subangular border more nearly horizontal and much more sharply defined.

Remarks.—The type of *pulchellus* came from Ross River, a northern tributary of the Pelly. Skulls of males from the southwestern corner of Yukon (Donjek River and Champagne Landing) differ in greater occipito-nasal length, more highly arched cranium, more elevated rostrum, and less deeply emarginate heel of M^2.

I refer to *pulchellus* an adult female, No. 204187, from McConnell River, Yukon, and a still older female, No. 215113, from Ross Mountains.

Skull measurements.—Adult male (type): Basal length, 292; occipito-nasal length, 281; palatal length, 160; zygomatic breadth, 196; interorbital breadth, 66.

URSUS PULCHELLUS EREUNETES SUBSP. NOV.

KOOTENAY GRIZZLY.

Type No. 222323, ♂ ad., from Beaverfoot Range, Kootenay District, British Columbia. Collected October 1, 1916, by George Hill, of Field, British Columbia.

Characters.—Size rather small; occiput shortly truncate; vault of cranium and basicranial axis well arched; fronto-nasal region elevated, sloping gradually upward, not dished; rostrum small, rather narrow, rising gradually into shield; point of shield ending about two-thirds distance from plane of postorbitals to fronto-parietal suture; zygomata slender, rather broadly outbowed for size of skull. Last upper molar broad anteriorly, the anterior part of cingulum on inner side produced, the heel emarginate, narrowing posteriorly, subtriangular; middle lower molar large and massive.

Skull in general similar to that of *pulchellus* but slightly larger, with more elevated fronto-nasal region, flatter shield, much more slender zygomata, and much longer occipito-sphenoid; teeth as in *pulchellus* except that M^1 is smaller, and M_2 is less quadrangular anteriorly.

Skull measurements.—Adult male (type): Basal length, 297; occipito-nasal length, 278; palatal length, 165; zygomatic breadth, 203; interorbital breadth, 72.

URSUS ORIBASUS SP. NOV.

LIARD RIVER GRIZZLY.

Type No. 223991, ♂ ad. (rather old), U. S. National Museum, Biological Survey collection. From Upper Liard River, Yukon, near British Columbia boundary. Killed by J. Thompson in the spring of 1916. (Purchased from William Drury, of Whitehorse.)

Characters.—*Adult male* (type): Size large; hump absent or in-

conspicuous; color dark; claws long (longest 90 mm.[1]) and unusually straight; top convex in section, dark horn color, paler at tips and along upper surface; skull long, narrow, and arched, with elevated straight-sloping fronto-nasal region (much like that of *ereunetes* but much longer posteriorly). Frontal shield, rostrum, and molar teeth narrower than in any other member of the *shoshone* group.

Color.—General ground color dark brown to dusky; muzzle dull golden brown, becoming much darker between eyes; a dark ring around each eye; cheeks chestnut brown; top of head, nape, and shoulders strongly washed with yellowish buffy; back washed with soiled buffy; rump dark brownish dusky; legs and feet dusky blackish.

Cranial characters.—Adult male (type): Skull rather large, long, narrow, rather strongly arched both above and below, with high straight-sloping (not dished) fronto-nasal region. Frontal shield narrow, flat, gently sloping, the point reaching two-thirds distance from postorbitals to parietals; postorbitals rather small, horizontally outstanding; rostrum narrow and high, in same plane with frontal shield; braincase and sagittal crest long; inion and occipital overhang marked; zygomata well outstanding, strongly subtriangular, squamosal base broadly expanded; basicranium and palate arched; palate and postpalatal shelf narrow; occipito-sphenoid 92 mm.; mastoids large, divergent. Underjaw long; ramus long and flat; subangular border short and broad; coronoid blade narrow. Canines rather long; molars narrow and rather small; M^2 small, narrowly triangular, the heel small, thin, and pointed; PM_4 imperfectly of grizzly type.

Cranial comparisons.—Old male (type) compared with old male *chelan* and *idahoensis* (both types): Length, height, and arching essentially same; shield narrower, flatter, and more nearly horizontal; sinus case and rostrum narrower; top of rostrum higher and more completely in fronto-nasal plane; zygomatic arches shorter and more angular (less outbowed), the inclosed space (temporal fossa) much smaller. Underjaw shorter and weaker; subangular border shorter; coronoid blade narrower.

Old male (type) compared with adult male *ereunetes* (type): Similar in general appearance but *length much greater;* shield flatter; rostrum more elevated; braincase much longer; sagittal crest much longer and higher; inion more strongly produced; squamosal base of zygoma broadly expanded (in *ereunetes* not expanded). Canines longer; molars smaller and *very much narrower.*

[1] Claw of second or index finger longest, but second, third, and fourth practically subequal; claw of thumb very long. Claw measurements of right hand (those of left hand more worn at tips) from upper exposed base to tip: First, 82 mm.; second, 90; third, 88; fourth, 89; fifth, 68.

Remarks.—*Ursus oribasus* appears to be closely related to *pulchellus* and *ereunetes*, both of which have decidedly smaller skulls with larger teeth. It is related also to *idahoensis* and *chelan*, which are about the same size, but have much broader skulls and differ otherwise as already pointed out.

Skull measurements.—Adult male (type): Basal length, 310; occipito-nasal length, 304; palatal length, 172; zygomatic breadth, 215; interorbital breadth, 75.

URSUS CHELAN MERRIAM.

CHELAN GRIZZLY.

Ursus chelan Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 136–137, September 6, 1916.

Type locality.—East slope Cascade Mountains, northern Chelan County, Washington.

Type specimen.—No. 205185, ♂ old, U. S. National Museum, Biological Survey collection. Killed in Township 30 N, Range 16 East, Willamette Meridian, Wenatchee National Forest. Collected September 1, 1913, by D. S. Rice.

Range.—Cascade and Cassiar Mountains from northern Washington to upper Stikine River and Dease Lake, British Columbia.

Cranial characters.—(External characters unknown). Skull of medium or rather large size; facial axis strongly deflected from basicranial axis; vault of cranium well arched, highest over posterior frontal region; sagittal crest long, high, arcuate, rising anteriorly above general level of top of cranium. Affinities apparently with *hylodromus* on the one hand, and with *shoshone* and *pervagor* on the other. Frontal shield narrow, flattened, short pointed posteriorly, ending about midway between fronto-parietal suture and plane of postorbitals, slightly sulcate medially; postorbital processes rather broad, flat, outstanding horizontally (not depressed or decurved); fronto-nasal region including posterior two-thirds of nasals sloping strongly, forming part of long fronto-facial plane; rostrum small, short, somewhat depressed, sloping anteriorly to nares, gradually rising posteriorly into frontal plane; braincase long, arched, frontal part keeled into sagittal crest; palate arched antero-posteriorly, slightly concave; postpalatal shelf broad; zygomata broadly spreading, rounded and outbowed posteriorly, vertically expanded and strongly arched; mastoids of medium length, spreading; underjaw massive; ramus swollen on outer side over roots of M_2 and M_3, bellied under last molars; coronoid blade high, its anterior border rather strongly recurved, the apex overarching high coronoid notch but barely reaching plane of front of condyle; teeth rather small for size of skull (so badly worn in type specimen that proportions of canines can not be determined).

Cranial comparisons.—Old male *chelan* differs from all its relatives in the degree of deflection of the facial part of the skull, and exceeds all except *hylodromus* in the arching of the palate.

Old male (type) compared with *pervagor* (type): Basal length slightly less; zygomatic breadth greater; frontal shield shorter pointed and flatter; postorbitals flatter and apparently broader; sagittal crest longer, higher anteriorly and more convex; rostrum shorter and more strongly sloping anteriorly; nares more truncate; zygomata more strongly outbowed, more arched, more expanded vertically, squamosal arm longer (squamoso-jugal suture much longer); palate shorter and more strongly arched; underjaw shorter, its inferior ramus much shorter; coronoid blade slightly higher and more falcate. Some of these differences may be due to age, the skull of the type of *chelan* being very old, while the type of *pervagor* is only adult. However, it differs rather conspicuously from equally old male *pervagor* from Bridge River (No. 4, Provincial Museum, Victoria, B. C.) as will be seen from the following: Basal length 20 mm. less; occipito-nasal length slightly greater; zygomatic breadth less; facial part strongly deflected (in *pervagor* not deflected); palate arched (in *pervagor* not arched); frontal shield shallowly sulcate medially (in *pervagor* broadly concave); postorbitals broad, flat, horizontally outstanding (in *pervagor* long, peglike, uplifted, and arched); braincase and sagittal crest arched (in *pervagor* straight and nearly horizontal); occipital overhang much greater; zygomata less widely outbowed.

Old male (type) compared with old male *hylodromus* (No. 205170) from Selkirk Mountains, British Columbia: Size larger (basal length only slightly greater but occipito-sphenoid and occipito-nasal lengths much greater, and skull as a whole distinctly larger); vault of cranium decidedly more highly arched; facial angle more strongly deflected from basicranial axis; zygomata much more widely spreading and outbowed and much more arched; frontal shield rising less abruptly from rostrum, more evenly sloping, rising higher posteriorly, and much shorter pointed; braincase and sagittal crest much longer, the crest higher and convex or arcuate anteriorly; occipital overhang greater; palate more strongly arched (antero-posteriorly); mastoids longer and strongly spreading. Underjaw longer and more massive, more swollen on outer side below middle and posterior molars; its inferior border more bellied posteriorly; coronoid blade very much higher.

Old male (type) compared with old male *washake* (type): Size slightly larger (basal length essentially the same, but upper part of skull much longer); vault of cranium more highly arched; frontal shield continuing to rise posteriorly (instead of flattened) and much shorter pointed; rostrum decidedly broader; postorbital processes

not elevated; lachrymal duct within orbit (not cutting rim as seen from front); braincase compressed and keeled anteriorly (in *washake* depressed); sagittal crest much longer and convex instead of straight; squamosal arm of zygoma longer and more broadly expanded vertically; palate concave and arched antero-posteriorly, instead of flat; postpalatal shelf longer and less broadly flattened; occipito-sphenoid longer; mastoids longer and more spreading. Molars smaller.

Skull measurements.—Old male (type): Basal length, 314; occipito-nasal length, 323; palatal length, 170; zygomatic breadth, 225; interorbital breadth, 86.

URSUS SHOSHONE Merriam.

Shoshone Grizzly.

Ursus shoshone Merriam, Proc. Biol. Soc. Washington, XXVII, p. 184, August 13, 1914.

Type locality.—Estes Park, Rocky Mountains of northern Colorado.

Type specimen.—No. 203185, ♂ old, U. S. National Museum, Biological Survey collection.

Range.—Mountains of Colorado and Wyoming.

Characters.—Size medium or rather large, but much smaller than *horribilis* and *bairdi*—skull about same size as *absarokus*, but narrower and widely different. External characters unknown.

Cranial characters.—Adult male (type): Skull rather long and high, with flattish, short-pointed, long-sloping frontal shield continuing plane of rostrum to highest point, about midway between postorbitals and fronto-parietal suture; zygomata moderately spreading, outbowed; anterior (frontal) part of braincase keeling into sagittal crest; sagittal crest long and high; lambdoid crest high; postorbital processes peglike, outstanding, rather slender; nasal region slightly dished and sulcate in middle third (nasals dipping toward one another—may be individual); rostrum of moderate breadth, strongly ascending in plane of frontal shield; palate slightly dished between posterior molars; postpalatal shelf broad; postpalatal notch long and narrow; lachrymal duct cutting orbital rim but mainly on inner side. Underjaw rather long; ramus broad vertically, flattish, highest posteriorly; coronoid blade high, rather strongly sloping, the apex cutting plane of condyle. Canines (absent in type but present in other males) slender; molars medium; M^2 large with long heel.

Adult female (No. 203761, from Fort Fred Steele, Wyoming): Skull long, low, and rather slender; frontal shield narrow, long, lyre pointed posteriorly, flat interorbitally; postorbitals slender and

outstanding; rostrum slender; sagittal crest short, reaching only halfway from inion to fronto-parietal suture; lambdoid crest moderate; palate dished between posterior molars; postpalatal shelf broad; notch moderate; meatus tube short; ramus flat and light; apex of coronoid produced posteriorly, overhanging deep coronoid notch. Teeth rather small; upper molars relatively large, M^2 with long heel, cut-turned posteriorly; lower molars narrow.

Cranial comparisons.—Adult male compared with adult male *horriæus:* Rostrum, nasals, and frontal shield more elevated and much more strongly ascending posteriorly (less flattened and less nearly horizontal); lambdoid much more strongly developed.

Adult male compared with adult male *absarokus:* Frontal shield flat, rising gradually in long continuous slope to highest point, about 25 mm. anterior to fronto-parietal suture (in *absarokus* arched, strongly convex, and rising suddenly to highest point, immediately behind orbits); postorbital processes more slender; fronto-nasal region only slightly dished; rostrum more slender; braincase narrower; breadth across squamosal shelves less.

Remarks.—Skulls from the Wind River and Absaroka Mountains have the last upper molar smaller, the heel less strongly developed.

Skull measurements.—Old male (type): Basal length, 320; occipito-nasal length, 317; palatal length, 166; zygomatic breadth, 208; interorbital breadth, 78.

URSUS KENNERLYI[1] MERRIAM.

SONORA GRIZZLY.

Ursus kennerlyi Merriam, Proc. Biol. Soc. Washington, XXVII, p. 194, August 13, 1914.

Type locality.—Mountains of northeastern Sonora, near Los Nogales, Mexico.

Type specimen.—Skull No. 2086, ♂ old; skin No. 1047, U. S. National Museum. Collected in June, 1855, by Dr. C. B. Kennerly.

Range.—Nothing is known of the range of *kennerlyi* except that the type specimen came from mountains near Nogales, Sonora. Its affinities with *utahensis* suggest that formerly it may have had a disconnected distribution northward in the mountains of central Arizona.

Characters.—Size rather small. *Ursus kennerlyi* is a strongly marked member of the *arizonæ-utahensis* group, most nearly related to *utahensis* but *very much smaller*, although the teeth are about same size. The skull, though that of an old male, agrees in size (length) with that of female *utahensis*.

[1] Named in honor of Dr. C. B. Kennerly, who collected the type specimen.

Color.—The prevailing color is dull pale brownish yellow with amber tinge. The tips only are of this color, the basal and larger portion being of a dark chestnut-brown, passing into blackish, which extends nearly to yellowish tips, the blackish predominating along median line of back and posteriorly; legs blackish brown slightly tinged with chestnut (Baird).

Cranial characters.—Size rather small; skull long, narrow, and high, but not much arched; rostrum narrow and high, in same plane with shield; fronto-nasal region strongly elevated, making a convexity slightly above otherwise continuous plane of rostrum and frontal shield; rostrum and fronto-nasal region subterete, constricted (but not strongly pinched in) in front of orbits; nares much higher than broad; frontal shield flat, rather short pointed posteriorly, passing into sagittal crest about one-third distance from fronto-parietal suture to postorbitals; postorbital processes long, rather slender, outstanding, and slightly decurved; frontal part of brain-case elevated; zygomata moderately spreading and outbowed; palate long, somewhat concave; squamosal shelves broad; coronoid broadly falcate; ramus flat and broad vertically. Teeth of medium size (badly worn).

Cranial comparisons.—Old male (type) compared with old male *horriæus* (type): Size essentially the same; vault of cranium higher over posterior frontal region; frontal shield slightly convex (not sulcate or depressed between orbits or elsewhere), longer pointed posteriorly; fronto-nasal region markedly elevated instead of depressed; rostrum much higher posteriorly, rising in same plane with frontal shield and strongly compressed; postorbital processes more slender and less decurved; sagittal crest much shorter; angle of jaw shorter; inferior border of ramus decidedly longer; apex of coronoid more slender. Teeth so badly worn that detailed characters are lost; in size, however, they agree essentially with those of *horriæus* except that the large lower premolar is decidedly smaller.

Skull measurements.—Old male (type): Basal length, 314;[1] occipito-nasal length, 306; palatal length, 165; zygomatic breadth, 205; interorbital breadth, 75.

URSUS UTAHENSIS Merriam.

Utah Grizzly.

Ursus utahensis Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 193–194, August 13, 1914.

Type locality.—North Fork Salina Creek, 10 or 12 miles southeast of Mayfield, Utah.

[1] Restored.

Type specimen.—No. 180193, ♂ old, U. S. National Museum, Biological Survey collection. Collected May 22, 1911, by Mart Martenson.

Range.—Southern Wasatch and Pine Valley Mountains; limits unknown.

Characters.—Size large; coloration apparently normal. Skull long, narrow, and high, but not arched; fronto-nasal region high and very narrow—strongly pinched in.

Color.—Skin of head of male killed on Pine Valley Mountain, southwest Utah (obtained from forest ranger, September 24, 1907, by Clarence Birdseye; original No. 989): Muzzle pale brown; face and throat, except pale lip edgings and long hairs of median line of throat, dark brown, becoming grizzled posteriorly; top of head very dark; grizzled posteriorly by brown-tipped hairs.

Cranial characters.—Adult male (type, and equally old male from northeast corner Sevier National Forest): Size large; skull very long, high, and exceedingly narrow; zygomata moderately spreading and outbowed; frontal shield narrow, flattened posteriorly, falling away laterally immediately in front of orbits, leaving a high fronto-nasal ridge; short pointed posteriorly; sagittal crest long and high, reaching anteriorly nearly to midway between fronto-parietal suture and plane of postorbital processes; postorbital processes very long, slender, peglike, and horizontally extended; rostrum long, high, rather narrow, and strongly compressed below nasals; palate and postpalatal shelf exceedingly long; postpalatal shelf and notch narrow; interpterygoid fossa exceptionally deep; basisphenoid strongly concave. Underjaw very long, ramus flat and exceedingly broad vertically; coronoid blade high and moderately recurved. Dentition light for so large a skull; canines rather small; upper and lower molariform series medium or rather small; middle lower molar decidedly narrow; M^2 small, the heel narrowed on outer side.

An imperfect skull of an *old male* (No. 167390) from Pine Valley Mountain, southwest Utah, differs from the type in having still smaller teeth both above and below, the molars, fourth premolar, and canines being but little larger than those of the female from the type locality.

Adult female (No. 180207, from type locality): Similar in general to male, but much smaller and somewhat less extreme. Skull long and narrow; frontals and fronto-nasal region essentially the same but sagittal crest shorter; zygomata relatively as well as actually much narrower (much less spreading) and not outbowed; rostrum narrowest anteriorly; molars smaller; canines much smaller.

Cranial comparisons.—Old male (type) compared with adult and old males of *bairdi* (the only neighboring species of approximately same size): Rostrum longer and decidedly narrower; base of rostrum in

front of orbits more compressed; postorbital processes longer and more slender; palate longer; postpalatal shelf narrower; interpterygoid canal much deeper; ramus of jaw longer, decidedly broader (vertically), flatter, and much thinner under M_2 and M_3; upper molariform teeth, middle lower molar, and lower canines much smaller.

Skull measurements.—Old male (type): Basal length, 348; occipitonasal length, 337; palatal length, 194; zygomatic breadth, 226; interorbital breadth, 79.

URSUS PERTURBANS sp. nov.

Mount Taylor Grizzly.

Type No. 222102, ♂ old, U. S. National Museum, Biological Survey collection. Collected near Mount Taylor, northern New Mexico, July 9, 1916, by Ed. Anderson.

Characters.—Size very large; skull long and narrow, with narrowly spreading zygomata and exceedingly high sagittal crest; affinities with *utahensis*, *idahoensis*, and more remotely with *arizonæ*. Claws moderate, slightly curved, mainly ivory whitish on top, darker on sides.

Color.—*Adult male* (type): General ground color dusky; face and head dark brown, becoming dusky around eyes; body dusky, back grizzled with dark golden tips; legs and feet black.

Cranial characters.—*Adult male* (type): Skull conspicuously long and narrow, the narrowness marked in braincase, frontal shield, rostrum, palate, postpalatal notch, and basicranial axis; postorbital processes moderately outstanding horizontally, frontal shield broadly and shallowly concave, becoming flat in old age, very short posteriorly, the point entering sagittal crest in midfrontal region (less than halfway from postorbital processes to fronto-parietal suture); fronto-nasal region very slightly dished; rostrum narrow and rather high in type specimen (somewhat broader in very old skull from Datil Mountains, No. 140086); frontal part of braincase keeling into crest; underjaw long; coronoid blade high; ramus straight, its inferior border slightly concave under M_1, only slightly upcurved posteriorly, and not broadly expanded vertically; diastema long.

Teeth of medium size, about as in *idahoensis* (much smaller than in *horribilis* and *bairdi*); heel of M^2 long, flat, emarginate, and slightly everted, resembling that of *idahoensis;* PM_4 strikingly small—much smaller than in any other known grizzly and no larger than in some of the black bears (*Euarctos*), its crown falling below plane of molar crowns. Upper canines rather small, as in *idahoensis* and *arizonæ;* lower canines more slender than in these species.

The skull of a still older male (No. 140086) killed some years ago at Kid Springs, Datil Mountains, New Mexico, 10 miles northeast of Datil, and secured for the Biological Survey by N. Hollister, in October, 1905, resembles the type in essential characters, but is even longer and owing to greater age has the frontal shield flatter, the fronto-nasal region less dished, the sagittal crest even more highly developed, the interpterygoid fossa even longer and narrower.

Cranial comparisons.—Old male (type) compared with old male *utahensis* (type): Size and general appearance similar, but underjaw widely dissimilar; nasals and fronto-nasal region less elevated; rostrum smaller; sagittal crest more highly developed; zygomata less spreading; palate and postpalatal shelf shorter; postpalatal shelf less narrowed; underjaw *very much smaller*, shorter, and lighter, the ramus *much less broadly expanded* vertically, its inferior border shorter and less upcurved posteriorly; coronoid blade much smaller and lower. Canines much smaller; molars decidedly larger, especially $M_{\overline{2}}$; heel of M^2 much larger and broader posteriorly.

Remarks.—*Ursus perturbans* appears to have affinities in several directions. In length and slenderness of skull it resembles *utahensis* more closely than any other species, but the underjaw differs amazingly from that of *utahensis*, being relatively small and light, while that of *utahensis* is large and remarkably broad vertically. In dental characters, especially the form of M^2, it resembles *idahoensis*. In the great development of the sagittal crest it exceeds all known grizzlies, not excepting *horribilis*.

Skull measurements.—Old male (type): Basal length, 338; occipito-nasal length, 339; palatal length, 182.5; zygomatic breadth, 210; interorbital breadth, 83.

URSUS ROGERSI ROGERSI[1] SP. NOV.

ROGERS GRIZZLY.

Type No. 222983, ♂ ad., U. S. National Museum, Biological Survey collection. Collected high up on Greybull River, Absaroka Mountains, Wyoming, in the fall of 1890, by Archibald Rogers, and by him presented to the Biological Survey.

Characters.—Skull very large and long, the length of the adult male equalling or slightly exceeding that of *horribilis*, *bairdi*, *utahensis*, and *perturbans;* fronto-nasal region elevated and compressed, forming part of long fronto-nasal plane, as in *bairdi* and *utahensis;* frontal shield rather narrow, faintly convex transversely; postorbitals rather weak and somewhat decurved; sinus case keeling into

[1] Named for Archibald Rogers, of New York, who collected and presented the type specimen.

sagittal crest; rostrum long and rather slender, high posteriorly, strongly sloping; palate narrow and very long; interpterygoid fossa narrow and very long; zygomata moderate, rather low, as in *utahensis* and *idahoensis*—not arched as in *horribilis*, *bairdi*, and *imperator;* underjaw long and massive with ramus rather broadly expanded posteriorly, but very much less so than in *utahensis*. Canines small; molars moderate. Relationships with *arizonæ*, *bisonophagus*, and *idahoensis*, but size much larger; and also with *utahensis*, with which it agrees essentially in size.

Cranial comparisons.—Adult male (type, perhaps not quite fully adult) compared with males of the three related forms, *arizonæ* (type, adult), *bisonophagus* (type, young-adult) and *idahoensis* (type, old): General appearance similar, but skull as a whole, palate, and interpterygoid fossa much longer; underjaw very much longer, larger, and more massive; coronoid blade broader and higher; canines of approximately same length but lower canines more massive basally; molars in general similar, but last upper molar longer, with heel rather broadly rounded posteriorly, instead of emarginate or subtriangular; M_1 smaller; crown of M_3 much longer. More detailed comparisons seem unnecessary, though it may be remarked that from *idahoensis*, its nearest neighbor on the west, it differs markedly not only in greater size, but also in very much longer, larger, and more massive underjaw, and in the following dental characters: M^1 smaller; heel of M^2 broader and not emarginate; M_3 much longer.

Adult male (type) compared with old male *utahensis* (type): Size essentially the same though the basal length is greater; frontal shield somewhat broader; postorbitals less strongly developed, shorter, depressed instead of horizontally outstanding; rostrum larger and less compressed; interpterygoid fossa longer and less deep, palate and postpalatal shelf broader; underjaw of essentially same length, but ramus less broadly flattened. Canines apparently less elongate (in *utahensis* broken); last upper molar larger, the heel broader and more broadly rounded posteriorly; crowns of middle and last lower molars longer.

Skull measurements.—Adult male (type): Basal length, 353; occipito-nasal length, 345; palatal length, 193; zygomatic breadth, 211; interorbital breadth, 86.

URSUS ROGERSI BISONOPHAGUS SUBSP. NOV.

BLACK HILLS GRIZZLY.

Type No. 181089, ♂ young-adult, U. S. National Museum, Biological Survey collection. From Bear Lodge, Sundance National Forest, Black Hills, northeastern Wyoming. Collected in February, 1887, by Paul Kleineidam.

Range.—Black Hills of South Dakota and adjacent northeast corner of Wyoming.

Characters.—Size large; skull long, slender, and rather low, smoothly rounded on sides, with weak decurved postorbitals, and elevated fronto-nasal region. Affinities with *arizonæ* and *rogersi.* Claws of moderate length, strongly curved, smoothly polished, dark horn color, marked toward tips with pale yellowish, and most of them with whitish (superficially) on upper side of basal half.

Color.—Type: Muzzle pale brown (apparently old pelage); head and face blackish, becoming slightly grizzled posteriorly and on lower part of cheeks by wash of yellowish-brown-tipped hairs; entire body, legs, and feet very dark brown overlaid on back by wash of light tips.

Cranial characters.—Young-adult male (type): Similar in general to *rogersi.* Viewed from *above:* Closely similar except for smaller size and differences in the development of certain parts attributable in the main to lesser age (shield more convex transversely; postorbitals slightly less outstanding; fronto-nasal region slightly higher, almost forming a hump). Viewed from *below:* Palate and postpalatal shelf *very much shorter;* postpalatal notch less narrow; underjaw smaller and lighter; canines longer; M^1 slightly larger; M^2 with heel subtriangular, strongly narrowed on outer side as in *arizonæ* (in *rogersi* not narrowed but rather broadly rounded); M_1 slightly larger; M_3 much smaller. Fully adult skulls would doubtless show other differences.

Cranial comparisons.—Young-adult male (type) compared with adult male *arizonæ* (type): Skull and teeth similar but skull longer and narrower anteriorly; vault of cranium slightly less arched; rostrum narrower; fronto-nasal region slightly more compressed and more elevated, continuing frontal plane; frontal shield slightly narrower, somewhat more convex transversely, its sides more smoothly rounded (doubtless because slightly younger); postorbital processes less developed; lambdoid crest more strongly developed; postpalatal shelf smaller. Underjaw slightly longer; inferior border of ramus longer and more upcurved posteriorly; ramus more broadly expanded vertically; coronoid blade higher and flatter (fossa less deeply excavated), its anterior border more nearly vertical; upper molars somewhat larger; middle lower molars smaller; upper canines essentially the same; lower canines somewhat longer and more slender.

Remarks.—The range of *bisonophagus* appears to be completely isolated from that of its nearest relative *rogersi* of the mountains between Yellowstone Park and Bighorn Basin. On the other hand, its range appears to overlap parts of those of *absarokus*, *horribilis*, and *bairdi.* From *bairdi*, which it resembles in form of skull, it is easily

distinguished by decidedly smaller size and very much smaller canines and molars.

Skull measurements.—Young-adult male (type): Basal length, 331;[1] occipito-nasal length, 323; palatal length, 173; zygomatic breadth, 200; interorbital breadth, 80.

URSUS PERVAGOR MERRIAM.

LILLOOET GRIZZLY.

Ursus pervagor Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 186–187, August 13, 1914

Type locality.—Pemberton Lake (now Lillooet Lake), British Columbia.

Type specimen.—No. 187887, ♂ ad., U. S. National Museum (=No. 6510, Merriam collection). Collected in May, 1883, by John Fannin.

Range.—Interior of southwestern British Columbia; known only from Lillooet Lake and Bridge River.

Characters.—Size rather large. External characters unknown.

Cranial characters.—Adult male (type): Size large; skull long, rather narrow, high, moderately dished; zygomata moderately spreading and outbowed; frontal shield of moderate breadth, rather flat, strongly sloping, shallowly sulcate medially, swollen on each side just behind plane of postorbitals; postorbital processes outstanding, thick, peglike; postpalatal shelf rather broad and flat; frontal part of braincase elevated and compressed, supporting posterior part of frontal shield; palate long; squamosal shelf long; mastoids long; interpterygoid fossa short and rather broad; underjaw long; coronoid broad and rather vertical; ramus long, swollen on outer side. Teeth small, particularly the canines and lower molars.

Cranial comparisons.—Adult male (type) compared with adult male *canadensis* (type): Considerably larger; vault of cranium much higher; frontal shield much broader, higher, more strongly sloping, and less flat; frontal part of braincase elevated and compressed, rising strongly to temporal impressions (in *canadensis* not compressed except at sagittal crest); postorbital processes much larger; rostrum more strongly ascending; occipito-sphenoid longer (98 mm. against 90); underjaw much longer; coronoid blade higher, its apex less recurved. Canines about same size; large upper premolar, upper molars, and M_1 and M_2 decidedly smaller.

Adult male (type) compared with adult male *caurinus:* Frontal shield broader, less elevated posteriorly; fronto-nasal region less strongly dished; coronoid blade less nearly vertical; upper canines slightly shorter; lower canines conspicuously smaller and shorter.

[1] Restored.

Adult male (type) compared with adult male *eulophus* (type and older skulls): Similar in general, both having the fronto-facial region long sloping and flattish, but differing in many characters. The skull of *pervagor* differs from that of *eulophus* in being slightly shorter, less highly arched, frontal shield less elevated posteriorly; postorbitals larger, more horizontally outstanding; sagittal crest shorter and straighter, not arched; braincase, rostrum, and palate shorter; squamosal shelf shorter; postpalatal shelf broader and shorter; interpterygoid notch broader; underjaw smaller and less massive; inferior border of ramus shorter and less broadly expanded; coronoid lower, the apex less narrowed and less recurved, with less development of inferior ridge of fossa; teeth (canines and molars) slightly smaller.

Skull measurements.—Adult male (type): Basal length, 330; occipito-nasal length, 322; palatal length, 178; zygomatic breadth, 224; interorbital breadth, 81.

URSUS CAURINUS MERRIAM.

LYNN CANAL GRIZZLY.

Ursus caurinus Merriam, Proc. Biol. Soc. Washington, XXVII, p. 187, August 13, 1914.

Type locality.—Berners Bay, east side of Lynn Canal, Southeastern Alaska.

Type specimen.—No. 176591, ♀ ad., U. S. National Museum, Biological Survey collection. Collected June 8, 1911 by A. Hasselborg.

Range.—Coast of mainland of Southeastern Alaska from Chilkat River valley and Lynn Canal south an unknown distance.

Characters.—Very closely related to *eulophus* of Admiralty Island. Size rather large; skull long and rather narrow; canines long, the lower ones massive; claws smoothly polished.

Color.—Upperparts yellowish buff; face and most of head pale brown or drab; ears, hump, and underparts conspicuously darker; legs and feet dark brown or brownish black.

Cranial characters.—*Male and female:* Both skulls long and narrow, strongly arched posteriorly, moderately dished; frontal shield of medium breadth, strongly ascending; postorbital processes weak and decurved except in old age; frontal part of braincase elevated, forming an uplifted base for posterior part of frontal shield, behind which it keels into sagittal crest as in *eulophus;* palate long; postpalatal shelf rather narrow; squamosal shelf long; lachrymal duct opening within orbital rim; ramus of jaw broad and flattened, notably higher posteriorly than anteriorly. Teeth rather small for size of skull; last upper molar long and narrow, tapering posteriorly.

Unfortunately, no fully adult male *caurinus* has been obtained, but I have secured a skull of a young-adult male (No. 205169) from Berners Bay, Lynn Canal, and another (No. 210140) from Chilkat River valley. These present the following characters: Skull long, high, and narrow, rather highly arched and dished; frontals rising rather strongly from rostrum; frontal shield rather narrow, long sloping, convex transversely in these youngish skulls (doubtless flattish in adults), slightly sulcate medially; long pointed, the point nearly reaching parietals; postorbital processes rather broad and slightly decurved (doubtless more outstanding with age); fronto-nasal region dished; rostrum moderate; nasals nearly horizontal anteriorly, rising posteriorly into frontal shield; frontal part of braincase compressed and elevated, keeling into temporal impressions and anterior part of sagittal crest; squamosal shelves long. Underjaw rather long; ramus moderate, its inferior border bellied posteriorly; coronoid blade moderate and rather vertical; apex not strongly recurved; palate, postpalatal shelf and notch medium; teeth rather small for size of skull; molars only slightly larger than those of female; M^2 rather narrow, with narrow slightly everted heel; canines, especially lower canines, decidedly thicker than those of female; M_1 rather swollen in both male and female; M_2 small and narrowest posteriorly; PM_4 with main cusp rather small, conical, anterior, with gradually sloping incompletely sulcate heel, rarely with traces of posterior cusplets, sometimes with anterior cusplet on inner side of cingulum.

The Chilkat Valley male is a year older than the Berners Bay skull, and broader across the frontals; postorbital processes more outstanding, ramus of underjaw more bellied posteriorly; coronoid blade broader above; M_1 smaller and thinner.

Cranial comparisons.—Ursus caurinus appears to be rather closely related to *pervagor* of the Lillooet region in the interior of British Columbia, and to *eulophus* of Admiralty Island, Southeastern Alaska, but unhappily no skulls of fully adult males are available for comparison.

Young-adult male (No. 210140, from Chilkat River valley) compared with adult male *eulophus* (type) and with a young adult *eulophus* (No. 203284), both from Admiralty Island: Frontal shield narrower anteriorly and *much narrower posteriorly* (narrowed behind postorbitals by usual incurving temporal ridges, while in *eulophus* the ridges are nearly straight and the posterior part of shield correspondingly broader); fronto-nasal region more strongly dished; underjaw longer; ramus thicker (more swollen on outer side); coronoid blade broader above and much less recurved. Canines essentially same; M_1 smaller; M^2 broader in middle and posteriorly.

Adult female (type) compared with young-adult female *eulophus* (No. 137470): Basal, occipito-nasal, and occipito-sphenoid lengths

essentially same; vault of cranium much less arched; frontal shield flatter, narrower interorbitally and postorbitally; postorbitals much smaller and outstanding instead of strongly decurved; fronto-nasal region scarcely dished; rostrum lower; nasals smaller; palate shorter; underjaw more massive; coronoid broader and less recurved; M_1 thicker; M^2 narrower throughout, the heel narrowed on outer side.

Young-adult male compared with adult male *pervagor:* Frontal shield narrower, more elevated posteriorly; fronto-nasal region more strongly dished; coronoid blade more nearly vertical. M^2 narrower, with narrower heel. Upper canines slightly longer; lower canines conspicuously longer and larger.

Skull measurements.—Adult female (type): Basal length, 295; occipito-nasal length, 285; palatal length, 161; zygomatic breadth, 196; interorbital breadth, 66.

URSUS EULOPHUS Merriam.

Admiralty Island Crested Bear.

Ursus eulophus Merriam, Proc. Biol. Soc. Washington, XVII, p. 153, October 6, 1904.

Type locality.—Admiralty Island, Southeastern Alaska.

Type specimen.—No. 81102, ♂ ad., U. S. National Museum, Biological Survey collection. Collected in 1896 by Lieut. G. T. Emmons.

Range.—Admiralty Island.

Characters.—Size large; color rich dark brown; claws blue-black, of moderate length; skull long, rather narrow, and high, with weak decurved postorbital processes.

Color.[1]—General color of head and body in fresh pelage, rich dark brown or seal brown; muzzle paler; legs, feet, and belly dusky or blackish; neck and shoulders sometimes grizzled by admixture of yellowish-tipped hairs.

Cranial characters.—Adult males: Skull large, long, high, and rather narrow; frontal shield long and rather narrow, shallowly grooved medially, gradually sloping (not abruptly elevated); temporal impressions long and only slightly incurved, meeting at fronto-parietal suture; postorbital processes weak and decurved; fronto-nasal region elevated in plane of shield; rostrum long and high; anterior third of nasals horizontal, posterior two-thirds rising in fronto-nasal plane; zygomata moderately spreading, subangular; squamosal root only slightly expanded; palate and postpalatal shelf long and narrow; ascending arms of maxillæ long, passing far beyond nasals and reaching back over anterior two-thirds of orbit; nares rather small; braincase long anteriorly, rather narrow, com-

[1] Color from skins in Mus. Vert. Zool., Univ. California, obtained on Admiralty Island by Miss Annie M. Alexander.

pressed, and keeling into sagittal crest; sagittal crest high, curved, and relatively short; ramus of jaw high vertically, its inferior border *strongly bellied* posteriorly; coronoid blade large and moderately high. Canines long; molars rather small for so large a skull.

Cranial comparisons.—Adult male (type) compared with adult male *pervagor* (type): Skull longer; arch of cranium higher; frontal shield longer sloping, rising higher posteriorly; rostrum longer; braincase longer; sagittal crest more convex; palate and postpalatal shelf longer; shelf and notch narrower; underjaw larger, longer, more massive; inferior border of ramus longer, more strongly bellied posteriorly and broader vertically; coronoid fossa deeper, its inferior border much more sharply defined by strongly developed ridge for muscular attachment. Canines and molars larger.

Skull measurements.—Adult male (type): Basal length, 346; occipito-nasal length, 343; palatal length, 190; zygomatic breadth, 221; interorbital breadth, 81.

URSUS KLAMATHENSIS MERRIAM.[1]

KLAMATH GRIZZLY.

Ursus klamathensis Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 185–186, August 13, 1914.

Type locality.—Beswick, near mouth of Shovel Creek, Klamath River, northern California.

Type specimen.—No. 178735, ♂ ad., U. S. National Museum, Biological Survey collection. Collected and presented by Charles Farwell Edson.

Range.—Siskiyou Mountains of northern California and southern Oregon, ranging north in recent times to Fort Klamath region and Rogue River valley; in early days to lower Willamette Valley (presumably same species); south in Sierra Nevada an unknown distance. (Skull from lower McCloud River referred to this species.)

Characters.—Size of male large; skull in general of the *idahoensis* type, but larger and with heavier canines. Claws moderate, rather strongly curved, horn color, washed with yellowish basally and with pale yellowish markings at tips, marked longitudinally with fine parallel striæ. Skin characters unknown.

Cranial characters.—Skull large and high, highest about 40 mm. in front of fronto-parietal suture; rostrum long, high, and ascending in plane of frontal shield; fronto-nasal region elevated, scarcely if at all dished; frontal shield broad, flat, sloping, and rather short pointed; postorbital processes moderate, peglike, horizontally outstanding; sagittal crest long and well developed; lachrymal duct

[1] Tentatively included in *arizonæ* group. (See Introduction, pp. 12–13.)

opening on orbital rim (rather posteriorly than anteriorly); zygomata moderately spreading, only moderately expanded vertically; anterior (frontal) part of braincase keeling into sagittal crest; occiput produced posteriorly (overhang much greater than in *californicus*); squamosal shelves long and broad; palate rather flat, slightly arched lengthwise; postpalatal shelf broad and flat; occipitosphenoid short for so large a skull (length 89 mm.); basioccipital very broad anteriorly; mastoids vertical and short. Underjaw long; ramus exceptionally broad and flat vertically; coronoid blade large and high, broad basally. Canines very large; molars moderate; last upper molar relatively small, the heel emarginate or obliquely truncate on outer side; middle lower molar with anterior moiety much larger than posterior. Large upper premolar absent and no trace of alveolus.

Cranial comparisons.—Curiously enough *klamathensis* does not require close comparison with any of the other species inhabiting California, its only near relatives being members of the *shoshone-idahoensis* group of the Rocky Mountains, and *pervagor* of interior British Columbia.

Adult male (type) compared with old male *idahoensis* (No. 187888, =No. 93, Merriam collection, from North Fork Teton River, eastern Idaho): Similar in general form and proportions but larger (condylobasilar length 350 mm. contrasted with 335); vault of cranium somewhat higher; frontal shield broader and flatter; palatal length about the same; postpalatal length much greater (150 contrasted with 135); opening of lachrymal duct slightly more posterior; occipital overhang greater; basioccipital anteriorly very much broader; ramus of underjaw longer and much broader vertically; coronoid blade higher. Canines larger and longer; last upper molar shorter.

Adult male (type) compared with adult male *pervagor* (type): Similar in size and general characters; vault of cranium slightly higher; frontal shield flatter and somewhat broader; postorbitals not quite so large; fronto-nasal region more elevated (in *pervagor* slightly dished); rostrum broader anteriorly; occipital overhang greater; ramus of underjaw much more broadly expanded vertically and flatter; canines and molars very much larger.

Adult male (type) compared with old male *henshawi* (type): *Ursus klamathensis* and *U. henshawi* belong to widely different groups and do not require detailed comparison. *U. klamathensis* may be distinguished at a glance by its much larger size, much higher vault of cranium, highly elevated and continuously sloping fronto-nasal region and rostrum, and peglike postorbitals—in striking contrast to the much smaller, lower, and strongly dished skull of *henshawi*,

with its low depressed rostrum and large broadly rounded postorbitals.

Adult male (type) compared with adult male *californicus* (from coast region south of San Francisco Bay): The differences are marked in the skull and striking in the teeth. In *klamathensis* the vault of the cranium is lower posteriorly and higher anteriorly; the frontal shield flatter laterally; the rostrum shorter; the base of the cranium (occipito-sphenoid) decidedly shorter. The last upper and middle lower molars are widely different, the heel of M^2 in *californicus* large, long, and broad posteriorly, while in *klamathensis* it is small and emarginate on outer side; the anterior part of M_2 in *californicus* is normal, while in *klamathensis* it is disproportionately large.

Skull measurements.—Adult male (type): Basal length, 331; occipito-nasal length, 337; palatal length, 175; zygomatic breadth, 223; interorbital breadth, 85.5.

URSUS MENDOCINENSIS Merriam.[1]

Mendocino Grizzly.

Ursus mendocinensis Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 145–146, September 6, 1916.

Type locality.—Long Valley, Mendocino County, California.

Type specimen.—No. 206625, ♂ old, U. S. National Museum, Biological Survey collection. Obtained through Charles J. and Frank H. Hittell.

Characters.—Size rather large, about equaling *klamathensis* but apparently smaller than *californicus* and *colusus;* external characters unknown. Affinities with *klamathensis*, with which it may intergrade at the north.

Cranial characters.—Skull short, broad, highly arched, and strongly dished, with widely outstanding zygomata and truncate occiput. Frontal shield of moderate breadth, short pointed posteriorly, slightly convex between orbits, strongly sloping to rostrum; rostrum short, broad, and strongly depressed; postorbital processes moderate, sub-peglike, horizontally outstanding; sagittal crest high, thick, humped anteriorly, short posteriorly; occiput obliquely truncate; occipital overhang slight compared with that of *californicus* and *colusus;* palate short and rather broad; postpalatal shelf of moderate breadth, flat; postpalatal notch moderate; mastoids rather short, directed anteriorly. Underjaw absent. Teeth gone except left hind molar, which is short, with small heel, obliquely truncate on outer side (as in *klamathensis*).

[1] Tentatively included in *arizonæ* group. (See Introduction, pp. 12–13.)

Cranial comparisons.—Similar in general to *klamathensis* but fronto-nasal region strongly dished, *rostrum shorter, broader, flatter on top, and depressed instead of elevated;* zygomata more widely outstanding; palate broader; occipital overhang less.

Skull measurements.—Old male (type): Basal length, 327; occipito-nasal length, 323; palatal length, 183; interorbital breadth, 84.5.

URSUS MAGISTER MERRIAM.[1]

SOUTHERN CALIFORNIA GRIZZLY.

Ursus magister Merriam, Proc. Biol. Soc. Washington, XXVII, p. 189, August 13, 1914.

Type locality.—Los Biacitos, head of San Onofre Canyon, Santa Ana Mountains, Southern California.

Type specimen.—No. 160155, ♂ old, U. S. National Museum, Biological Survey collection. Killed in August, 1900 or 1901, by Henry A. Stewart and by him presented to the Biological Survey.

Range.—Santa Ana or Trabuco Mountains, Cuyamaca and Santa Rosa Mountains, and probably San Jacinto Mountains. Believed to be extinct.

Characters.—Size of male huge (estimated weight over 1,400 pounds), largest of known grizzlies, considerably larger than *californicus* of the Monterey region, and even than *horribilis*, the great buffalo-killing grizzly of the Plains (only equaled by the largest *alexandræ* of Kenai Peninsula); sexual disparity great; skull of female hardly half the bulk of male; skull of male of a rather generalized type; not dished. Claws of old female from head of Trabuco Canyon, Santa Ana Mountains, exceedingly long, strongly curved, mainly yellowish above.

Color.—(Old female from head of Trabuco Canyon): General color dusky or sooty all over except head and grizzling of back. Muzzle gray or mouse brown, palest above; top of head and neck very dark brown, sparsely grizzled with pale-tipped hairs; back dusky grizzled with grayish; legs and underparts wholly blackish.

Cranial characters.—Adult male (type): Skull exceedingly large, long; vault of cranium arched, but not abruptly; rostrum long and high; fronto-nasal region elevated, in same plane with frontal shield and rostrum; frontal shield flattish-convex, faintly sulcate medially and slightly swollen on each side between postorbital processes, the point decurved and reaching fronto-parietal suture; zygomata only moderately spreading, angular, the posterior root expanded and rising abruptly from plane of squamosal shelf; sagittal crest rather short; palate scooped out anteriorly, forming a basinlike depression surrounding the anterior palatine foramina; occipito-sphenoid

[1] Tentatively included in *arizonæ* group. (See Introduction, pp. 12–13.)

length 103.5 mm. Underjaw long; ramus broad and flat vertically, its inferior border moderately bellied and incurved posteriorly; coronoid blade large, its apex strongly recurved, cutting plane of middle of condyle. Teeth large and broad but by no means disproportionate to large size of skull; M^1 broad; last upper molar absent, but from its alveolus and its form in female, obviously broad, short, strongly triangular, the heel small, narrowed posteriorly, obliquely emarginate on outer side; PM_4 broad, with rather short slightly sloping heel, narrow imperfect sulcus without posterior cusplets; M_1 apparently normal (much worn in type specimen); middle lower molar absent in type specimen but apparently normal (judging from the female, in which, however, it is badly worn).

Female of extreme age (No. 156594, from Trabuco Canyon, killed January 5, 1908, by Andrew Joplin and Edward Adkinson): Size small; rostrum short and depressed; fronto-nasal region strongly dished; frontal shield flattish, slightly sulcate interorbitally, short pointed, beaded posteriorly by elevated temporal impressions, rising rather abruptly at orbits; sagittal crest long and nearly horizontal; palate and postpalatal shelf broad, flat posteriorly, concave anteriorly.

Cranial comparisons.—Ursus magister does not require close comparison with any other species. While the largest skulls of old male *californicus* equal it in basal length, they are so much lower, narrower, and smaller in every way that detailed comparisons are unnecessary. The species which it most nearly resembles is *bairdi* from the mountains of Colorado, but the resemblance is not close. It differs from *bairdi* in somewhat larger size, much more highly arched vault of cranium, much broader and more strongly sloping frontal shield, more posterior mastoids, longer underjaw with much more broadly flattened and less massive ramus, and in important tooth characters.

Between the two geographically is *utahensis*, which, like *magister*, has the ramus of the underjaw very broadly flattened vertically, but in form of cranium *utahensis* goes to the opposite extreme, the frontal shield, rostrum, and braincase being exceptionally narrow, and the fronto-nasal region compressed and elevated.

Flesh measurements.—Old male (type): Height at shoulder from flat of foot 4 ft. (=1,220 mm.); total length, snout to tail, 9½ ft.[1] (=2,900 mm.); sole of largest foot without claws: length 12 in. (=305 mm.); breadth 8 in. (=204 mm.). Length of old female from Trabuco Canyon, measured in the flesh by Andrew Joplin, 6 ft. 3 in.

Skull measurements.—Old male (type): Basal length, 365; occipito-nasal length, 366; palatal length, 197; zygomatic breadth, 236; interorbital breadth, 97.

[1] Apparently an error; possibly intended for snout to claws of extended hind foot.

Hylodromus Group.

URSUS HYLODROMUS Elliot.

FOREST GRIZZLY.

(Plate XI.)

Ursus hylodromus Elliot, Field Columb. Mus. Pub. 87, Zool. Ser. III, pp 257–258, December, 1913. (Described as a black bear!) Purchased from Mackay & Dippie, taxidermists, Calgary.

Ursus selkirki Merriam, Proc. Biol. Soc. Washington, XXIX, p. 150, September 6, 1916. (From Selkirk Mountains, Upper Columbia River, British Columbia.)

Type locality.—Rocky Mountains of western Alberta (precise locality unknown).

Type specimen.—No. 19065, ♀ young-adult, Field Museum of Natural History.

Range.—Rocky Mountain region of western Alberta and eastern British Columbia, including Selkirk Range.

Characters.—Size of male large, of female small; external characters unknown.

Cranial characters.—Young-adult female (type[1]): Size small, skull short posteriorly (occiput less extended than in most species); moderately arched and dished; zygomata not outstanding and only slightly bowed; frontal shield of moderate breadth, rising rather strongly from rostrum, its apex sublyrate; postorbital processes large, outstanding; rostrum rather high, strongly ascending posteriorly; sagittal crest short, reaching only two-thirds distance from occiput to fronto-parietal suture; squamosal shelf narrow and nearly horizontal; postpalatal shelf rather broad.

Old male (No. 205170) from Selkirk Mountains, upper Columbia River, British Columbia (assumed to be typical): Size medium; skull long, low arched, highest immediately in front of fronto-parietal suture, and of medium breadth; braincase and palate arched; shield flattish, long pointed, sloping gradually from point to rostrum, faintly sulcate medially; postorbitals broadly subtriangular, flat on top and slightly decurved, convex posteriorly, concave anteriorly; rostrum moderate, nearly horizontal; fronto-nasal region rising very gradually into shield; sagittal crest short; palate of medium breadth, slightly troughed and arched; postpalatal shelf broad and flat; zygomata subtriangular, not widely outstanding, strongly arched anteroposteriorly; squamosal root long but not broadly expanded; mas-

[1] Through the courtesy of the officials of the Field Museum I have had the privilege of examining the type skull of *hylodromus* and comparing it with skulls in the National Museum collection.

toids short, not divergent; meatus tube large and free; ramus of underjaw straight; coronoid blade low, broad in middle part. Teeth of medium size (too badly worn to admit of description).

Cranial comparisons.—Old male (No. 205170, from Selkirk Mountains) compared with old male *kluane* (type): Size smaller; vault of cranium materially lower; top of skull lower and flatter throughout; shield narrower, much flatter, and longer pointed; sagittal crest much shorter and lower; occipital overhang and inion much less developed; zygomata more triangular (less bowed); braincase, palate, and underjaw much shorter; coronoid blade lower; subangular border shorter and more strongly defined. Teeth very badly worn but canines and molars evidently much smaller.

Compared with *idahoensis* and *chelan* (both types): Similar in general but smaller; vault of cranium *much lower;* frontal shield somewhat narrower, longer pointed posteriorly; postorbital processes broader basally but less widely outstanding; sagittal crest much shorter, its anterior part less distinctly keeled from sinus case; zygomata shorter and more sharply triangular; underjaw shorter; coronoid blade lower; subangular notch and border similar.

Compared with *latifrons*, whose range it approaches on the north but with which it does not appear to be related, it is easily distinguished by smaller size, flatter and very much narrower frontal shield, more elevated and evenly sloping fronto-nasal region, less outbowed and more triangular zygomata, much shorter underjaw and ramus, and much lower coronoid blade.

Remarks.—The type specimen of *hylodromus* is a skull of a young-adult female from western Alberta, exact locality unknown. Until recently so few males have been available from this region that I was long in doubt as to which was its proper mate. In the light of present material, however, it has been possible to match up males and females of most of the species of eastern British Columbia and western Alberta with some confidence, and I now feel reasonably certain that the type specimen of the species described by me as *Ursus selkirki* from the Selkirk Mountains on the upper Columbia River is in reality an old male *hylodromus*, the name *selkirki* thus falling as a synonym.

Skull measurements.—Old male (No. 205170) from Selkirk Mountains: Basal length, 305; occipito-nasal length, 306; palatal length, 169; zygomatic breadth, 206; interorbital breadth, 74. Female young-adult (type): Basal length, 275; occipito-nasal length, 257; palatal length, 154; zygomatic breadth, 173; interorbital breadth, 69.

URSUS KLUANE KLUANE Merriam.

Kluane Grizzly.

Ursus kluane Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 141–143, September 6, 1916.

Type locality.—McConnell River, Yukon.

Type specimen.—No. 204188, ♂ old, U. S. National Museum, Biological Survey collection. Collected by Smith and Geddis July 15, 1914.

Range.—Southwest corner of Yukon Territory east of the St. Elias Range, extending northwesterly in Alaska to Mount McKinley region (head of Toklat), easterly in Yukon Territory to McConnell River (north-northeast of Teslin Lake) and probably south into northwest corner of British Columbia.

Cranial characters.—Adult male: Skull medium, rather long, narrow, somewhat arched and dished, with long braincase, long convex sagittal crest, and unusually broad decurved postorbitals. Frontal shield of medium width, strongly convex both transversely and antero-posteriorly, rising rather strongly from rostrum, slightly sulcate medially and moderately swollen over orbits; very short pointed, the point ending about midway between parietals and plane of postorbitals; postorbitals broad, decurved, strongly convex anteriorly, concave posteriorly; fronto-nasal region somewhat depressed; rostrum high and narrow, rounded above (subterete); nares truncate; sagittal crest very long and arcuate; occipital overhang and inion well developed; zygomata not widely outstanding, somewhat bowed, rounded posteriorly; palate moderate; postpalatal shelf large and broad; notch rather broad and short; mastoids long and divergent; underjaw rather long; coronoid blade high and narrow, the apex rather strongly recurved; teeth too badly worn to admit of description (apparently large for size of skull).

Adult female: Size small, nearly as small as female *pallasi;* fronto-nasal region moderately dished and usually sulcate; braincase moderately arched, highest just in front of fronto-parietal suture; temporal impressions meeting over anterior part of parietals (probably somewhat more anteriorly in old skulls); zygomata moderately outbowed, subtriangular; frontal shield of medium breadth, lyrate pointed posteriorly; postorbital processes rather broad for so small a skull, moderately decurved; underjaw short; coronoid blade broad basally and rather short. Teeth (canines, incisors, and molars) rather large for size of skull, decidedly larger than in *pallasi;* molars, both upper and lower, very much larger.

Cranial comparisons.—The species requiring comparison with *kluane* are *toklat*, *pulchellus*, and *pallasi*. Old male (type) compared with old male *toklat*, from Alaska Range, near north base of Mount McKinley: Size slightly larger; occipito-nasal length, length of braincase, and length of sagittal crest very much greater; frontal shield more convex transversely; postorbital processes much larger and broader; rostrum higher, more rounded on top; nares more squarely truncate; underjaw longer; inferior border of ramus more convex posteriorly; coronoid blade decidedly higher, narrower above, the apex more strongly recurved; teeth badly worn in both, but canines decidedly longer in *kluane;* molars apparently somewhat larger.

Compared with adult male *pulchellus:* Similar in general, but skull as a whole, braincase, palate, and underjaw *very much longer;* frontal shield *very much broader;* inferior border of ramus less abruptly upcurved; subangular border less nearly horizontal and much less sharply defined.

Adult female compared with adult female *toklat* (comparison hardly necessary because of the great difference in size): Basal length at least 20 mm. less; vault of cranium and frontal shield lower; braincase less constricted anteriorly; posterior part of shield much longer and broader, reaching or passing the fronto-parietal suture; sagittal crest much shorter; postpalatal shelf less broad; underjaw and inferior border of ramus shorter; coronoid blade about same height; canines about same size; molariform series (upper and lower) about same length, but proportions of individual teeth different: M^1 much larger; M^2 with shorter heel; M_1 larger.

Old male (type) compared with old male *pallasi* (type): Size decidedly greater; skull about an inch longer and much more highly arched, with conspicuously longer braincase and longer sagittal crest; crest strongly arched instead of nearly straight; postorbitals very much larger, broader, and more strongly decurved; fronto-nasal region much more elevated and less dished; rostrum much higher, rounded above instead of depressed; palate much longer, more arched and more concave; underjaw much longer; coronoid higher.

Adult female compared with adult female *pallasi:* Skulls very much alike in size and appearance (that of *kluane* slightly larger), but teeth strikingly different. In *kluane*, canines larger; molars very much larger.

Skull measurements.—Old male (type): Basal length, 317; occipito-nasal length, 324; palatal length, 177; zygomatic breadth, 210; interorbital breadth, 85.

URSUS KLUANE IMPIGER SUBSP. NOV.

INDUSTRIOUS GRIZZLY.

Type No. 210708, ♂, not quite fully adult. From Columbia Valley, British Columbia. Collected in April, 1914, by Mackay & Dippie.

Cranial characters.—Adult male: Similar in general to *kluane* (No. 221620, ♂ ad., Kluane River), but shield narrower and less sulcate, less swollen over orbits; nasals less elevated; palate much shorter and narrower; postpalatal shelf narrower; underjaw shorter; subangular border shorter; subangular notch and space much more strongly defined. Teeth smaller throughout, especially M^2 and $M_{\overline{2}}$, but $M_{\overline{1}}$ swollen as in *kluane*.

Female young-adult from Brisco,[1] Columbia Valley (No. 210707): Vault well arched; shield posteriorly broadly lyrate, elevated by rising sinus case; rostrum long and slender; fronto-nasal region dished; palate long, troughed; underjaw long and straight. Teeth large.

Cranial comparisons.—Male young-adult (type) compared with old male *hylodromus* from Selkirk Mountains (No. 205170): Vault of cranium much more highly arched and narrower, the narrow frontal shield rising higher and more strongly, but not abruptly, from rostrum; shield strongly convex (in old *hylodromus* nearly flat); postorbitals much more slender, outstanding, depressed, and somewhat decurved as in *kluane;* fronto-nasal region more dished; palate narrower; inferior border of underjaw much longer; subangular border shorter; coronoid blade higher.

Female young-adult (No. 210707) compared with female *kluane:* Skull as a whole, rostrum, occipito-sphenoid, palate, and underjaw much longer; ramus straighter; subangular border same; teeth essentially same except that $M_{\overline{1}}$ is smaller. Compared with female *hylodromus* (type): Skull as a whole, rostrum, occipito-sphenoid, palate, and underjaw longer (but not so much longer as in comparison with female *kluane*); ramus straighter; subangular border shorter; teeth similar.

Remarks.—Ursus hylodromus, *U. impiger*, and *U. kluane* form a rather closely related group ranging from western Alberta and southeastern British Columbia northwesterly to southwestern Yukon. From the material now in hand *impiger* appears to be most nearly

[1] Skulls of females identified as *impiger* have been examined from Brisco, Columbia Valley, British Columbia (No. 210707); Morley, Alberta (No. 210706); Jasper, Alberta (No. 222745); and headwaters North Fork Blackfoot River, western Montana (No. 203188).

related to *kluane*, but additional skulls of adults may show that its affinities with *hylodromus* are equally close.

Skull measurements.—Adult male (type): Basal length, 309; occipito-nasal length, 293; palatal length, 162; zygomatic breadth, 197; interorbital breadth, 72.

URSUS PELLYENSIS sp. nov.

Pelly Grizzly.

Type No. 215477, ♂ young-adult. U. S. National Museum, Biological Survey collection. From the Ketza Divide, Pelly Mountains, Yukon. Collected September 30, 1915, by Fred E. Enevoldsen.

Characters.—Skull of medium size, rather long and narrow, apparently related to *hylodromus*: Frontal shield narrow, long pointed (point reaching fronto-parietal suture but in older specimens ending much more anteriorly), rising strongly from rostrum; rostrum rather narrow and high; fronto-nasal region dished; postorbitals broad, strongly decurved (in old skulls doubtless more outstanding); sinus case keeling into posterior part of shield; palate moderate (rather broad for so narrow a skull), slightly arched and slightly troughed; underjaw long for size of skull; inferior border of ramus long, not upturned; subangular border short; coronoid rather high; canines long, the lower ones large for size of skull; molars long and narrow, especially $M_{\bar{1}}$ and $M_{\bar{2}}$; anterior part of $M_{\bar{2}}$ exceptionally long and posterior part relatively narrower than in most species; $PM_{\bar{4}}$ subconical.

Female skull (based on four rather old specimens from Pelly and Ross Mountains, Nos. 215710, 215711, 215713, and 221600): Size small; frontal shield of moderate breadth, rather short pointed posteriorly, entering sagittal crest anterior to fronto-parietal suture; postorbital processes well developed, outstanding; rostrum rather small; frontal shield rising moderately from rostrum, shallowly sulcate medially; zygomata subtriangular. Dentition moderate; heel of last upper molar slightly emarginate, rounded posteriorly; canines small and slender.

Cranial comparisons.—Young-adult male (type) compared with young-adult male *hylodromus* (No. 210708 from Columbia Valley, British Columbia): Size smaller (basal length about 10 mm. less); vault of cranium less highly arched; sinus case more definitely keeled to support posterior part of shield; postorbitals broader, more decurved, less outstanding; palate broader; molar series about same; upper canines essentially same; lower canines larger; upper molar series essentially same length; lower molar series longer and narrower; $M_{\bar{1}}$ much longer and more slender.

Young-adult male (type) compared with adult male *pulchellus* from the neighboring Ross River (No. 221599): Size slightly greater; shield and rostrum broader (in *pulchellus* exceptionally narrow); postorbitals broader and more decurved; palate longer and broader; postpalatal notch much shorter; coronoid blade larger; molars, upper and lower, strikingly narrower and less massive.

Female *pellyensis* compared with female *toklat:* Size smaller; vault *much lower and depressed*—sinus case not keeled into front of sagittal crest; fronto-nasal region less strongly depressed and dished; rostrum and nasals flatter; palate about same length; postpalatal length much less; underjaw much shorter. Canines smaller; molar series shorter; heel of M^2 less elongate.

Skull measurements.—Young-adult male (type): Basal length, 299; occipito-nasal length, 294; palatal length, 168; zygomatic breadth, 186; interorbital breadth, 73.

URSUS ANDERSONI[1] SP. NOV.[2]

ANDERSON BEAR.

Type No. 34402, ♂ ad. (rather old), American Museum of Natural History. Collected on east branch Dease River[3] near Great Bear Lake, Mackenzie, May 12, 1911, by Dr. R. M. Anderson.

Characters.—Size medium or rather large; frontal region including postorbitals rather flat and narrow as in *pellyensis* (in strong contrast with the broader swollen frontals and elevated outstanding postorbitals of *richardsoni*); vault moderately arched.

Cranial characters.—Frontal shield rather narrow, strongly sloping, flattened, short pointed posteriorly; postorbitals moderate (short in contrast with those of *richardsoni*), horizontal (not decurved); sagittal crest long and strongly developed, humped anteriorly, projecting posteriorly in prominent inion; rostrum narrow, rather high, compressed below middle of nasals; orbits strongly sloping (retreating); occipital overhang marked; squamosal shelf long; palate long and narrow; postpalatal shelf moderate; zygomata well outstanding and somewhat bowed. Underjaw moderate; coronoid blade strongly recurved, apex sharp pointed. Molars broad and rather large: M^1 and M_1 together 62 mm. (in type skull); lower molars 74 mm. Canines large (too much broken to afford measurements).

Cranial comparisons.—The adult male resembles, though not very closely, both *pellyensis* and *tahltanicus*. Compared with the type specimen of *pellyensis:* Size essentially same; shield shorter and flatter with more horizontally outstanding postorbitals (differences

[1] Named for Dr. R. M. Anderson, who collected the type specimen.
[2] Tentatively included in *hylodromus* group. (See Introduction, pp. 12–13.)
[3] Not to be confused with the better-known Dease River of northern British Columbia.

attributable in large part at least to difference in age); zygomata much less broadly outstanding (also attributable to age); postpalatal notch decidedly longer; coronoid blade lower. Canines apparently larger (badly broken); molars broader and more massive. Compared with an old male (No. 134486) from Macmillan River, presumably old *pellyensis*, it is much smaller and narrower; shield narrower, flatter, and shorter posteriorly; postorbitals flatter and more nearly horizontal on top; rostrum narrower; sagittal crest longer and rising higher anteriorly; palate, postpalatal shelf, diastema, and occipito-sphenoid much shorter; underjaw much shorter; coronoid lower. Dentition heavier; canines and molars larger.

Compared with old male *tahltánicus* (type), with which it agrees essentially in size, height of vault of cranium, slope and flatness of shield, form of rostrum, spread and form of zygomata, and size and form of underjaw, it differs as follows: Shield narrower both interorbitally and across postorbitals; point of shield much shorter; fronto-nasal region slightly dished (in *tahltanicus* not dished); sagittal crest much longer, higher anteriorly, and keeled from sinus case. Dentition heavier; canines and molars much larger.

Skull measurements.—Adult male (type): Basal length, 300; occipito-nasal length, 285; palatal length, 165; zygomatic breadth, 211; interorbital breadth, 76.

Horriæus Group.

URSUS APACHE MERRIAM.

APACHE GRIZZLY.

Ursus apache Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 134–135, September 6, 1916.

Type locality.—Whorton Creek, south slope of White Mountains, eastern Arizona (a few miles west of Blue).

Type specimen.—No. 212436, ♂ ad., U. S. National Museum, Biological Survey collection. Collected April 3, 1913, by B. V. Lilly.

Cranial characters.—Skull short, broad, and low, rather massive, moderately dished, with broad frontal shield and exceedingly broad outstanding postorbitals. Frontal shield broad, shallowly sulcate medially between orbits; very slightly and rather flatly swollen over orbits; long pointed posteriorly, meeting short sagittal crest at fronto-parietal suture; rostrum short, high, and rather narrow; *zygomata strongly outbowed and outstanding anteriorly as well as posteriorly;* ramus of jaw rather short, bellied under last molars; coronoid blade high, sloping strongly outward, the apex overarching shallow coronoid notch, but not cutting plane of condyle; dentition moderate.

Cranial comparisons.—Old male (type) compared with old male *horriæus* (type): Size somewhat greater; vault of cranium materially

higher; shield much broader both interorbitally and across postorbital processes; the posterior part much longer and horizontal or sloping posteriorly (in *horriæus* short and sloping strongly forward from apex of posterior point); sagittal crest very much shorter; palate broader and flat (in *horriæus* concave and arched); zygomata broadly outbowed (in *horriæus* narrowly triangular); meatus tube strongly compressed between mastoid and glenoid (in *horriæus* large and free); underjaw much more massive; ramus longer; broadly expanded vertically and upcurved posteriorly; coronoid blade higher. Teeth apparently similar (in *horriæus* badly worn).

Compared with adult male *absarokus*, to which it appears to be related, the skull of *apache* differs as follows: Vault of cranium lower, less arched; frontal shield broader and flatter; postorbitals much broader and flatter, standing out more horizontally; fronto-nasal region more depressed; rostrum shorter; *orbits notably smaller* (lower vertically); squamosal trough shorter antero-posteriorly; zygomata very much more strongly outbowed and conspicuously more outstanding anteriorly; underjaw and inferior border of ramus shorter; coronoid blade of equal height; teeth slightly smaller (difference slight).

Old male (type) compared with adult male *arizonæ* (type): Basal length, occipito-nasal length, length of palate, interorbital breadth, and occipito-sphenoid length essentially the same; zygomata very much more outstanding and bowed instead of subtriangular; frontal shield less flat, of essentially the same breadth interorbitally as in *arizonæ*, but very much wider across postorbital processes, rising strongly from plane of rostrum; postorbital processes much more broadly outstanding; orbital rims more swollen; fronto-nasal region much less elevated; rostrum much smaller, narrower, less swollen, depressed basally, and horizontal instead of tapering; palate and postpalatal shelf much narrower. Underjaw stronger; ramus broader vertically; coronoid blade higher; molars slightly smaller; heel of M^2 shorter, less distinctly emarginate on outer side (more tapering).

Skull measurements.—Adult male (type): Basal length, 325; occipito-nasal length, 315; palatal length, 171.5; zygomatic breadth, 234; interorbital breadth, 89.

URSUS HORRIÆUS Baird.

New Mexico Grizzly.

(Pl. XV.)

Ursus horribilis var. ***horriæus*** Baird, Mammals North Amer., Pacific RR. Reports, VIII, pp. 224, 225, 1857 (name, type locality, and measurements).

Ursus horribilis var. *horriæus* Baird, Mammals Mexican Boundary Survey, pp. 24–29, 1859. (Full description, including a specimen from Nogales, since made the type of another species—*kennerlyi*.)

Ursus (*Danis*) *horriaceus* Gray, Catalog. Carn., Pach., and Edent., British Museum, p. 229, 1869.

Type locality.—Coppermines, southwestern New Mexico.

Type specimen.—No. 990, ♂ old, U. S. National Museum. Collected in 1855, by J. H. Clark.

Range.—Parts of New Mexico, south to Casas Grandes, Chihuahua, Mexico; probably extending into eastern Arizona.

Characters.—Size medium; external characters unknown; skull low and flat with broad outstanding postorbital processes.

Cranial characters.—Old male (type): Skull long, low, narrow, and flat; frontal shield short pointed posteriorly, temporal impressions conspicuously beaded, curving strongly inward, and meeting halfway between plane of postorbital processes and fronto-parietal suture; frontal shield flattish, shallowly concave, swollen over orbits; postorbital processes large, broad, widely outstanding and moderately decurved; fronto-nasal region slightly dished; rostrum narrow; sagittal crest long and rather high; occipital overhang and inion marked; zygomatic arches angular, rather squarely but not widely spreading posteriorly; squamosal root of zygoma moderately expanded vertically; lachrymal duct cutting orbital rim anterior to orbit; palate and interpterygoid fossa rather narrow. Teeth of medium size (badly worn in type).

An *old female* (No. 67405, from mountains north of Silver City, New Mexico, near type locality), collected in 1893 by Dr. A. K. Fisher, is assumed to be *horriæus*. Unfortunately the occipital region is absent so that measurements of length can not be taken. Skull low, with moderately spreading angular zygomata, flat long-pointed frontal shield, elevated flat fronto-nasal region (in plane of shield), and narrow rostrum, without trace of dishing except slight change of angle at middle of nasals; highest point of cranium about 25 mm. anterior to fronto-parietal suture; postorbital processes moderate or weak, subtriangular, slightly decurved; lachyrmal duct cutting orbital rim anteriorly; rostrum somewhat compressed a little below nasals; palate short (145), concave between last molars; postpalatal shelf moderately broad, short, and flat. Teeth small.

Cranial comparisons.—Old male (type) compared with old male *apache* (type): Size somewhat smaller; vault of cranium lower; shield much narrower, the point much shorter; palate concave and arched instead of flat; zygomata narrowly triangular instead of broadly outbowed; ramus of jaw shorter.

Old male (type) compared with adult male *shoshone* (type): Size essentially the same (basal length slightly less but occipito-nasal length same); vault of cranium much lower and flatter; frontal shield much lower and more nearly horizontal, less strongly sloping,

slightly broader, more swollen over orbits, and broadly depressed interorbitally instead of flat or slightly convex; postorbital processes very much larger, broader, and more widely outstanding; frontal part of braincase broader and depressed—not keeling into sagittal crest; zygomata angular—not outbowed; occipito-sphenoid shorter; lachrymal duct more anterior; inferior border of ramus shorter; coronoid blade less high.

Old female compared with old females of *nelsoni:* Size larger (basal length about 10 mm. longer); vault of cranium higher over posterior frontal region; frontal shield broader, flatter anteriorly; zygomatic arches slightly more spreading. Teeth, especially canines and molars, materially larger.

Skull measurements.—Old male (type): Basal length, 312; occipito-nasal length, 310; palatal length, 169; zygomatic breadth, 207; interorbital breadth, 79.

URSUS HENSHAWI[1] MERRIAM.

HENSHAW GRIZZLY.

Ursus henshawi Merriam, Proc. Biol. Soc. Washington, XXVII, p. 190, August 13, 1914.

Type locality.—Southern Sierra Nevada, near Havilah, Kern County, California.

Type specimen.—No. 15671, ♂ old, U. S. National Museum. Collected in 1875 by Dr. J. T. Rothrock and Henry W. Henshaw.

Range.—Lower slopes of southern part of Sierra Nevada; limits unknown.

Characters.—Size rather small—by far the smallest of the California grizzlies; size and general cranial characters as in *horriæus*, but fronto-nasal region strongly dished and rostrum strongly depressed. Last upper molar short and broad, the heel short and subtriangular. Skin characters unknown.

Cranial characters.—Old male (type): Skull long, narrow, and rather low; zygomata subtriangular, narrowly spreading; frontal shield gently sloping, flat-concave; postorbital processes massive, and somewhat arched; orbital rims swollen; fronto-nasal region strongly depressed and dished; rostrum low, depressed.

Cranial comparisons.—Compared with an equally old male *horriæus* (type, from Coppermines, New Mexico): Surprisingly similar in general, with similar broad outstanding postorbitals, but rostrum strongly depressed; nasals flattened and horizontal anteriorly; fronto-nasal region concave and strongly dished (in *horriæus* rather high and not dished); frontal shield strongly and broadly concave between orbits and between postorbital processes (only faintly depressed medi-

[1] Named for Henry W. Henshaw, formerly chief of the Biological Survey.

ally in *horriæus*); more strongly sloping anteriorly; postorbital processes shorter and blunter; orbital rims more prominent, relatively thin, somewhat everted, continuing to lachrymal notch—their prominence anteriorly due in part to presence of a broad sulcus in ascending arm of maxillary immediately in front of orbit; lachrymal duct opening in orbit posterior to orbital rim (in *horriæus* on or anterior to rim); anterior nares broader than high (contrary true in *horriæus*); lambdoid crest higher; sagittal crest and inion much shorter; occipital overhang much less; palate decidedly broader; interpterygoid canal shorter; mastoid processes much longer and more divergent; anterior part of pterygoids more broadly expanded vertically and articulating with a like expansion of posterior arms of palatines (probably not constant). Upper molars decidedly broader (canines broken off).

Compared with two old males of *tularensis* (type, No. 3536, and No. 3537, from Fort Tejon, California): Size smaller; occipito-sphenoid length and frontal breadth essentially the same; vault of cranium and rostrum very much lower; fronto-nasal region more deeply concave, more strongly sloping, and strikingly more dished; rostrum smaller, lower, and strongly depressed instead of elevated; occipital overhang and development of inion conspicuously less; posterior part of sagittal crest not elevated or produced. Underjaw decidedly shorter, ramus much less broadly flattened vertically and more strongly bellied posteriorly. Last upper molar much smaller, the heel conspicuously shorter and narrowed on outer side.

Skull measurements.—Old male (type): Basal length, 318; occipito-nasal length, 305; palatal length, 173; zygomatic breadth, 204; interorbital breadth, 76.

Stikeenensis Group.

URSUS STIKEENENSIS MERRIAM.

STIKINE GRIZZLY.

(Pl. IX.)

Ursus stikeenensis Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 178–179, August 13, 1914.

Type locality.—Tatletuey Lake, tributary to Finlay River, near head of Skeena River, northern British Columbia.

Type specimen.—No. 202794, ♂ ad., U. S. National Museum, Biological Survey collection. Collected September 23, 1913, by Charles R. Cross, jr., and Edward A. Preble; original No. 5772.

Range.—Region about head of Finlay River, and Dease Lake region, northern British Columbia, and northerly in Yukon.

Characters.—Adult male (type): Size medium; skull short, broad, and highly arched; face strongly pugged from abrupt rising of frontal region; claws short and strongly curved for a grizzly (longest 60 mm.—tips worn by digging), dark, marked with yellowish on tips and sides. Upper molars large. Total length before skinning 1,830 mm.; hind foot 267 mm.; estimated height at shoulder 990 mm. (39 inches).

Color.—Type specimen: General ground color dark brown, grizzled and washed with pale-tipped hairs. Muzzle pale brown, becoming darker between eyes and on sides of face; top of head in front of ears washed with yellowish brown, almost forming a golden brown band between the darker ungrizzled frontal region and the more whitish color of the neck; general ground color of body very dark, bountifully overlaid on neck and back by pale buffy-tipped hairs which give a whitish cast to the neck; ears dark; legs and feet blackish; underparts dark brown; hairs on sides of throat long and grizzly.

Cranial characters.—Adult male (type): Size medium or large; skull short posteriorly, broad, highly arched, strongly dished, with abruptly ascending frontals and large molar teeth. Rostrum short, broad, broadening and strongly ascending posteriorly; nasals strongly upturned posteriorly; frontal shield rather broad, rising abruptly and swollen in front of and above orbits, sulcate medially, short pointed, the point ending in sagittal crest about 30 mm. anterior to fronto-parietal suture; postorbital processes large, broad, subtriangular, and decurved (more broadly rounded and more outstanding in older skull); braincase long for size of skull; zygomata rather broadly spreading, subtriangular, not much expanded vertically; palate and postpalatal shelf broad. Underjaw and inferior border of ramus very short. Molars large and broad.

Cranial comparisons.—Adult male compared with adult male *absarokus*: Size nearly the same though *absarokus* appears the larger; basal length and frontal breadth approximately the same, but occipito-nasal length much greater in *absarokus*. In *stikeenensis* rostrum lower, flatter, and more nearly horizontal; frontal shield and posterior part of nasals rising much more abruptly; frontals much more swollen in front of upper part of orbits; point of shield much shorter (ending midway between plane of postorbitals and fronto-parietal suture, while in *absarokus* it reaches posteriorly to suture); inion short; palate broader; underjaw shorter; coronoid lower.

Adult male compared with adult male *tahltanicus* (both inhabiting the same region): Basal length, zygomatic breadth, and frontal breadth essentially the same, but frontal region much higher and rising abruptly at orbits instead of sloping gently in plane of rostrum; rostrum broader, flatter, and more nearly horizontal (appear-

ing shorter); postorbitals much larger and less horizontally outstanding; palate longer; underjaw longer. Dentition heavier.

Skull measurements.—Adult male (type): Basal length, 321; occipito-nasal length, 305; palatal length, 171; zygomatic breadth, 217; interorbital breadth, 84.

URSUS CRASSODON SP. NOV.

BIG-TOOTH GRIZZLY.

Type No. 171049, ♂ old, U. S. National Museum, Biological Survey collection. Collected on Klappan Creek (=Third South Fork Stikine River), September, 1907, by Dr. E. P. Richardson, of Boston.

Cranial characters.—Old male (type): Frontal shield broad, lyrate posteriorly, the point reaching or slightly passing fronto-parietal suture; shield rising abruptly from rostrum, sulcate anteriorly but nearly flat between postorbitals; postorbitals broadly rounded and horizontally outstanding; rostrum of medium breadth, nearly horizontal; braincase short; sinus case rising to support postorbital part of shield; zygomata moderately outstanding, subtriangular, the squamosal root not broadly expanded; squamosal shelf narrow; palate and postpalatal shelf moderate; ramus short; coronoid blade rather small, moderately recurved at apex; canines rather large; *molars enormous* for size of skull: M^1 and M^2 very broad; heel of M^2 subtriangular, narrowing posteriorly.

I refer to this species two young males from Yukon, one (No. 209896) from White River, the other (No. 1839, Ottawa Museum) from Wolf Lake near Teslin Lake, both in the third year; and an old female (No. 202792) from Tatletuey Lake on the upper Finlay. Besides these, two very old male skulls from southern Yukon (No. 223760 from Glenlyon Mountains and No. 223767 from Quiet Lake at head of Big Salmon River) are provisionally referred to the species, but not without considerable hesitation. Both are high, short, and broad as in *crassodon*, but the teeth are too much worn to admit of reliable comparison. One (No. 223760) is so extremely aged that the roots of the canines have worked down and become absorbed basally, leaving the middle part of the rostrum narrower than normal.

Skull measurements.—Old male (type): Basal length, 320;[1] occipito-nasal length, 306;[1] palatal length, 175; zygomatic breadth, 222; interorbital breadth, 84.

URSUS CRASSUS SP. NOV.[2]

THICKSET GRIZZLY.

Type No. 225473, ♂ ad., U. S. National Museum, Biological Survey collection. From upper Macmillan River, Yukon. Collected in September, 1916, by William Drury.

[1] Partly restored.

[2] Tentatively included in *stikeenensis* group. (See Introduction, pp. 12–13.)

Characters.—Size large; hump apparent but not conspicuous; general color dark; claws of medium length, narrow, moderately curved, smooth, whitish above, with dark sides.

Color.—Muzzle pale brownish; top of head and neck strongly washed with yellowish or golden buffy; shoulders and back lightly tipped with same on dark background; legs and feet dusky.

Cranial characters.—Adult male (type): Skull rather large, short, broad, rather high, but not highly arched, and unusually massive. Shield broad, convex, faintly sulcate, sloping gradually into rostrum, the point reaching fronto-parietal suture; postorbitals rather broad, decurved in convexity of shield; rostrum large and high, rising in plane of shield; sagittal crest short; zygomata moderate; palate narrow and strongly troughed; postpalatal shelf short; underjaw rather short, massive; coronoid blade high and nearly vertical; subangular border short. Teeth large; canines massive; M^2 very long, its heel exceptionally long and flat, slightly emarginate and everted.

Cranial comparisons.—The skull of the adult male (type) viewed from above bears a striking likeness to that of adult male *hoots*, but when turned over the likeness ceases. It agrees with *hoots* essentially in size, massiveness, arching of vault of cranium, and frontal breadth; but frontal shield is more convex; postorbitals more decurved; rostrum somewhat more ascending (higher posteriorly); orbital rims less swollen; palate decidedly narrower and troughed instead of flat; coronoid more nearly vertical; subangular border shorter; teeth strikingly larger throughout—incisors, canines, and molars. The teeth of *hoots* are small for size of skull, those of *crassus* exceptionally large.

Male adult (type) compared with male adult *crassodon* (type): Size slightly greater; frontal shield much broader, more gently sloping, and more convex transversely, with decurved postorbitals (in *crassodon* shield flattish, nearly horizontal, with horizontally outstanding postorbitals and descending abruptly to rostrum); rostrum very much larger and higher and sloping gradually into shield; ramus much longer; subangular border shorter; coronoid larger and higher. Upper canines about same; lower canines much larger; upper and lower molar series of about same length but upper molars much narrower and less massive.

Remarks.—The skull of an immature male (No. 6552) collected by R. MacFarlane, May 1, 1863, on Anderson River, 50 miles southeast of old Fort Anderson, has very large teeth, especially M^2, thus differing widely from any adult Barren Ground bear thus far examined. Two still younger skulls collected on the Barren Grounds in 1911, by Dr. R. M. Anderson (No. 34411 Amer. Mus. Nat. Hist. from Horton River, and 34413 from Langton Bay), also have the crown of M^2 very long. These three skulls I provisionally refer to *crassus*.

It is a singular fact, in view of the wide dissimilarity of the skulls, that the teeth of male *crassus* and male *kluane* are very much alike.

Skull measurements.—Adult male (type): Basal length, 325; occipito-nasal length, 322; palatal length, 171; zygomatic breadth, 224; interorbital breadth, 94.

URSUS MIRABILIS MERRIAM.[1]

STRANGE GRIZZLY.

Ursus mirabilis Merriam, Proc. Biol. Soc. Washington, XXIX, p. 146, September 6, 1916.

Type locality.—Admiralty Island, Alaska.

Type specimen.—No. 137471, ♂ ad., U. S. National Museum, Biological Survey collection. Collected June 26, 1905, by Cyrus Catt.

Characters.—A true grizzly, of medium size, related to *stikeenensis* of the mainland, and having the same high bulging forehead; external characters unknown.

Cranial characters.—*Adult male* (type): Skull of medium size, short, with rather broadly spreading zygomata and highly arched (almost domed) frontal region. Frontal shield of moderate breadth, short pointed posteriorly, rising abruptly from rostrum, convex both antero-posteriorly and transversely, slightly sulcate medially, moderately swollen on each side of sulcus; postorbital processes moderate, broader than peglike, slightly decurved (continuing convexity of frontals); fronto-nasal region strongly dished; rostrum high, narrow, strongly sloping; zygomata rather broadly outstanding, slightly bowed; palate and postpalatal shelf rather broad; underjaw short; ramus bellied posteriorly; coronoid blade high and rather vertical, the apex not reaching plane of condyle. Upper canines rather long; molars rather broad and short.

Cranial comparisons.—*Ursus mirabilis* requires comparison with only a single species—*stikeenensis* of the neighboring mainland: Size smaller; frontal shield narrower and more bulging anteriorly, rising more abruptly from rostrum; rostrum narrower, materially higher, and more sloping; zygomata more widely outstanding; occipital overhang more pronounced; palate and postpalatal shelf similar; underjaw less massive; coronoid blade narrower and higher; teeth similar, but heel of last upper molar much shorter.

Skull measurements.—Adult male (type): Basal length, 308; occipito-nasal length, 310; palatal length, 168; zygomatic breadth, 230; interorbital breadth, 81.

[1] Tentatively included in *stikeenensis* group. (See Introduction, pp. 12–13.)

URSUS ABSAROKUS MERRIAM.[1]

ABSAROKA GRIZZLY.

Ursus absarokus Merriam, Proc. Biol. Soc. Washington, XXVII, p 181, August 13, 1914.

Type locality.—Near head of Little Bighorn River, northern part of Bighorn Mountains, Montana.

Type specimen.—No. 67391, ♂ ad., U. S. National Museum, Biological Survey collection. Collected in May, 1893; purchased for Biological Survey by J. Alden Loring.

Range.—Laramie and Bighorn Mountains, eastern Wyoming, Black Hills region, South Dakota, and northward along Little Missouri to Missouri and Yellowstone Rivers.

Characters.—Size large, but much less than *horribilis* and with much smaller molars—especially M^2.

Color.—Head of young-adult (No. 203524) killed by Howard Eaton on the Little Missouri at mouth of Bear Creek, near Middle or "Bullion" Butte, October 27, 1880: Muzzle pale brown, changing to grizzled dark brown on head and face; a large patch of dark brown free from grizzling on side of face extending from eye to angle of jaw; chin and gular region dark brown (except anterior part of chin, which has not yet molted the pale old coat); top and sides of neck and doubtless body also, strongly grizzled.

Cranial characters.—*Adult male* (type specimen, and other males from Bighorn and Laramie Mountains): Vault of cranium rather highly arched; zygomata moderately outstanding and slightly bowed; frontal shield rather broad, rising strongly from rostrum, convex both antero-posteriorly and transversely; slightly swollen on each side of median line just behind plane of orbits, faintly depressed medially between orbits; postorbital processes large, outstanding, and slightly decurved, the tips bluntly rounded; sagittal crest nearly straight, reaching anteriorly to fronto-parietal suture; rostrum large and high, rising strongly into frontal shield; postpalatal shelf broad and flat; nasals large and long; top of coronoid high and broadly rounded, its apex short, not reaching posteriorly to plane of condyle. Teeth rather large, especially M^2 which is long and broad, the heel emarginate on outer side.

Cranial comparisons.—Adult male (type) compared with adult male *shoshone* (type): Basal length essentially the same but skull somewhat larger and more massive, broader, highest point more

[1] Tentatively included in *stikeenensis* group. (See Introduction, pp. 12–13.)

anterior; frontal shield broader, domed (strongly convex both antero-posteriorly and transversely) and rising rather abruptly from plane of rostrum (in *shoshone* flat); point of shield much longer posteriorly, reaching to or nearly to fronto-parietal suture. Molars larger—especially M^2.

Skull measurements.—Adult male (type): Basal length, 322; occipito-nasal length, 322; palatal length, 172; zygomatic breadth, 218; interorbital breadth, 88.

Alascensis Group.

URSUS ALASCENSIS MERRIAM.

ALASKA GRIZZLY.

(Pl. XII.)

Ursus horribilis alascensis Merriam, Proc. Biol. Soc. Washington, X, pp. 74–75, April 13, 1896.

Type locality.—Unalaklik River, Alaska.

Type specimen.[1]—No. 76466, ♂ old, U. S. National Museum, Biological Survey collection. Collected in 1895, by the late Rudolf Neumann, of Iliuliuk, Alaska.

Range.—Norton Sound region, Alaska (Unalaklik and Shaktolik Hills) southerly over the Nushagak and Kuskokwim Rivers to Chinitna on Cook Inlet. Limits unknown.

Cranial characters.—Old male (type): Size small; braincase broad anteriorly; frontal shield rather broad, flattish, very short pointed posteriorly with correspondingly elongate sagittal crest, moderately sulcate interorbitally, otherwise convex in cross section, rising rather strongly from facial plane; postorbitals rather small, moderately decurved; fronto-nasal region moderately dished; zygomata subtriangular, not broadly outstanding; palate rather broad and concave; postpalatal shelf broad and short; notch rather broad; jaw rather long; inferior border of ramus long, moderately convex posteriorly; coronoid blade moderate, rather high, the apex recurved. Teeth moderate; last upper molar broad and short, with short obliquely truncate heel; first lower molar sinuous, a strong concavity on outer side.

Adult female:[2] Long and high; vault of cranium well arched, highest about midway of frontals; frontal shield rather narrow, not flattened but arching high above facial plane; swollen between me-

[1] In describing this bear 20 years ago I neglected to designate a type, and the original material included skulls of more than one species. I take this opportunity therefore to fix the type of *Ursus alascensis* on one of the original specimens (No. 76466, U. S. National Museum, Biological Survey collection) and to redefine the species.

[2] In the absence of skulls of adult females from the type region it is assumed that females from the Nushagak, Kuskokwim, and Chinitna Rivers are fairly typical of *alascensis*.

dian sulcus and orbits; postorbital processes decurved; palate and postpalatal shelf long. Last upper molar with short heel.

Cranial comparisons.—Old male (type) compared with old male *toklat* (No. 158811, collected by Charles Sheldon at head of Toklat River near northern base of Mount McKinley): Size and general appearance essentially the same, but vault of cranium less elevated; frontal shield narrower and shorter (the point reaching about halfway from plane of postorbitals to parietals); sagittal crest longer; zygomata *much less broadly outstanding*, less arched; underjaw decidedly longer; inferior border of ramus longer; coronoid decidedly higher; heel of last upper molar *very much shorter.*

Adult female compared with adult female *toklat*: Skull decidedly larger; vault of cranium much higher and more arched (in *toklat* low and flat), highest about middle of frontals instead of at hinder end; rostrum larger (longer, broader, and higher); face more sloping (nasals less nearly horizontal); frontals much more swollen between sulcus and orbits; postorbital processes more decurved; palate, postpalatal shelf, and occipito-sphenoid notably longer; last upper molar very much shorter.

Adult male compared with adult male *tundrensis* of same region: Size smaller (basilar and occipito-nasal lengths fully an inch less); skull less massive; frontals narrower, rising more abruptly from facial plane and more swollen over orbits; rostrum more slender; palate less flattened; ramus of jaw less swollen posteriorly; coronoid less falcate; canines smaller, decidedly shorter, and more curved; molars decidedly smaller.

Skull measurements—Old male (type): Basal length, 310; occipito-nasal length, 298.5; palatal length, 166; zygomatic breadth, 206; interorbital breadth, 79.

URSUS TOKLAT Merriam.

Toklat Grizzly.

Ursus toklat Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 182–183, August 13, 1914.

Type locality.—Head of Toklat River, north base of Alaska Range, near Mount McKinley, Alaska.

Type specimen.—No. 158813, ♀ ad., U. S. National Museum, Biological Survey collection. Collected May 24, 1908, by Charles Sheldon, and by him presented to the Biological Survey; original No. 324. Mother of cub No. 158814 (original No. 325).

Range.—So far as known, restricted to Alaska Range.

Characters.—Size medium; skulls of both male and female rather highly arched and dished, that of female much smaller and lower than male. Last upper molar large; heel very long. Claws horny and smooth.

Color.—Color variable, upperparts ranging from ordinary "grizzly bear color" to creamy white; claws usually dark throughout, but in many cases more or less marked with white.

Cranial characters.—Adult males: Size medium; rostrum high, subterete above, nearly horizontal; frontal shield abruptly elevated, convex or domed, swollen over orbits, sulcate medially, rather long pointed (reaching fronto-parietal suture); postorbital processes rather small and strongly decurved; squamosal shelves short; palate arched and excavated longitudinally; postpalatal shelf rather broad; zygomata very broadly spreading and angular (zygomatic breadth in proportion to basal length much greater than in any other true grizzly, about equaling that of *sheldoni*); sagittal crest short. Last upper molar large, its heel normally very long. *Adult female:* Skull rather long and narrow, with broadly spreading zygomata and strongly dished fronto-nasal region; frontal shield rather flat, sulcate between orbits, varying from lyre pointed to short pointed; postorbital processes outstanding horizontally; rostrum rather slender, nearly horizontal. In most specimens the highest point of cranium culminates in a rather abrupt change of angle at or near the fronto-parietal suture, forming a sort of "hump," a condition usual also in skulls of female grizzlies from the upper Yukon and northern British Columbia.

Cranial comparisons.—Old male compared with old male *alascensis:* Frontal region more elevated; sagittal crest shorter; zygomatic breadth much greater; heel of last upper molar much longer.

Adult female compared with female *alascensis:* Size smaller; vault of cranium decidedly lower, highest over posterior part of frontals instead of over middle of frontals; frontal shield narrow, flattened, sloping (not arched and not materially swollen over orbits); postorbital processes outstanding horizontally; palate, postpalatal shelf, and occipito-sphenoid shorter; M^2 with heel much longer.

Adult female compared with adult female *phœonyx:* Size decidedly greater; teeth much larger, especially the canines and last upper molars.

Adult female compared with adult female *kluane:* Length much greater; facial part of skull about the same; braincase and postpalatal parts much longer; vault of cranium higher; sagittal crest longer and higher, reaching forward over posterior frontals; point of shield much shorter; underjaw and inferior border of ramus much longer; teeth about the same size but M^1 usually smaller; heel of M^2 longer.

Skull measurements.—Old male (No. 158811, from head Toklat River, Alaska): Basal length, 304; occipito-nasal length, 298; palatal

length, 169.5; zygomatic breadth, 222; interorbital breadth, 80. Old female (type): Basal length, 283; occipito-nasal length, 267; palatal length, 157; zygomatic breadth, 187; interorbital breadth, 73.

URSUS LATIFRONS Merriam.

Broad-Fronted Grizzly.

Ursus phœonyx latifrons Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 183–184, August 13, 1914.

Type locality.—Jasper House, Alberta.

Type specimen.—No. 75612, ♂ old, U. S. National Museum, Biological Survey collection. Collected September 15, 1895, by J. Alden Loring. Original No. 3270.

Range.—Rocky Mountains of western Alberta and eastern British Columbia from Jasper House northwesterly to region between headwaters of Parsnip and Great Bend of Fraser River and thence to extreme headwaters of Stikine River; limits of range unknown.

Characters.—Size medium or rather large. External characters unknown. Affinities with the geographically remote *toklat*.

Cranial characters.—*Adult male* (type): Size medium; base elongate posteriorly; vault of cranium rather low, only slightly arched, top flattish; frontal shield very broad (interorbitally 93 mm., between tips of postorbitals 130), rising from rostrum rather abruptly, broadly but shallowly depressed medially, swollen over orbits, the point ending in sagittal crest some distance (apparently more than an inch) anterior to fronto-parietal suture; postorbital processes *broad*, outstanding, and only slightly depressed; fronto-nasal region slightly dished; rostrum rather high, nearly horizontal, rounded above; postpalatal shelf rather broad; notch rather narrow; zygomata strongly outbowed but not widely spreading; underjaw long; coronoid blade broad basally, rather low, its anterior border sloping strongly backward. Teeth too badly worn to admit of description. *Adult female* (No. 209378) collected by F. K. Vreeland, September 17, 1915, near head of Big Salmon or North Fork Fraser River between Big Bend of the Fraser and headwaters of the Parsnip: Similar in general to that of male with the usual sexual difference in frontal shield, which is lyrate pointed posteriorly; frontal shield broad—broadly depressed medially between orbits, swollen over orbits; postorbital processes strongly developed, outstanding, slightly decurved; sagittal crest short, high posteriorly, covering about three-quarters of suture between parietals; postpalatal shelf rather broad and flat; mastoids short and appressed; postpalatal notch short, of moderate breadth; zygomata moderately outstanding, less bowed than in the male; coronoid blade broad basally, rather low, recurved

at apex; canines of medium size; molars large, especially last upper molar.

Cranial comparisons.—Old male (type) compared with old male *toklat* (from type locality): Frontal shield much broader and less elevated; braincase less arched; palate flatter (in *toklat* distinctly arched antero-posteriorly); zygomata more rounded basally and more *outbowed* (less angular); underjaw slightly longer; inferior border of ramus much longer; coronoid blade broader and higher. The basal part of the skull is longer in *latifrons* than in *toklat*. This is apparent whether the skull is viewed from above or below. In *latifrons*, seen from above, the distance from occipital crest to postorbital process is materially greater; while seen from below, the distance from occipital condyle to postpalatal notch is likewise greater. Another difference appears rather strikingly when the skull is viewed from below: in *latifrons* the squamosal base of the zygoma slopes gradually forward, while in *toklat* the curve is much shorter and more abrupt, so that the bases of the zygomata stand out much more squarely, practically at right angles to cranial axis.

While skulls of adult male *latifrons* differ strikingly from those of male *toklat*, skulls of the adult females are surprisingly alike, agreeing in general appearance, basal length, breadth of palate, and large size of last upper molar, though in *latifrons* this tooth is actually broader than in most specimens of *toklat*. The two agree essentially also in lower molars and canines. The underjaw in *latifrons*, however, is shorter, and coronoid blade lower than in *toklat*.

Old male compared with old male *kluane:* Frontal region much broader and flatter; postorbital processes much less decurved; sagittal crest shorter and straight instead of arched; rostrum less elevated and less narrowly rounded above; nasals flatter; zygomata more widely spreading and more strongly outbowed posteriorly; coronoid blade broader at base.

Adult female compared with adult female *kluane:* Skull much larger, longer, and more massive; frontal shield *much broader;* vault of cranium flatter (less arched over posterior frontals); rostrum higher; zygomata more widely outstanding; palate much broader; last upper molar much larger; lower molars and canines approximately same size. While the skull of female *latifrons* is much larger than that of female *kluane*, the underjaw is only slightly larger.

Adult female compared with adult female *phæonyx*: Size much larger; frontal region much broader; rostrum broader; nasals more nearly horizontal; arch of cranium more depressed; underjaw longer; coronoid blade broader; molars much larger. (Comparison of males is unnecessary, the male of *phæonyx* having a large, broad, massive skull resembling that of *dalli.*)

Skull measurements.—Old male (type): Basal length, 324; occipito-nasal length, 312; palatal length, 173; zygomatic breadth, 214.5; interorbital breadth, 94.

Richardsoni Group.

URSUS RICHARDSONI SWAINSON.

BARREN GROUND BEAR.

Ursus Richardsoni Swainson, Animals in Menageries, pp. 54–56, 1838.

Type locality.—Shore of Arctic Ocean, on west side of Bathurst Inlet near mouth of Hood River.[1]

Characters.—Size medium; color variable, from yellowish to grizzly brown; foreclaws of medium length, smooth; skull medium or small, with broadly spreading zygomata.

Cranial characters.—Adult males: Two adult or rather old male skulls collected by Dr. R. M. Anderson in 1915, and loaned me by the Museum of the Geological Survey of Canada, at Ottawa (one No. 2774 from Dolphin and Union Straits, the other No. 2776 from near mouth of Coppermine River), are assumed to be typical: Size medium; cranium high in relation to size, but not much arched; basicranium flat; shield rising abruptly from rostrum, of medium breadth, broadly and strongly sulcate medially, swollen over orbits, short pointed; postorbital processes massive, outstanding, arched over orbits and slightly decurved; orbits nearly vertical; rostrum moderate, rather high and narrow, sloping into sulcus of shield: orbits prominent, rising well above fronto-nasal plane; zygomata moderate, somewhat outbowed; nares subrectangular, broader than high; palate rather short; postpalatal shelf moderate or rather broad; squamosal shelf weak posteriorly; underjaw rather short; infra-angular border of ramus short; apex of coronoid only slightly recurved, falling short of plane of condyle; angular process projecting beyond condyle. Teeth medium; canines rather large; M^2 with moderate heel, narrowing posteriorly; cusps of posterior molars weak, those of inner side of M_2 nearly obsolete (in striking contrast with the highly developed cusps of both upper and lower molars of *pellyensis*).

An exceedingly old male in the National Museum (No. 6255), collected on Anderson River by R. MacFarlane, has the shield less swollen over and in front of orbits, and even shorter pointed poste-

[1] Swainson's description was based on and largely quoted from Richardson's account of "an old and lean male, killed on the shores of the Arctic Sea on the 1st of August, 1821." (Article on the Barren Ground Bear, in Fauna Boreali-Americana, pp. 21–24, 1829.) And in Franklin's "Narrative of a Journey to the Shores of the Polar Sea," p. 373, 1823, under date of August 1, 1821, the party being at the mouth of Hood River on Bathurst Inlet, the killing of a lean male brown bear is chronicled in some detail. It appears therefore that the type locality of *Ursus richardsoni* is Hood River, Bathurst Inlet.

riorly; rostrum more depressed; sagittal crest longer and somewhat higher (but still not high) and somewhat humped over posterior frontals; zygomata more broadly outstanding.

Skull measurements.—Old male (No. 6255) from Anderson River: Basal length, 311; occipito-nasal length, 286; palatal length, 163; zygomatic breadth, 227; interorbital breadth, 72.5. Old male (No. 2774, Ottawa Museum) from Dolphin and Union Strait: Basal length, 316; occipito-nasal length, 290; palatal length, 170; zygomatic breadth, 211; interorbital breadth, 79. Adult male (No. 2776, Ottawa Museum) from near mouth Coppermine River: Basal length, 299; occipito-nasal length, 288; palatal length, 163; zygomatic breadth, 217; interorbital breadth, 82.5.

URSUS RUSSELLI[1] MERRIAM.[2]

MACKENZIE DELTA GRIZZLY.

Ursus russelli Merriam, Proc. Biol. Soc. Washington, XXVII, p. 178, August 13, 1914.

Type locality.—West side Mackenzie River delta, Canada.

Type specimen.—No. 21301, ♂ old, University of Iowa Museum. Collected June 28, 1894, by Frank Russell. Mounted skin with skull separate.

Range.—Lower Mackenzie region; limits unknown.

Characters.—Size rather small. Color a curious pale drab-brown, somewhat darker on legs and feet; ears conspicuously hairy. Claws smooth, moderately to strongly curved; brownish horn color with paler (almost amber) tips. Teeth large; last upper molar of great size and peculiar glassy texture in type skull. Affinities uncertain.

Cranial characters.—Adult male (type): Skull of medium size, about equaling old male of *alascensis;* rather short; fairly broad across zygomata; frontal shield sloping strongly upward, moderately sulcate, swollen over orbits, but orbits not everted; posterior point of shield rather short, ending about one-third the distance from fronto-parietal suture to postorbital processes; postorbital processes peglike, standing out nearly horizontally—not depressed as in *alascensis;* muzzle rather narrow and high; zygomata slender, the posterior roots not expanded vertically; palate flat, not excavated or arched as in several species; underjaw massive, heavier under $M_{\overline{2}}$ and $M_{\overline{3}}$ than in *alascensis;* coronoid blade falcate but not narrowly so.

Cranial comparisons.—From *richardsoni*, its neighbor on the east, with which it agrees in size and in certain dental characters, it differs in much more highly vaulted cranium; more highly sloping (less

[1] Named for Frank Russell, who collected the type specimen.

[2] Tentatively included in *richardsoni* group. (See Introduction, pp. 12–18.)

nearly horizontal) braincase; much more elevated frontal region, and very much narrower rostrum. The frontal shield is much longer than in *richardsoni*, the temporal impressions curving backward to meet one another about one-third the distance between postorbital processes and fronto-parietal suture, instead of turning abruptly inward; postorbital processes more slender than in *richardsoni;* sagittal crest shorter and less nearly horizontal; upper molars *very much larger*, particularly broader. Zygomatic arches bowed outward in both species—not sharply angular as in many large bears.

Skull measurements.—Old male (type): Basal length, 310; occipito-nasal length, 300; palatal length, 163; zygomatic breadth, 220; interorbital breadth, 79.5.

URSUS PHÆONYX Merriam.

TANANA GRIZZLY.

Ursus horribilis phæonyx Merriam, Proc. Biol. Soc. Washington, XVII, p. 154. October 6, 1904.

Type locality.—Glacier Mountain, Tanana Mountains, Alaska (about 2 miles below source of Comet Creek, near Fortymile Creek, between Yukon and Tanana Rivers).

Type specimen.—No. 133231, ♀ ad., U. S. National Museum, Biological Survey collection. Collected July 12, 1903, by W. H. Osgood.

Range.—Tanana Mountains between Tanana and Yukon Rivers.

Characters.—Size of male large; of female small (sexual disparity great, much greater than in *dalli*).

Color.—Upperparts varying from creamy or buffy to dark "grizzly color"; underparts and muzzle pale brown; legs very dark brown, varying to blackish brown; claws horny and smooth, usually dark but sometimes marked with whitish. Last upper molar of medium size or rather small.

Cranial characters.—Old male (No. 201586, from Ketchumstock, assumed to be typical of *phæonyx*): Size medium or rather large; skull broad and short, moderately arched and dished, with broadly outstanding zygomata and rather deeply sulcate strongly sloping frontal shield. Frontal shield of moderate breadth, strongly swollen over orbits and bases of postorbitals, short pointed posteriorly, the point ending midway between fronto-parietal suture and plane of postorbitals; postorbitals triangular, broad basally, convex posteriorly, straight or concave anteriorly; rostrum moderate, nearly horizontal, sulcate-depressed on top; fronto-nasal region distinctly dished; squamosal shelves broad and rather short, the outer margin arched and upturned; middle part of zygomata moderately expanded vertically; palate broad and short; postpalatal shelf broad; notch relatively narrow. Underjaw long for size of skull, massive;

coronoid blade high, rather narrow, and rather vertical, the recurved apex not reaching plane of condyle. Teeth medium.

Adult female (type): Size small; vault of cranium well arched posteriorly, highest point 25 to 30 mm. in front of fronto-parietal suture; braincase rather broad, not much constricted anteriorly, not compressed, and with no tendency to keel into anterior part of sagittal crest; frontal shield moderately flattened, shallowly sulcate medially and slightly swollen on each side of median depression, gently sloping into rostrum posteriorly, the lyrate point reaching nearly to parietals; rostrum rather small; zygomata moderately outstanding; palate medium; postpalatal shelf rather broad and short. Underjaw long; inferior border of ramus long and straight; coronoids rather small, the apex strongly recurved, cutting plane of condyle.

Cranial comparisons.—Old female (type) compared with adult female *kluane:* Size somewhat larger; braincase broader anteriorly; frontal shield broader; palate and postpalatal shelf broader; occipito-sphenoid and postpalatal lengths much greater. Underjaw much longer; inferior border of ramus longer and straighter. Teeth too badly worn to admit of description but apparently about same size as in *kluane.*

Old female (type) compared with adult female *toklat* from Alaska Range, near Mount McKinley: Basal length somewhat less; braincase less contracted and much broader anteriorly (not compressed and with no tendency to keel into anterior part of sagittal crest); frontal shield less deeply sulcate anteriorly and much longer pointed posteriorly; fronto-nasal region less depressed; underjaw shorter; ramus straighter and lighter; coronoid much smaller, narrower, and lower; upper canines apparently about the same; last upper molar smaller; lower canines more slender; lower molars apparently about the same, but so completely worn off in type specimen that comparison is impossible.

Remarks.—The skull of the adult male *phæonyx* (if the sexes are correctly mated) is large, broad, and rather massive, requiring comparison with only a single known species, *Ursus dalli.* The female on the other hand is small and resembles in a general way the females of the still smaller *kluane*, *pulchellus*, and *pallasi.*

Skull measurements.—Old male (No. 205186, from Ketchumstock, Alaska): Basal length, 327; occipito-nasal length, 309; palatal length, 176; zygomatic breadth, 242; interorbital breadth, 85. Old female (type): Basal length, 280; occipito-nasal length, 267; palatal length, 148; zygomatic breadth, 189; interorbital breadth, 68.

URSUS INTERNATIONALIS Merriam.

Alaska Boundary Grizzly.

Ursus internationalis Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 177–178, August 13, 1914.

Type locality.—Alaska-Yukon Boundary, about 50 miles south of Arctic coast (lat. 69° 00′ 30″).

Type specimen.—No. 1763, ♂ ad., Ottawa Museum. Killed July 3, 1912, by Frederick Lambart, of Canadian Boundary Survey.

Range.—Region bordering Arctic coast along international boundary, and doubtless adjacent mountains, between the coast and the Yukon-Porcupine; limits unknown.

Characters.—Size medium or rather large; affinities doubtful. Color a peculiar pale yellowish brown. Head strongly arched; muzzle and frontal region broad. Large lower premolar strictly conical, without heel, as in the brown bears.

Cranial characters.—Skull of medium size, massive, strongly arched and dished, highest over anterior part of braincase; frontal shield broad, very short pointed posteriorly, sulcate medially and swollen over orbits; postorbitals bluntly rounded, strongly decurved, not widely projecting; fronto-nasal region strongly dished; rostrum large and broad; sagittal crest long but feebly developed; zygomata subtriangular, not widely outstanding, and not much expanded vertically; palate and postpalatal shelf rather broad; notch moderate. Teeth rather small for size of skull; heel of last upper molar small and obliquely truncate on outer side; large lower premolar strictly of brown-bear type—a single cone without heel, sulcus, or posterior cusplets; first lower molar broad and somewhat sinuous; middle lower molar narrow and short posteriorly.

Skull measurements.—Adult male (type): Basal length, 309; occipito-nasal length, 293; palatal length, 169; zygomatic breadth, 203.5; interorbital breadth, 82.

URSUS OPHRUS[1] Merriam.

High-Brow Grizzly.

(Pl. X.)

Ursus ophrus Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 148–149, September 6, 1916.

Type locality.—Eastern British Columbia (exact locality unknown).

Type specimen.—No. 210252, ♂ old, U. S. National Museum, Biological Survey collection. Collected in 1915, by E. W. Darbey.

[1] *Ophrus*, with reference to the unusual brows.

Cranial characters.—Skull short, strongly dished, remarkably high, the deeply sulcate frontal shield rising abruptly high over orbits, with thickened brows and large outstanding arched postorbital processes. Frontal shield of moderate breadth; deeply and broadly concave between orbits, swollen over orbits and passing out into strongly outstanding postorbitals, short pointed posteriorly; fronto-nasal region deeply sulcate; middle part of nasals flat; sagittal crest high and reaching anteriorly nearly midway from fronto-parietal suture to plane of postorbitals; rostrum rather small and narrow; palate rather narrow; postpalatal shelf rather broad; zygomata broadly and strongly outbowed; mastoids rather long. Underjaw long, its inferior margin rather long and nearly straight; subangular tubercle considerably posterior to inferior dental foramen; coronoid blade broad, its apex only moderately recurved, ending anterior to plane of condyle; canines of medium size, the lower ones rather massive; molars of medium size, the upper rather small for size of skull.

Skull measurements.—Old male (type): Basal length, 323;[1] occipito-nasal length, 304; palatal length, 175; zygomatic breadth, 229; interorbital breadth, 85.

URSUS WASHAKE Merriam.

Washakie Grizzly.

Ursus washake Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 152–154, September 6, 1916.

Type locality.—North Fork Shoshone River, Absaroka Mountains, western Wyoming (between Bighorn Basin and Yellowstone National Park).

Type specimen.—No. 213005, ♂ ad., U. S. National Museum, Biological Survey collection. Killed September, 1913, by Col. J. A. McGuire.

Cranial characters.—Old male (type): Size medium, about equaling male *shoshone* and male *horribilis;* skull rather short and high, moderately arched, with broad, elevated postorbitals and rather broadly outbowed zygomata. Frontal shield rather narrow, sloping strongly upward anteriorly, highest at postorbital processes, horizontal posteriorly, broadly concave between postorbital processes; postorbital processes large, broad, subtriangular as viewed from above, outstanding, elevated and slightly arched, rising well above frontal plane and passing anteriorly into thickened orbital rims; fronto-nasal region dished (change of angle about middle of nasals); rostrum rather small, strongly compressed horizontally between nasals and roots of canines, making nasals appear elevated; anterior nares small; zygomata rather slender, broadly spreading, rounded

[1] Restored.

and strongly outbowed posteriorly, only slightly expanded vertically; sagittal crest low; postpalatal shelf broad, flat, and rather short; occipito-sphenoid 87 mm. (=distance from front of canine to or slightly beyond middle of M^1). Underjaw moderate; ramus bellied posteriorly; coronoid blade high and rather falcate, the apex cutting plane of condyle (line from apex to tip of angular process passing well behind condyle). Teeth moderate or rather large; M^2 large.

Cranial comparisons.—Old male (type) compared with adult male *ophrus* (type): Size about the same, but appearing smaller; frontal shield less elevated and less deeply concave; fronto-nasal region elevated instead of sulcate-dished; zygomata less widely outbowed; postorbitals much broader and less elevated; orbital rims less swollen; postpalatal shelf shorter and broader; mastoids shorter; nares smaller and lower. Underjaw more massive; inferior border of ramus more swollen and much more bellied posteriorly; coronoid blade higher and more falcate, the apex reaching much farther posteriorly (cutting plane of hinder part of condyle).

Compared with adult male *canadensis* (type), to which it is not related but with which it agrees essentially in basal and occipito-sphenoid length: Frontal shield less flat, more elevated laterally, highest at postorbitals instead of at posterior point; fronto-nasal region more dished; rostrum smaller, narrower basally, more strongly compressed below nasals; postorbital processes very much larger, broader, and more massive, elevated, arched, and subtriangular, instead of slender and narrowly peglike; zygomata more outbowed and arched; sagittal crest low and straight instead of high and arched; inion less developed; braincase anteriorly broader and more depressed—not tending to "keel" into sagittal crest as in *canadensis;* occipito-nasal length less, although basal length of skull is essentially the same in both. Underjaw longer; inferior border of ramus shorter and more strongly bellied; coronoid blade higher and more falcate, its apex reaching farther posteriorly; distance from angle to subangular process much greater; diastema in both jaws much longer. Last upper and middle lower molars not quite so broad.

Compared with adult male *absarokus* (type): Size smaller; vault of cranium decidedly lower; braincase anteriorly broadly depressed; frontal shield narrower, lower, and flatter, concave instead of convex between postorbital processes; postorbital processes (viewed from above) *broadly triangular, uplifted, and somewhat arched* instead of pegshape; orbital rims more thickened and elevated; rostrum smaller, lower, more slender, and much more compressed horizontally between nasals and roots of canines, making the nasals appear elevated; sagittal crest lower; occipito-sphenoid shorter; occiput lower; anterior nares smaller. Underjaw shorter; inferior border of

ramus much shorter; coronoid blade more falcate, its apex reaching farther posteriorly; angular process more slender and more produced posteriorly (line connecting apex of coronoid with angle passing well behind condyle—in *absarokus* cutting condyle near middle). Molars smaller.

Skull measurements.—Adult male (type): Basal length, 310; occipito-nasal length, 305; palatal length, 170; zygomatic breadth, 217; interorbital breadth, 76.

Kidderi Group.

URSUS KIDDERI KIDDERI[1] MERRIAM.

KIDDER BEAR.

(Pl. VIII.)

Ursus kidderi Merriam, Proc. Biol. Soc. Washington, XV, p. 78, March 22, 1902.

Type locality.—Chinitna Bay, Cook Inlet, Alaska.

Type specimen.—No. 116562, ♂ young (not fully grown), U. S. National Museum, Biological Survey collection. Collected June 9, 1901, by James H. Kidder.

Range.—Alaska Peninsula for its entire length.

Characters.—Size medium—small compared with *gyas* of the same region; sexual disparity small, female nearly as large as male; skull of adult male hardly half the bulk of male *gyas;* skull of adult female nearly the same size as that of female *gyas;* color yellowish brown; claws rather short, blue-black.

Color.—June specimens (in left-over winter pelage): General color yellowish brown, darkest on belly and legs, legs much darker than body. Most of the Kidder bears in the National Zoological Park are pale buffy yellowish, or yellowish cream color.

Cranial characters.—Adult male: Skull long, rather low, narrow, and massive; frontal shield narrow, moderately sloping; swollen over orbits and rather deeply sulcate or troughed medially; fronto-nasal region slightly dished; rostrum and nasals high and rather long; postorbital processes peglike, outstanding; braincase elongate; zygomata angular, only moderately spreading; sagittal crest long; palate long; mastoids long; underjaw long, with long ramus and moderate or low coronoid blade. *Adult female:* Skull in general like that of male but slightly smaller and with more slender rostrum and slightly smaller teeth. The sagittal crest extends much farther forward than in the females of most species, in this respect also resembling the male. The sexual difference in size of teeth appears to be covered by individual variation.

[1] Named for James H. Kidder, who collected and presented the type specimen.

Cranial comparisons.—Adult male and female compared with adult female *gyas:* Adult males require no comparison, owing to the great difference in size of skull and teeth, but with the females the case is very different, the size being essentially the same. In *fully adult* females *kidderi* is easily distinguished by the *lowness* of the vault of the cranium and *greater length of the sagittal crest*—female *gyas* being rather highly domed and having the short sagittal crest of most female bears.

Males of *kidderi* are sometimes hard to tell from females of *gyas*, but in the case of fully adult skulls they may be distinguished as follows: Male *kidderi* averages longer, both in basal and occipito-nasal length, is much less highly arched, and is more obliquely truncate posteriorly so that the occiput overhangs, giving the effect of a longer braincase. The rostrum also is somewhat longer. The frontal shield is quite different, being very much shorter posteriorly, ending about an inch in *front* of the parietals, whereas in female *gyas* the posterior point of the shield extends posteriorly to about the same distance *behind* the fronto-parietal suture. Thus in adult male *kidderi* the frontal shield is horizontal or *slopes forward* from its most posterior point, while in adult female *gyas* it *slopes backward* for some distance—from a point at least an inch in front of the fronto-parietal suture—the shield thus overreaching the highest point of the arch of the skull and sloping downward in both directions. The occipito-sphenoid length is slightly greater in female *gyas* than in male *kidderi.*

Comparison of cubs of the second, third, and fourth years: Cubs of *kidderi* after the molars are in position and the permanent canines partly exposed, are easily told from those of male *gyas* of corresponding age by the relatively small size of the teeth, especially the canines, molars, and outer upper incisors. It is not so easy, however, to tell them from female *gyas*, and in some cases it may be impossible. The most constant character appears to be the *length of the canines*, and this can not be determined in cubs less than three or three and a half years of age. The canines are slightly longer in male *kidderi* than in female *gyas*, and their diameter also is usually, but not always, greater. As a rule, also, the crowns of the molars are larger, especially longer, in male *kidderi* the combined length of the first and second lower molars averaging about 4 mm. greater than in female *gyas.* As the teeth become worn with use the differences become less and less obvious, so that after the third year the distinctions are not easy of recognition.

Skull measurements.—Average of 3 males from Belkofski, Alaska Peninsula: Basal length, 330; occipito-nasal length, 312; palatal length, 177; zygomatic breadth, 207; interorbital breadth, 74.

Average of 4 females from Pavlof Bay, Alaska Peninsula: Basal length, 330; occipito-nasal length, 312; palatal length, 181.5; zygomatic breadth, 218; interorbital breadth, 80.5.

URSUS KIDDERI TUNDRENSIS Merriam.

TUNDRA BEAR.

Ursus kidderi tundrensis Merriam, Proc. Biol. Soc. Washington, XXVII, p. 196, August 13, 1914.

Type locality.—Shaktolik River, Norton Sound, Alaska.

Type specimen.—No. 76470, ♂ ad., U. S. National Museum, Biological Survey collection. Collected by natives, September, 1894, and secured through the late Rudolf Neumann, then of Iliuliuk, Unalaska.

Range.—Tundra region of northwestern Alaska from Shaktolik River on Norton Sound, southerly across the lower Yukon, Kuskokwim, and Nushagak Rivers to Bristol Bay and north side of base of Alaska Peninsula.

Characters.—Size medium (small in contrast with *gyas*), about equaling *kidderi*. External characters unknown, but doubtless little different from *kidderi*. Known to the natives as "Red Bear."

Cranial characters.—Size medium, about as in *kidderi;* skull rather long and heavy; frontals broad and flat, broadly but not deeply sulcate medially; postorbital processes small; coronoid blade falcate and rather high.

Cranial comparisons.—Similar to *kidderi* in essential cranial and dental characters, but differing in having the frontal shield and postorbital processes *very much broader and flatter*, and the frontal sulcus less marked. As in *kidderi* there is little difference in the sexes except that the females have narrower muzzles and narrower frontal shields. A young male (No. 16375) from Andreafski on the lower Yukon, collected by E. W. Nelson, has somewhat shorter canines than the others.

From *alascensis*, the grizzly of the same general region, skulls of *tundrensis* (adult males in both cases) may be distinguished by the following characters: Size larger (basilar and occipito-nasal lengths fully an inch greater); skull as a whole much more massive; frontals broader, rising less abruptly from facial plane, less swollen over orbits; rostrum less slender; palate more flat; ramus of jaw thicker under $M_{\frac{2}{2}}$ and $M_{\frac{3}{3}}$; coronoid blade more falcate; canines larger, decidedly longer, and somewhat less curved; molars decidedly larger.

Skull measurements.—Adult male (type): Basal length, 333; occipito-nasal length, 317; palatal length, 178; zygomatic breadth, 228; interorbital breadth, 93.

URSUS EXIMIUS Merriam.

Knik Bear.

Ursus eximius Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 139–140, September 6, 1916.

Type locality.—Head of Knik Arm, Cook Inlet, Alaska.

Type specimen.—No. 122495, ♂ ad., U. S. National Museum. Collected by G. W. Palmer.

Characters.—Size rather large; color uniform rich dark brown suggesting seal brown; muzzle brown, paler than rest of head; back of head and neck lightly sprinkled with pale-tipped hairs; claws of medium thickness, only slightly curved, decidedly short, probably from wear, smooth, very dark horn color, becoming paler on sides toward tip. Skull long and narrow, with narrow highly arched frontals. Related to *kidderi.*

Cranial characters.—Adult male (type): Skull long, extremely narrow in fronto-nasal region, rather highly arched and strongly dished. Frontal shield exceedingly narrow, convex, shallowly sulcate medially, strongly arched anteriorly, horizontal posteriorly, long-pointed, the point nearly reaching fronto-parietal suture; postorbital processes slender, peglike, moderately outstanding; fronto-nasal region strongly dished; rostrum long, narrow, high, compressed between nasals and canine roots; zygomata moderately outstanding, subtriangular; palate long and narrow; postpalatal shelf relatively broad; notch rather broad; mastoids long, strongly divergent; underjaw long, moderately massive, the ramus broad vertically; coronoid blade rather broad, the apex not strongly recurved; teeth of medium size; M^2 with rather long heel, not much narrowed posteriorly; M^1 relatively large and broad; PM_4 a single cone without distinct heel but sulcate posteriorly.

Adult female (No. 205176, from type locality): Skull long and narrow; vault of cranium moderately arched, the highest part forming a hump at fronto-parietal suture; frontal shield narrow, flattish, sulcate medially, the point reaching fronto-parietal suture; postorbitals weak, subtriangular, not decurved; fronto-nasal region moderately dished; rostrum narrow, compressed between nasals and canine roots; zygomata moderately spreading, subtriangular; postpalatal shelf relatively broad; notch moderate; inferior border of ramus convex from plane of front molar posteriorly; coronoid blade broad and low.

Cranial comparisons.—Ursus eximius appears to be related to only a single species, *kidderi* of Alaska Peninsula. Adult male (type) compared with a series of *kidderi* from various points on Alaska Peninsula: Size about the same; vault of cranium more highly arched; frontal shield narrower, more strongly convex in cross sec-

tion, less deeply sulcate; postpalatal processes more slender, peglike, and outstanding; fronto-nasal region more dished; rostrum more slender; nasals longer posteriorly, more completely wedge-shaped, reaching posteriorly to plane of postpalatal processes; mastoids longer and more divergent.

Adult female (No. 205176, from head of Knik Arm) compared with adult female *kidderi:* Size materially smaller; frontal shield and rostrum much narrower; vault of cranium notably higher over fronto-parietal suture; braincase narrower; nasals longer posteriorly; underjaw smaller and lighter.

Adult male (type) compared with adult male *alascensis* (No. 76466, from Unalaklik River, Norton Sound, Alaska): Skull much longer, more highly arched, and narrower throughout. Frontal shield much more elevated, narrower, and longer posteriorly; fronto-nasal region more strongly dished; rostrum narrower and higher; lambdoid crest more strongly developed; palate and postpalatal shelf much longer; occipito-sphenoid much longer; mastoids much longer and strongly divergent; underjaw longer; coronoid blade much higher; teeth larger; heel of M^2 much longer.

Adult female compared with female *alascensis:* Length essentially the same; skull narrower throughout; frontal shield lower, much narrower and flatter, rising less abruptly from rostrum; fronto-nasal region sulcate but less strongly dished; rostrum slightly more slender; postpalatal shelf narrower. Underjaw about same length; inferior border of ramus more evenly convex (less abruptly bellied); coronoid blade broader; canines about same size; molars somewhat larger.

Skull measurements.—Adult male (type): Basal length, 331; occipito-nasal length, 319; palatal length, 185; zygomatic breadth, 215; interorbital breadth, 71.

Innuitus Group.

URSUS INNUITUS Merriam.

Innuit Bear.

(Pl. VII.)

Ursus innuitus Merriam, Proc. Biol. Soc. Washington, XXVII, p. 177, August 13, 1914.

Type locality.—Golofnin Bay, south side of Seward Peninsula, northwestern Alaska.

Type specimen.—No. 179780, ♂ old, U. S. National Museum, Biological Survey collection. Collected in 1886, by Edward F. Ball.

Range.—Coastal region of Norton Sound, Alaska, from Unalaklik northward and westward; limits unknown.

Characters.—Size large; external characters unknown. Molars large and massive, especially M^2. Large lower premolar subconical, apparently of the brown bear type. But in the north the grizzly type of premolar often fails in true grizzlies; hence not having seen the claws, it is at present impossible to say whether *innuitus* is a brown bear or a grizzly.

Cranial characters.—Old male (type): Skull large; basal length essentially the same as in *horribilis* and *alexandræ* but occipito-nasal length much less, owing to shortness of occiput; fronto-nasal region strikingly dished; rostrum short, exceedingly broad (of same breadth as in *alexandræ*, very much broader than in *horribilis*), strongly depressed; frontal shield exceedingly broad interorbitally, rising high and abruptly from rostrum, nearly horizontal behind plane of postorbital processes, rather deeply sulcate medially and strongly swollen over orbits; postorbital processes large, subtriangular, outstanding and decurved; nasals nearly horizontal; palate and postpalatal shelf broad; postpalatal notch of medium width; zygomata broadly spreading and somewhat outbowed posteriorly, acute anteriorly; nares broader than high; sagittal crest short, extending only about 25 mm. beyond fronto-parietal suture, straight (not arched), high posteriorly; lambdoid crest large and full; coronoid blade narrow and high; ramus long and flat. Canines badly broken, apparently long; last lower premolar broad, broader posteriorly than anteriorly, the cusp small and sloping posteriorly without heel or marginal cusplets, but with pit and indication of narrow sulcus; molars exceptionally large and broad, the last upper one with heel strikingly long and broad, agreeing almost exactly with that of true *horribilis* from eastern Montana.

Two youngish skulls from Unalaklik (No. 82024, third year and No. 210554, fourth year) are believed to be females of this species. They are not old enough to show adult cranial characters except that the postpalatal shelf is broad and flat and the notch broad, but the teeth are perfect, full grown, and unworn. Canines of medium size (in the type badly broken and hence not available for comparison); molars large but smaller and less massive than those of type; M^2 large, cusps on inner side nearly obsolete (presenting little more than an undulating line), heel long and broad with large flat granular grinding surface.

Cranial comparisons.—The only species needing comparison with *innuitus* are *alexandræ* and *cressonus*. The old male skull resembles certain old skulls of *alexandræ* from Kenai Peninsula, but differs rather strikingly in truncation of occiput (the occipital overhang being very much less) and corresponding shortening of braincase and sagittal crest. The crest moreover is straight instead of arcuate

or arched, and the molars, especially M^1 and M^2 are very much larger.

Compared with old male *cressonus* (type): Basal length and zygomatic breadth essentially same; occipito-nasal length much less; frontal shield broader, much less elevated over orbits; rostrum much broader and lower; occipital overhang much less; braincase and sagittal crest much shorter; postpalatal shelf broader and flatter.

Skull measurements.—Old male (type): Basal length, 353; occipito-nasal length, 331; palatal length, 194; zygomatic breadth, 251; interorbital breadth, 104.

URSUS CRESSONUS Merriam.

Chitina Bear.

Ursus cressonus Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 137–139, September 6, 1916.

Type locality.—Lakina River, south slope of Wrangell Range, Alaska.

Type specimen.—No. 206529, ♂ old, U. S. National Museum, Biological Survey collection. Collected by Captain J. P. Hubrick, of McCarthy, Alaska, 1914.

Range.—Chitina River valley and adjacent slopes of Skolai and Wrangell Mountains, westerly doubtless through Chugach Mountains to the west side of Cook Inlet; occurs as far south as the Iliamna region.

Cranial characters.—Old male (type): Skull peculiar and distinctive; size large (basal length 357 mm.); skull long, narrow, high, and strongly dished; frontal shield highly elevated, rising abruptly from rostrum, rather broad, deeply sulcate throughout medially, swollen over orbits, short pointed posteriorly; orbits nearly vertical; postorbital processes small and strongly decurved; fronto-nasal region sulcate and strongly dished; rostrum rather short and narrow; nasals horizontal except posteriorly, where they rise strongly; braincase exceedingly long; sagittal crest high posteriorly, straight, and long, reaching anteriorly to halfway between parietals and plane of postorbitals; zygomatic arches moderately spreading, subtriangular (not outbowed), expanded vertically; palate and postpalatal shelf relatively long and narrow for so large a skull; postpalatal notch rather narrow and short; occipito-sphenoid long (about 103 mm.); mastoids outstanding; anterior nares rather small, subtruncate, and broader than high in type skull, higher and less truncate in the Iliamna skulls. Underjaw absent in type specimen, but in an old male from Iliamna on north side of Cook Inlet (No. 209885) which

in most respects closely matches the type, the ramus is broadly flattened vertically, much broader posteriorly than anteriorly, and the coronoid blade is high and rather vertical. In younger skulls from Iliamna the coronoid is broader basally and less high. Canines large and massive; molars moderate. The last upper molar is large in the type, smaller and more cut away on outer side of heel in the Iliamna specimens. No. 209885 from Iliamna agrees with the type, except that the nares is higher and less truncate, and the last upper molar smaller, with heel more cut away on outer edge.

Old female (No. 209881, from head of Chitina River, 80 miles from McCarthy, Alaska; collected by Capt. J. P. Hubrick): Size medium; cranium moderately arched; frontal shield broad, deeply sulcate anteriorly, strongly swollen over and posterior to orbits, the point lyrate and reaching parietals; postorbitals rather large, blunt, and somewhat decurved; fronto-nasal region strongly dished and depressed medially; rostrum rather large and high, nearly horizontal; palate and postpalatal shelf broad; postpalatal notch moderate and rather broad. Underjaw long; coronoid blade high and rather narrow, its apex only slightly recurved. Dentition light; canines small and short; molars rather narrow, apparently normal (too badly worn to admit of description, except that the heel of M^2 is moderately long and rather broadly rounded posteriorly).

Cranial comparisons.—Old male (type) compared with old male *dalli:* Size about the same; vault of cranium and frontal shield much more elevated, less flat, less nearly horizontal, and much more swollen over orbits; shield more deeply sulcate; postorbitals weak and decurved (in *dalli* larger and more horizontally outstanding); fronto-nasal region more strongly dished; rostrum narrower and longer; zygomata much less widely outstanding and much less bowed; palate longer; molars very much larger.

Old male (type) compared with adult male *nuchek* (type): Size, elevation of vault of cranium, and zygomatic breadth about the same; frontal shield somewhat broader, much more highly arched, much more swollen over orbits, much more deeply sulcate medially, shorter and more acutely pointed posteriorly; postorbitals smaller and more decurved; fronto-nasal region strongly dished; rostrum more depressed; nares more truncate; last upper molar of normal form, large, and with long posteriorly rounded heel, differing widely from the short, broad-in-the-middle, obliquely truncate tooth of *nuchek.*

Skull measurements.—Old male (type): Basal length, 357; occipito-nasal length, 354; palatal length, 199; zygomatic breadth, 244; interorbital breadth, 97.

URSUS ALEXANDRÆ[1] MERRIAM.[2]

ALEXANDER GRIZZLY.

Ursus alexandræ Merriam, Proc. Biol. Soc. Washington, XXVII, pp. 174–175, August 13, 1914.

Type locality.—Kusilof Lake, Kenai Peninsula, Alaska.

Type specimen.—Skull No. 4752, ♂ old, Museum of Vertebrate Zoology, University of California; original No. 218. Collected September, 1906. (Skull, skin, and skeleton complete.)

Range.—Kenai Peninsula, Alaska.

Characters.—Size very large; skull long and narrow; rostrum exceptionally broad for a grizzly; pelage very uniform in color, scarcely or not grizzled; claws enormous (second foreclaw of type specimen measuring: length from upper base, 91 mm; height at base, 25; breadth, 11.5). The longest claw in a specimen collected by Wilson Potter measures 120 mm.; in a male killed by Dall DeWeese, 110 mm.

Color.—Type, very old male, in fresh short fall pelage: General color pale, almost grayish brown, becoming yellowish brown between ears, contrasting with pale brown of muzzle; legs and feet only slightly darker than back; entire animal remarkably unicolor; underfur plumbeous, crinkled, and wooly. Another male, killed by Wilson Potter, of Philadelphia, in May, 1912 (belonging to skull No. 181102, presented by Wilson Potter), is pale buffy inclining to light reddish brown throughout, without grizzly appearance; legs only slightly darker. One killed by Dall DeWeese, of Canyon City, Colorado, September 7, 1897, is described by him as "grayish-yellow," with legs and sides chocolate-brown.

Cranial characters.—Skull large, long, rather narrow, with moderately spreading zygomata, short flattish frontal shield, outstanding postorbitals (with age); very broad rostrum for a grizzly, and long and high sagittal crest. Frontal shield not markedly elevated above plane of rostrum; posterior root of zygoma not expanded. Canines large and long.

Cranial comparisons.—Adult male compared with adult male *kenaicnsis:* Basal length, palate, and occipito-sphenoid length essentially the same; skull as a whole much narrower, frontal shield interorbitally and across postorbital processes much narrower, flatter, more nearly horizontal, not materially elevated above plane of rostrum; zygomata much less widely spreading, squamosal part much narrower (not expanded); sagittal crest much longer, reaching anteriorly over posterior third of frontals (in *kenaiensis* ending on or near frontoparietal suture); posterior third of frontals compressed, rising in

[1] Named for Annie M. Alexander, founder of the Museum of Vertebrate Zoology, University of California, Berkeley.

[2] Tentatively included in ***innuitus*** **group.** (See Introduction, pp. 12–13.)

a keel to sagittal crest. Canine teeth, both upper and lower, but especially the lower, much larger and longer.

Remarks.—The skull of *alexandræ* is of a generalized type, lacking the special distinctive features that characterize several of its neighbors—as *kenaiensis*, *sheldoni*, and others—none of which are true grizzlies. Among the grizzlies it stands alone in the great breadth of the rostrum, which in bears of its size is only exceeded by the widely different *kenaiensis*. *Ursus alexandræ* attains the largest size known among the grizzly bears, the biggest skulls equaling those of the huge *magister* of Southern California.

Skull measurements.—Old male (type): Basal length, 355; occipito-nasal length, 358; palatal length, 191; zygomatic breadth, 252; interorbital breadth, 87.

Townsendi Group.

URSUS TOWNSENDI[1] MERRIAM.

TOWNSEND BEAR.

Ursus townsendi Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 151–152, September 6, 1916.

Type locality.—Mainland of Southeastern Alaska (exact locality uncertain).

Type specimen.—No. 216643, ♂ old, U. S. National Museum. Purchased at Sitka, in 1889, by Dr. Charles H. Townsend.

Cranial characters.—Skull large, long, massive, rather low, and flat topped, dished, with extremely small teeth. Shield broad, flat, slightly depressed medially, the point ending anterior to parietals, sides reaching out broadly into very broad postorbitals, strongly sloping to rostrum; rostrum moderate, flat or depressed on top; nares truncate; zygomata moderately outstanding and moderately bowed; squamosal base broadly and abruptly expanded vertically; palate and postpalatal shelf moderate; notch rather narrow; mastoids long; occipito-sphenoid 95 mm.; basisphenoid rather deeply concave. Underjaw long; ramus broad and flat vertically; coronoid of moderate height, narrowing above, sloping strongly backward, apex cutting plane of posterior part of condyle; upper two-thirds of anterior border strongly inflected.

Cranial comparisons.—Old male (type) compared with male *caurinus*: Skull much larger, broader, more massive, and less arched; teeth smaller. Frontal shield very much broader interorbitally and postorbitally (interorbitally 91 mm. contrasted with 81 or less;

[1] Named for Dr. Charles H. Townsend, formerly naturalist of the Fish Commission steamer *Albatross*, now director of the New York Aquarium, who collected the specimen and presented it to the U. S. National Museum.

across postorbitals 130 contrasted with 116); postorbitals very much broader and flatter; rostrum more nearly horizontal; nares truncate instead of sloping; zygomata more widely outstanding and more broadly expanded vertically.

Skull measurements.—Old male (type): Basal length, 348; occipito-nasal length, 353; palatal length, 183; zygomatic breadth, 245; interorbital breadth, 91.5.

Dalli Group.

URSUS DALLI[1] MERRIAM.

DALL BROWN BEAR.

Ursus dalli Merriam, Proc. Biol. Soc. Washington, X, pp. 71–73, April 13, 1896.

Type locality.—Yakutat Bay (northwest side), Alaska.

Type specimen.—No. 75048, ♂ old, U. S. National Museum.

Range.—Malaspina Glacier and region northwest of Yakutat Bay, Alaska.

Characters.—Size very large; skull without very pronounced characters, although differing sufficiently from its neighbors. General color dark brown, strongly grizzled.

Color.—Adult male (from Malaspina Glacier, belonging to skull No. 210293, killed by G. Frederick Norton): Muzzle pale brown, becoming much darker on head and sides of face; general body color dark brown, moderately grizzled with pale-tipped hairs, the grizzling beginning on top of head a little in front of plane of ears and extending posteriorly to middle part of back.

Cranial characters.—Adult male: Skull large, vault of cranium fairly high but not arched; frontal shield broad, rather flat, broadly sulcate or concave medially, rather short pointed posteriorly, with large, rounded, broadly outstanding postorbital processes; fronto-nasal region moderately dished; rostrum broad and short, in some skulls slightly depressed; sagittal crest of medium length, rather high and nearly straight; zygomata rather broadly outstanding and strongly outbowed; squamosal root expanded in old age; squamosal shelf broad; braincase narrow anteriorly, tending to keel into sagittal crest; nares small.

Note.—The type skull of *dalli* (No. 75048, ♂ old) is abnormal: abnormally large, abnormally high (vault of cranium abnormally arched); fronto-nasal region abnormally elevated—not dished as usual; and underjaw abnormally long. No. 75047 (old ♂) and No. 210293 (adult ♂) are far more typical.

[1] Named for William H. Dall, of the Smithsonian Institution.

Adult females (No. 140085, from Copper River delta, July, 1905, A. G. Maddren; and old female, No. 210308, from Bering Lake, 1915, J. L. Hill): Size, medium; skull broad and short for a female; moderately arched, and moderately dished, with rather broad frontal shield and broad rostrum. Frontal shield rather broad, strongly sulcate medially, swollen over orbits; postorbital processes rather weak and strongly decurved; point of shield ending at fronto-parietal suture; fronto-nasal region strongly sloping, rostrum large, broad, and rather short; sagittal crest confined to parietals, high for a female; postpalatal shelf medium or broad, strongly rounded on sides; zygomata moderately spreading, subtriangular, the posterior base somewhat bowed and vertically expanded; underjaw rather short; coronoid high, falcate, the apex cutting or overreaching plane of condyle; teeth medium; heel of M^2 rather long, slightly emarginate on outer side, the extreme tip with tendency to turn outward.

Cranial comparisons.—Adult and old males (Nos. 75047 and 210293) compared with adult male *nuchek* (No. 146459, type): Size about the same (basal length essentially same, but occipito-nasal length decidedly less); frontal shield broader and more acutely pointed; vault of cranium less high and more nearly horizontal; postorbitals more outstanding; rostrum slightly shorter and more depressed (appearing broader); zygomata more outbowed (less triangular); palate somewhat shorter; mastoids more appressed, closer to glenoid processes, constricting meatus tube (in *nuchek* more outstanding, leaving wide postglenoid space with correspondingly large open meatus); coronoid blade broader above (less falcate). Canines almost the same; molars decidedly smaller and less massive and in details quite different (as stated under *nuchek*).

Adult female (No. 140085, from Copper River delta) compared with female *nuchek* (No. 44049, from near Mount St. Elias): Skulls so different as not to require close comparison, that of *dalli* being massive, broadly arched or domed, and with massive underjaw, while that of *nuchek* is light, slender, and narrow, with low narrow flattened frontal region, long slender rostrum, and light underjaw. The teeth also differ strikingly.

Adult and old male compared with old male *cressonus* (type): Size about the same; vault of cranium and frontal shield much less elevated, flatter, more nearly horizontal, and much less swollen over orbits; shield less deeply sulcate; postorbitals larger and more horizontally outstanding (in *cressonus* weak and decurved); fronto-nasal region less strongly dished; rostrum broader and shorter; zygomata much more widely outstanding and much more bowed; palate shorter; molars very much smaller.

Adult and old female compared with old female *cressonus:* Skull larger, broader, and more highly arched; frontal shield broader, less deeply sulcate and less swollen over orbits; fronto-nasal region more strongly dished; rostrum smaller and lower; zygomata less outstanding, less arched, much less expanded vertically and more sharply angular; underjaw much shorter and lighter; coronoid smaller and lower. Teeth smaller throughout.

Adult and old male compared with adult and old male *kenaiensis:* Size the same or somewhat smaller; skull much less massive; braincase conspicuously narrower; frontal shield interorbitally narrower, shorter pointed posteriorly; fronto-nasal region normally more strongly dished; postorbital processes less broadly rounded; rostrum less massive and less elevated; sagittal crest much longer; occipito-sphenoid shorter; mastoids usually less outstanding.

Skull measurements.—Old male (No. 75047, from Yakutat Bay, Alaska): Basal length, 345;[1] occipito-nasal length, 342; palatal length, 190; zygomatic breadth, 263; interorbital breadth, 91.5. Old male (No. 210293, from Malaspina Glacier): Basal length, 345; occipito-nasal length. 338; palatal length, 188; zygomatic breadth, 248; interorbital breadth, 96.

URSUS HOOTS[2] MERRIAM.

STIKINE BROWN BEAR.

Ursus hoots Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 140–141, September 6, 1916.

Type locality.—Clearwater Creek, a north branch of Stikine River, British Columbia.

Type specimen.—No. 206136, ♂ ad., U. S. National Museum, Biological Survey collection. Collected by John Hyland; presented by Lincoln Ellsworth.

Cranial characters.—Size medium or large; skull massive; slightly dished, rather short, flattish on top, very broad across frontals and rostrum. Frontal shield broad, nearly flat, long pointed; broadly and shallowly sulcate medially as far back as posterior plane of postorbitals; postorbitals large, broad, and horizontally outstanding; fronto-nasal region sloping; rostrum broad and rather high; palate and postpalatal shelf broad; postpalatal notch moderate; sagittal crest short, ending at fronto-parietal suture; zygomata moderately outbowed, not broadly spreading; underjaw rather massive; ramus broad vertically, its inferior border upcurved posteriorly; coronoid blade broad at base, rather high and subfalcate, the apex curving strongly backward, cutting plane of condyle; dentition remarkably

[1] Restored.

[2] *Hoots*, the native Indian name for the big brown and grizzly bears of the coast region.

light for so large a skull; canines and molars (both upper and lower) surprisingly small.

Remarks.—*Ursus hoots* does not appear to be related to any of the other mainland species except the newly discovered *crassus* from the mountains on the upper Macmillan River, Yukon, from which it may be distinguished at a glance by the small size of its molar teeth. It may be related also to *sitkensis* of Baranof and Chichagof Islands, but differs in somewhat smaller size; less elevated posterior frontal region; broader postorbital processes; less broadly spreading zygomata; shorter and less spreading mastoids; less nearly vertical and more strongly recurved coronoid blade, the apex overarching a well-defined coronoid notch; smaller molars (both upper and lower); and smaller upper incisors. The large lower premolar has the upturned heel of the Sitka bear, but lacks the posterior sulcus and pair of cusplets of the grizzlies. Two additional old male skulls of *hoots* have been recently received from the Stikine River region. One of these (No. 224841) from Clearwater branch of Stikine—the type locality—agrees closely with the type specimen in size and form, but has slightly larger and especially broader molars (difference most marked in M). The skull is older than that of the type and the mastoids are more strongly developed and divergent. The other (No. 224839) is still older and was killed low down the Stikine. It is of approximately the same size as the type, but considerably older; the frontal shield is more broadly concave interorbitally and shorter pointed posteriorly; sagittal crest more strongly developed; squamosal base of zygoma much more broadly expanded; mastoids much longer and strongly divergent; postpalatal shelf flatter; coronoid blade broader at and above middle; molars slightly larger. An adult female from the type locality (No. 180883, from Clearwater branch of Stikine) resembles the male type very closely except for the smaller size of skull and teeth, and therefore needs no special description. A feature deserving mention is that in both sexes the point of the frontal shield ends at the fronto-parietal suture.

Skull measurements.—Adult male (type): Basal length, 333; occipito-nasal length, 325; palatal length, 179; zygomatic breadth, 228; interorbital breadth, 96.

URSUS SITKENSIS Merriam.

Sitka Brown Bear.

Ursus sitkensis Merriam, Proc. Biol. Soc. Washington, X, p. 73, April 13, 1896.

Type locality.—Sitka Islands, Alaska.

Type specimen.—No. 187891, ♂ ad., U. S. National Museum (No. 6543, Merriam collection). Collected by an Indian; purchased at Sitka, Alaska, and presented to C. Hart Merriam by J. Stanley-Brown.

Range.—Sitka Islands (Baranof and Chichagof), Alaska.

Characters.—Size large; coloration very dark; claws of moderate length, curved, dark blue-black, scurfy; skull broad and massive.

Color.—Dark; muzzle dark brown, sometimes chocolate brown or even sooty, paler in faded summer pelage; head and body very dark brown or even dusky, varying to dull brown in summer, washed on back of head, neck, and shoulders with yellowish or golden.

Cranial characters.—Adult male: Skull large, massive, dished, vault moderately elevated, frontal shield (normally) broad, strongly sloping, sulcate medially; postorbitals outstanding, broadly rounded; rostrum normally rather short and somewhat depressed; sagittal crest massive, straight; zygomata broadly outstanding and outbowed; palate moderate; postpalatal shelf normally rather long and of medium breadth; notch moderate or rather narrow; basioccipital broad; mastoids long and spreading.

Cranial comparisons.—Adult and old males compared with adult and old male *dalli:* Frontal shield higher posteriorly (in *dalli* highest at or immediately behind postorbitals), flatter and more sloping at base of postorbitals, thus tilting postorbital plane forward (in *dalli* looking more directly upward); a distinct thickening or hump present on each side of median sulcus behind plane of postorbitals (lacking in *dalli*); basioccipital usually broader; inion less strongly developed; mastoids longer, usually more outspreading and more distant from glenoid processes, leaving broader space for audital canal; auditory meatus larger; rostrum somewhat broader basally; distance from last lower molar to middle of condyle usually less; last upper molar somewhat longer and more nearly rectangular, the outer side of heel less oblique; M_1 normally with open saddle between posterior and anterior parts (in *dalli* a cusplet occupies the inner side of the saddle); PM_4 in *sitkensis* normally tricuspidate as seen in profile, there being both anterior and posterior cusplets on the cingulum (in *dalli* the anterior and posterior cusplets are absent and the main cusp is larger and higher and slopes posteriorly without horizontal heel).

Skull measurements.—Average of 2 adult males from Chichagof Island: Basal length, 358.5; occipito-nasal length, 354.5; palatal length, 189; zygomatic breadth, 260; interorbital breadth, 93.5.

URSUS SHIRASI[1] MERRIAM.

SHIRAS BROWN BEAR.

(Pl. VI.)

Ursus shirasi Merriam, Proc. Biol. Soc. Washington, XXVII, p. 195, August 13, 1914.

Type locality.—Pybus Bay, Admiralty Island, Alaska.

[1] Named for George Shiras, 4th, who collected and presented the specimen.

Type specimen.—No. 203030, ♂ old, U. S. National Museum, Biological Survey collection. Killed September 16, 1913, by George Shiras, 4th, and presented to the Biological Survey.

Range.—Restricted to Admiralty Island.

Characters.—A huge brown bear larger than the largest *sitkensis;* head highly arched; color black, except muzzle, which is dull brown; claws dark blue-black, dull, slightly scurfy (not smoothly polished as in the grizzlies), rather strongly curved and of moderate length (middle claw over curve, 92 mm.; from top of base to apex, 75), fourth and fifth rounded off on outer side.

Color.—Entire animal, except muzzle, coal black, showing when examined closely a brownish wash along middle of back; muzzle from nose pad to between eyes dull brown.

Cranial characters.—Old male (type): Skull large, broad, massive, strongly dished, and highly arched; zygomata large, broadly outbowed and rounded anteriorly as well as posteriorly; frontal shield remarkably short and broad (nearly twice as broad as long), deeply and broadly concave in cross section, with huge uplifted[1] broadly outstanding postorbital processes which arch over the orbits and are strongly decurved apically, completely roofing the orbits; temporal ridges beaded, short, meeting far forward (at least 25 mm. in front of fronto-parietal suture); sagittal crest long and high, humped over fronto-parietal suture; fronto-nasal region strongly concave; rostrum broad and short, rising strongly to meet frontal shield; palate broad; basioccipital and basisphenoid subequal; ramus strongly bellied under posterior molars; coronoid blade broad and high.

Dental characters.—Dentition heavy; canines large, the upper 47 mm. high above enamel line of outer side; molars large and rather broad; M^2 with large and broad heel; M_1 with strongly developed cusplet on inner side of saddle.

Remarks.—*Ursus shirasi* is a very large member of the brown bear group. Whether it is always black, like the type specimen, is not known. But of all the American bears its skull is the most striking and distinctive. The short broad frontal shield rising on each side into huge postorbital processes, which arch broadly over the orbits, serve to distinguish it at a glance from all other species, rendering close comparisons unnecessary. In this connection it is interesting to observe that *shirasi* and its neighbor *eulophus*, an inhabitant of the same island, present opposite extremes of departure from the normal ursine type—*eulophus* having a long narrow skull with slender elongate rostrum, long and narrow frontal shield, and

[1] Additional skulls of adult males recently received have the postorbitals equally large but less uplifted, not rising above frontal plane.

insignificant postorbital processes, while *shirasi* has an exceptionally broad skull with broad short rostrum, excessively broad and short frontal shield, and huge massive postorbital processes.

Skull measurements.—Adult male (type): Basal length, 355; occipito-nasal length, 348; palatal length, 191; zygomatic breadth, 259; interorbital breadth, 104.5.

URSUS NUCHEK MERRIAM.[1]

NUCHEK BROWN BEAR.

Ursus nuchek Merriam, Proc. Biol. Soc. Washington, XXIX, pp. 146–148, September 6, 1916.

Type locality.—Head of Nuchek Bay, Hinchinbrook Island, Prince William Sound, Alaska.

Type specimen.—No. 146459, ♂ old, U. S. National Museum, Biological Survey collection. Collected September 15, 1905, by C. Swanson.

Range.—Prince William Sound easterly to Mount St. Elias; limits unknown.

Characters.—Size large; external characters unknown; skull long, narrow, and moderately high; molars peculiar.

Cranial characters.—Adult male (type): Large, elongate; frontal shield relatively narrow, flattish, moderately depressed between orbits; orbital rims thickened; postorbital processes broad and flattish, moderately outstanding; posterior part of shield broad, ending about two-thirds distance from plane of postorbitals to fronto-parietal suture; sagittal crest rather long, straight, high posteriorly; rostrum long, high, rather narrow; fronto-nasal region sloping in facial plane; nasals slightly elevated anteriorly; zygomata moderately spreading, subtriangular, not much expanded vertically; post-palatal shelf moderate, its sides rounded; notch long and narrow; anterior nares small; meatus tube short and large. Underjaw massive; coronoid blade narrow and falcate. Teeth of medium size; molars broad (more massive than in *dalli*); last upper molar exceptionally short, broadest in middle, heel short and obliquely truncate on outer side; M^1 large, much broader posteriorly than anteriorly; middle lower molar peculiar: twin cusps of entoconid very small, low, and close together; main cusp of inner side large and high, reducing the posterior moiety of the tooth to about a third the length of the crown instead of about half as usual.

Young-adult female (No. 44049, from Chaix Hills near Mount St. Elias, Alaska; killed July 4, 1891, by the late Prof. I. C. Russell): Skull long, narrow, rather low, with narrow frontals, narrow ros-

[1] Tentatively included in *dalli* group. (See Introduction, pp. 12–13.)

trum, and moderately outstanding subtriangular zygomata. Frontal shield flattish, medially depressed interorbitally, sloping gradually into rostrum, rather short pointed posteriorly (ending about 15 mm. in front of parietals; in fully adult and old females it would be still shorter); postorbital processes moderate, horizontally outstanding, the tips rounded (not fully grown); palate concave, postpalatal shelf rather long and broad; notch rather narrow; basisphenoid strongly concave antero-posteriorly and transversely; underjaw long and slender. Canines long and slender; molars and large premolars with rather high cusps; last upper molar short, much broader in middle than anteriorly, heel short and obliquely truncate on outer side.

Cranial comparisons.—Ursus nuchek evidently overlaps the range of *dalli* and may come in contact with *cressonus*, necessitating comparisons with both.

Adult male (type) compared with adult and old male *dalli* (Nos. 75047 and 210293): Size about the same; basal length essentially the same, but occipito-nasal length decidedly greater; skull appearing longer and narrower; more elevated behind orbits and much more strongly sloping posteriorly; frontal shield narrower, the point broader posteriorly; vault of cranium higher and less nearly horizontal; postorbitals less outstanding; fronto-nasal region less dished; rostrum longer and not depressed (appearing narrower); zygomata less outbowed (more triangular); palate somewhat longer; postpalatal notch longer and narrower; mastoids less appressed, leaving wide postglenoid space with correspondingly large open meatus (in *dalli* closer to glenoid process, pressing on and contracting meatus tubes); coronoid blade narrower above (more falcate). Canines about the same; molars, both upper and lower, decidedly larger and more massive and in details quite different: M^2 exceptionally short and much broader in middle than elsewhere, the heel short and obliquely truncate on outer side; M^1 large, much broader posteriorly than anteriorly; middle lower molar peculiar, the twin cusps of entoconid very small, low, and close together; metaconid exceptionally large and high, reducing the posterior moiety of the crown to about one-third its length, instead of about half as in *dalli* and most species.

Young-adult female (No. 44049, from near Mount St. Elias) compared with adult female *dalli* (No. 140085, from Copper River delta): Skulls so strikingly different as not to require close comparison, that of *nuchek* being light, slender, narrow, with low narrow flattened frontal region, long slender rostrum, and light underjaw, while that of female *dalli* is massive, broadly arched or domed, and with massive underjaw. The teeth also differ strikingly.

Young-adult female (No. 44049) contrasted with old female *cressonus* (No. 209881): Size slightly smaller (when fully adult probably the same); frontal shield much narrower and flatter, much less deeply sulcate, much less swollen over orbits, and much shorter posteriorly; fronto-nasal region in same plane (in ♀ *cressonus* strongly dished); sagittal crest longer; nares smaller; canines (upper and lower) much longer; molars more massive; M^2 extremely short, much the broadest in middle, with short obliquely truncate heel (in *cressonus* normal).

Female (No. 44049) compared with female *kenaiensis* (No. 133244): Basal length essentially the same; cranium narrower, with narrower braincase, narrower shield, and narrower rostrum; zygomata less broadly spreading (would be more broadly spreading with age); occipito-sphenoid shorter; palate essentially same length but narrower; postpalatal shelf narrower; ramus more slender (conspicuously thinner below M_2 and M_3); its inferior border straighter, less upcurved posteriorly; coronoid lower and less narrowed above; cusps of larger premolars above and below much more highly developed; main cusp of upper premolars very much higher relative to posterior cusp; molar cusps also more strongly developed; last upper molar shorter and of peculiar form, as in the male.

Skull measurements.—Old male (type): Basal length, 360;[1] occipito-nasal length, 358; palatal length, 191; zygomatic breadth, 248; interorbital breadth, 88.

Gyas Group.

URSUS GYAS Merriam.

Peninsula Giant Bear.

(Pl. II.)

Ursus dalli gyas Merriam, Proc. Biol. Soc. Washington, XV, p. 78, March 22, 1902.

Ursus merriami Allen, Bull. Amer. Mus. Nat. Hist., XVI, p. 141, April 12, 1902.

Type locality.—Pavlof Bay, Alaska Peninsula.

Type specimen.—No. 91669, ♂ ad., U. S. National Museum, Biological Survey collection.

Range.—Entire length of Alaska Peninsula from Cook Inlet to Isanotski Strait and adjacent Unimak Island.

Characters.—Size huge, either largest living bear or second only to the great Kadiak bear (*middendorffi*). Claws rather long and smooth, dark when young, pale when old. Color variable, from grizzled brown to pale yellowish. Skull of male large, long, and massive, but not highly arched. Sexual disparity great.

[1] Restored.

Cranial characters.—Adult males: Skull large, long, and massive; frontal region moderately elevated, sloping gradually into rostrum, strongly depressed or troughed medially; slightly swollen over orbits and bases of postorbitals; postorbitals rather large, subtriangular, moderately outstanding; zygomata moderately outstanding and bowed; palate long and relatively narrow. Underjaw long and massive; coronoid blade very broad basally. Molars light for so large a skull. Viewed from behind, the posterior frontal region, with its depressed median trough and massive, outstanding, and elevated postorbital processes, suggests the spread wings of a bat or a butterfly.

Skulls of adult males which it seems necessary to call *gyas* present a surprisingly wide range in size and form. Among them are three quite different types which if isolated would undoubtedly develop into very distinct species.

1. *Typical form, with large elongate skull.*—Skull and teeth large and massive; zygomata widely spreading; sagittal crest high; frontals moderately elevated, broadly sulcate medially, swollen laterally; postorbital processes thick, massive, subtriangular, and decurved; nasal opening and rostrum proportionate to size of skull (but anterior nares very much smaller than in *middendorffi*). Teeth large; lower canines averaging about 19 mm. in diameter at base of enamel. This large form ranges over the entire length of Alaska Peninsula from Cook Inlet (where it was obtained at Chinitna by Kidder and Blake) to Morzhovoi Bay and Unimak Island. *Departures from normal:* The series of skulls at hand shows two prominent departures from typical *gyas*—one larger and more massive, the other smaller and lighter.

2. *Giant form, with exceptionally broad rostrum.*—Huge skulls with *broad massive rostrum* and exceedingly heavy jaws. This type is represented in the Biological Survey collection by two specimens, No. 91694 from Cold Bay, and No. 91704 from Belkofski Bay. The entire skull is larger and more massive, but the differences are most pronounced in the face and jaws. The frontal shield and postorbital processes are not broader than in some skulls of typical *gyas*, but the postorbital processes are *abruptly deflexed* at the tips, forming a thick massive hook over the orbit, much as in *middendorffi*. The rostrum is extraordinarily broad and massive, giving the skull, viewed from the front, a most peculiar aspect. The occipital flange (lambdoid crest) also is largely developed. The peculiarities of the underjaw are as striking as those of the rostrum. The inferior part of the ramus is greatly thickened anteriorly, and the posterior half is *strongly everted*, forming a broad lip, unlike anything seen in typical *gyas*. By reason of this peculiarity the jaws flare strongly outward under the last molars, and the flaring is so great that it is conspicuous even when looked at from above.

3. *Small form, with narrow rostrum.*—Smaller skulls, with narrower rostrum, more slender, horizontally outstanding postorbital processes and much smaller canines (exemplified by Nos. 82003 and 82004 from Pavlof Bay, and No. 91699 from Belkofski Bay). Compared with typical *gyas*, the skull as a whole is considerably smaller, shorter, and lighter; vault of cranium rather more flattened; rostrum decidedly narrower; canine teeth above and below decidedly more slender; last upper molar narrower. But the most conspicuous difference is in the postorbital processes, which instead of being broadly tri-

angular, massive, and decurved, are elongate, peglike, and stand out horizontally.

The above description applies to fully adult males of the form described by Allen under the name *Ursus merriami*, the type of which was an immature male. Unfortunately for *merriami*, the typical form seems to be connected with *gyas* by a series of intergrades. Thus, skull No. 862, Field Mus. Nat. Hist., has the small teeth and narrow muzzle of *merriami*, but the postorbital processes are broader posteriorly and slightly decurved; and Nos. 91691, 147630, 91675, U. S. Nat. Mus., Biological Survey collection, and No. 4585, Mus. Vert. Zool., Univ. California, complete the chain of intergrades, so that it is difficult to tell just where to draw a line between them.

Skulls of adult males of the small form have been examined from various localities from Cold Bay and Ugashik Lake and River westerly to Pavlof, Belkofski, Bear Bay, and Tonki Point.

Adult females: Skull of moderate size, conspicuously smaller than male; frontal region normally *elevated*, *domed*, *and rounded off*, the postorbital processes somewhat decurved, the frontal shield sulcate medially. Skulls of adult females differ among themselves in degree of elevation and doming of frontal shield, depth of median groove, relative massiveness, and other characters, but in the present imperfect state of knowledge it is impossible to assign positively any particular female to either of the above-described types of males.

Cranial comparisons.—Old male compared with old male *middendorffi* of essentially same size: Vault of cranium much less highly arched and never domed; postorbital processes more strongly developed and less decurved; zygomata less widely outstanding and far less bowed (ratio of zygomatic breadth to basal length much less); anterior nares normal, not flaring; coronoid blade less high. Last upper molar shorter and of different form, the heel obliquely truncate on outer side, narrowing posteriorly; lower molars broader and heavier.

Skull measurements.—Old male (type): Basal length, 380; occipito-nasal length, 394; palatal length, 206; zygomatic breadth, 286; interorbital breadth, 96.

URSUS MIDDENDORFFI Merriam.

KADIAK BEAR.

(Pl. III.)

Ursus middendorffi Merriam, Proc. Biol. Soc. Washington, X, pp. 67–69, April 13, 1896.

Ursus kadiaki Kleinschmidt, Outdoor Life, XXVII, p. 3, January, 1911.

Type locality.—Kodiak Island, Alaska.

Type specimen.—No. 54793, ♂ young-adult, U. S. National Museum, Biological Survey collection. Collected July 3, 1893, by B. J. Bretherton (original No. 176).

Range.—Kodiak and adjacent islands, Afognak and Shuyak; not known from mainland.

Cranial characters.—Size huge; skull of male exceedingly broad, high, and relatively short; frontal shield domed, sulcate medially and swollen over orbits (obliquely flattened in extreme age), rather short pointed posteriorly, passing into sagittal crest in fully adult skulls anterior to fronto-parietal suture; fronto-nasal region dished; postorbitals decurved and weak, small for size of skull; rostrum rather short and of medium breadth; anterior nares flaring; zygomata *extraordinarily outstanding and strongly outbowed;* palate rather broad; postpalatal shelf rather narrow; mastoids long and divergent. Underjaw large, massive, and rather short; coronoid blade high and moderately recurved; molars small for size of skull.

Cranial comparisons.—Old male compared with old male *gyas* of essentially same size: Vault of cranium much more highly arched and usually domed; postorbital processes weak and decurved; zygomatic arches much more widely outstanding and far more strongly bowed (ratio of zygomatic breadth to basal length much greater); anterior nares strongly flaring (in *gyas* not flaring); coronoid blade higher. Last upper molar with heel more broadly rounded; lower molars narrower.

Flesh measurements.—Young-adult male killed by J. H. Kidder on Shuyak Island, off Afognak, Alaska, July, 1901: Total length, nose to end of tail vertebræ, 8 ft.; nose to base of tail, 7 ft. 8¾ in.; height at shoulders, 4 ft. 5½ in.; length of forefoot, including claws, 1 ft. 2⅛ in.; hind foot, 1 ft. 4 in.; width of forefoot, 8¼ in.; width of hind foot, 7⅝ in.; length of fore claws, 4¼ in.; girth of body behind shoulders, 5 ft. 1⅝ in.; girth of neck, 3 ft. 2 in.; girth of head at ears, 3 ft. 1¾ in.; nose to tip of hind foot (animal lying on one side), 9 ft. 11 in. The body after the skin was removed was the size of a big ox.

Skull measurements.—No. 134407, largest of the males: Basal length, 392; occipito-nasal length, 369; palatal length, 211; zygomatic breadth, 306; interorbital breadth, 101.

Kenaiensis Group.

URSUS KENAIENSIS Merriam.

Kenai Giant Bear.

(Pl. IV.)

Ursus kenaiensis Merriam, Proc. Biol. Soc. Washington, XVII, p. 154, October 6, 1904.

Type locality.—Cape Elizabeth, at extreme west end of Kenai Peninsula, Alaska.

Type specimen.—No. 128672, ♀ ad., U. S. National Museum, Biological Survey collection. Collected in 1903 by C. A. Lambert.

Range.—Kenai Peninsula.

Characters.—Size large; appearance that of a big grizzly; coloration rather dark; claws moderately curved, dark, usually marked with whitish streaks on sides and near tip; longest claw in three adults 82–90 mm. Skull broad and massive, that of male strikingly larger than female.

Color.—Old male killed in October, 1912, by Wilson Potter, of Philadelphia (skull 181099): Muzzle pale fulvous-brown; cheeks and forehead similar but hairs longer and with pale tips; ground color of top of head, neck, and back much darker but deeply washed on tips with buffy or buffy whitish, giving these parts the look of a grizzly; legs and feet (but not belly) much darker.

Cranial characters.—Adult male: Skull large, broad, and massive, with broad frontal shield and rostrum, widely outbowed zygomata, large outstanding bluntly rounded postorbitals, and small anterior nares. Frontals broad throughout (interorbitally, postorbitally, and across postorbital processes); frontal shield well elevated above plane of rostrum, shallowly sulcate medially between orbits, slightly swollen over orbits, long pointed posteriorly; sagittal crest short, not reaching anteriorly beyond fronto-parietal suture; braincase broad anteriorly; rostrum broad throughout but much broader posteriorly than anteriorly; zygomata abruptly and widely outbowed, the squamosal root vertically expanded; palate very broad; underjaw large and massive, coronoid blade large and high, scarcely recurved. Canines small and short. *Adult female:* Skull broad, flat, and massive, with exceedingly broad rostrum, broadening posteriorly; zygomata broadly spreading; jugal broad anteriorly; frontals flattened, depressed, low posteriorly; postorbital processes large, blunt, and horizontally outstanding; palate exceedingly broad; nasals large and broad; anterior nares small. Canines small.

Cranial comparisons.—Adult male compared with adult male *alexandræ:* Length essentially the same, but *kenaiensis* much broader and more massive throughout; frontal shield broader throughout (interorbitally, postorbitally, and across postorbital processes), more elevated, convex (not flat) antero-posteriorly, shallowly sulcate interorbitally, slightly swollen over orbits; longer pointed posteriorly, with correspondingly shorter sagittal crest ending anteriorly at fronto-parietal suture; postorbital processes more massive and outstanding; frontal part of braincase not keeled or compressed; rostrum much broader, especially posteriorly; nasals shorter anteriorly; zygomata much more widely and abruptly spreading posteriorly, outbowed instead of angular; squamosal part rising abruptly and broadly expanded vertically, differing strikingly from the more slender and gently curving form in *alexandræ;* palate broader; mastoids more outstanding; ramus longer and more massive; coronoid blade more

nearly vertical, higher, broader in upper third, less recurved, not ending in posterior point. Canines, both upper and lower, smaller and shorter.

Adult female compared with adult female *alexandræ:* Skull shorter, both basally and on top; vault of cranium and rostrum lower; fronto-nasal region more dished; rostrum very much broader basally, its sides sloping anteriorly; braincase shorter (less occipital overhang); sagittal crest lower; occipito-sphenoid and base of skull shorter; palate broader; ramus more massive. Canines smaller (the lower notably more slender).

Adult and old males compared with adult and old male *dalli:* Size the same or somewhat larger; skull much more massive; braincase conspicuously broader; frontal shield interorbitally broader, longer pointed posteriorly; fronto-nasal region normally less strongly dished; postorbital processes more broadly rounded; rostrum more massive and more elevated; sagittal crest much shorter; occipito-sphenoid longer; mastoids usually more outstanding.

Skull measurements.—Average of 2 old males from Kenai Peninsula: Basal length, 367; occipito-nasal length, 360; palatal length, 197; zygomatic breadth, 263.5; interorbital breadth, 205. Adult female (type): Basal length, 288.5; occipito-nasal length, 285; palatal length, 158; zygomatic breadth, 214; interorbital breadth, 78.

URSUS SHELDONI[1] MERRIAM.

MONTAGUE ISLAND BEAR.

(Pl. V.)

Ursus sheldoni Merriam, Proc. Biol. Soc. Washington, XXIII, pp. 127–130, September 2, 1910.

Type locality.—Montague Island, Prince William Sound, Alaska.

Type specimen.—No. 137318, ♂ young-adult, U. S. National Museum, Biological Survey collection. Collected May, 1905, by Charles Sheldon.

Characters.—Size large; teeth and claws of the grizzly type; color variable, from dark to light brown. Skull broad and massive; vault of cranium domed; hairs over shoulders elongated to form a small but distinct hump.

Color.—General color brownish, varying from pale to dark, the hairs of the back sometimes yellowish tipped, those of the head grizzled; color darkest (almost blackish) on belly, legs, and feet; ears dark with whitish tips. An old she-bear killed by Sheldon, May 18,

[1] Named for Charles Sheldon, of New York, who collected and presented the type and other specimens.

1905, is very pale grizzled gray on the upperparts, and only moderately darker on the legs and feet. The cub of this bear, killed the same day, was in its second year (about 16 months old) and is very pale—almost buffy gray—with dark feet and legs, and a strongly marked hump.

Cranial characters.—Adult male (type): Large, massive, exceptionally broad, with broadly outbowed zygomata. Frontal shield long and broad, nearly horizontal from postorbitals posteriorly (actually sloping downward posteriorly); broadly sulcate medially between postorbital processes, moderately swollen on each side, the posterior part long and broad (temporal ridges in type specimen not curving inward as in most skulls), the point falling over middle of parietals (in old age doubtless more anterior); sagittal crest exceptionally short, confined in type skull to posterior half of parietals; fronto-nasal region elevated, forming a convexity instead of the usual depression between plane of rostrum and that of frontal shield; rostrum broad and short; nasals strongly sloping, dished at junction of anterior and middle thirds, the anterior third horizontal or slightly upturned; palate and postpalatal shelf very broad; notch rather broad; zygomata broadly outstanding, rounded posteriorly, somewhat bowed, not much expanded vertically (doubtless more broadly expanded in old age); squamosal shelves exceptionally broad; braincase narrowest on anterior part of parietals instead of on frontals. Underjaw large and massive; ramus broad vertically, broadest under posterior molars; coronoid blade elevated, moderate, vertical, the apex only slightly recurved. Dentition light; canines and molars small for size of skull.

Old female (No. 137316, mother of cub No. 137315) from Montague Island, May 18, 1905, collected and presented by Charles Sheldon: Skull of medium size, broad, flattish on top. Frontal shield flat, nearly horizontal, the posterior part broad and long, reaching past middle of parietals; postorbital processes strongly developed, almost peglike, horizontally outstanding; fronto-nasal region elevated in fronto-facial plane; rostrum short, rather broad; palate and postpalatal shelf broad; zygomata broadly outstanding, subtriangular, rounded posteriorly. Underjaw rather massive; coronoid moderate, the apex only slightly recurved; teeth small for size of skull; braincase very broad.

Cranial comparisons.—Skull in general similar to that of *kenaiensis* but basisphenoid broader and flatter, its length nearly equal to that of basioccipital; posterior roots of interpterygoid fossa more widely spreading; condyle of jaw more exserted (in *kenaiensis* sessile), reaching so far back that a line dropped from peak of coronoid to tip of angle touches or traverses it (in *kenaiensis* this line passes freely behind the condyle); coronoid, in females of same age, smaller

and lower, its area for muscular attachment less; ramus of jaw strongly bellied posteriorly, its inferior border below the coronoid strongly convex downward and curving evenly, with only a very slight break, to angular process. (In *kenaiensis* the inferior border of ramus is nearly straight, not appreciably bellied under coronoid, and ends abruptly in a step or jog at some distance behind the angle.)

In general form and appearance skulls of females closely resemble those of female *kenaiensis*, differing chiefly in the characters above mentioned and in certain dental peculiarities, notably the smaller size and more pointed heel of the last upper molar, and the oblique truncation of M^1.

Dental characters.—Teeth in general of the grizzly type. Last (fourth) lower premolar normally with horizontal heel, slightly upturned at posterior end, the shallow median sulcus reaching from cusp to end of heel, its defining ridges ending in slightly developed posterior cusplets. (In *kenaiensis* the last lower premolar is more conical, the heel sloping, the sulcus incomplete, with only a single posterior cusplet—on inner side of main cusp posteriorly.) First upper molar peculiar, having both ends obliquely truncate and parallel, sloping strongly from outer angles backward and inward; inner row of cusps pushed back so that each falls behind plane of corresponding cusp on outer side; tooth as a whole more nearly rectangular, its inner corners more nearly square (less rounded), and inner side more flattened and much less convex than in *kenaiensis*.

In the females the last lower molar is conspicuously smaller than in *kenaiensis*, and the last upper molar is smaller, narrower, more wedge-shape, and more pointed posteriorly. In one of the males it is similar. In the other three males the last upper molar is larger and less acute posteriorly than in the females, and the third cusp on the inner side is better developed.

Skull measurements.—Adult male (type): Basal length, 369; occipito-nasal length, 315; palatal length, 198; zygomatic breadth, 270; interorbital breadth, 102.5.

VETULARCTOS, A NEW GENUS RELATED TO URSUS.

Generic characters.—Skull like that of *Ursus*.[1] Teeth in the main like those of *Ursus*, but $M_{\overline{2}}$ quite different, presenting a broad flat squarish grinding surface with suppression of the hypoconid and entoconid, and absence of the usual posterior cusp and notch on outer side. M^2 with outer cusps (paracone and metacone) normal; inner cusps (protocone and hypocone) obsolete. $M_{\overline{2}}$ with anterior part (protoconid and metaconid) normal but rather low; posterior

[1] The type is a young-adult female. Skulls of adult males may show cranial differences.

part occupying more than half of crown, a flat rectangular platform, truncate posteriorly, and bordered by a low marginal rim bearing a single small cusp on inner side immediately behind the metaconid; hypoconid absent; entoconid obsolete; outer side of tooth nearly flat, without sulcus or reentrant angle and without notch between protoconid and hypoconid.

In the reduction or suppression of the inner cusps of M^1 and M^2, and of both inner and outer cusps of the large posterior moiety of M_3, together with the absence of a reentrant angle and notch on the outer side of M_2, *Vetularctos* resembles *Arctotherium* and *Tremarctos*. The details of these and other teeth in the three genera, however, are quite different and the genera have little in common. Nevertheless the resemblances are sufficient to suggest that *Vetularctos* may claim a rather ancient line of descent, from which *Arctotherium* and *Tremarctos* also arose—a line quite different from the one culminating in *Ursus* proper.

Type species.—Vetularctos inopinatus.

VETULARCTOS INOPINATUS sp. nov.

PATRIARCHAL BEAR.

Type, skull No. 7149 (skin No. 8706), ♀ nearly adult, U. S. National Museum, from Rendezvous Lake, northeast of Fort Anderson, Mackenzie. Collected June 24, 1864, by R. MacFarlane. Original No. 1979. Teeth practically unworn.

Color.—General color varying from whitish buff to pale yellowish buff (yellowest on back of head and neck), darkening to dull reddish brown on ankles, feet, and median line of belly. The pale body color covers the entire body from between eyes to base of tail and reaches down over thighs and upper part of legs. Muzzle golden brown, becoming dull fulvous-brown around eyes; top of head from between eyes posteriorly soiled buff; long hairs of cheeks washed with buffy; ears pale buffy. Fur everywhere full, soft, and woolly; basal fur of upperparts varying from grayish to grayish brown, but distal half or more than half, pale buffy, so the animal as a whole appears to be buffy whitish.

Cranial and dental characters.—Skull small, moderately arched above; basicranial axis arched, palate strongly arched and slightly concave longitudinally. Teeth peculiar, presenting a combination of long canines and well-developed cusps for seizing (main cusp of PM^4 and PM_4, outer cusps of M^1 and M^2 and anterior cusps of M_1) with broadly flattened surfaces for crushing (in M^2, M_2, and M_3). Incisors, canines, and premolars as in *Ursus;* posterior molars peculiar, showing a strong tendency toward the suppression of cusps, particularly those of the inner side. Crown of M^1 with outer cusps

(paracone and metacone) normal; inner cusps (protocone and hypocone—slightly worn) low, scarcely rising above level of median part of tooth; no middle cusplet. Crown of M^2 with outer cusps (paracone and metacone) normal; inner cusps (protocone and hypocone) obsolete, represented by a low ridge scarcely projecting above the granular surface of the interior of the crown. Crown of $M_{\overline{1}}$ normal, but anterior part higher than posterior. Crown of $M_{\overline{2}}$ very remarkable (see description of genus). Crown of $M_{\overline{3}}$ flat, with only insignificant marginal thickenings to represent protoconid and metaconid, the flat crown forming a direct continuation of the large crushing platform of the preceding tooth.

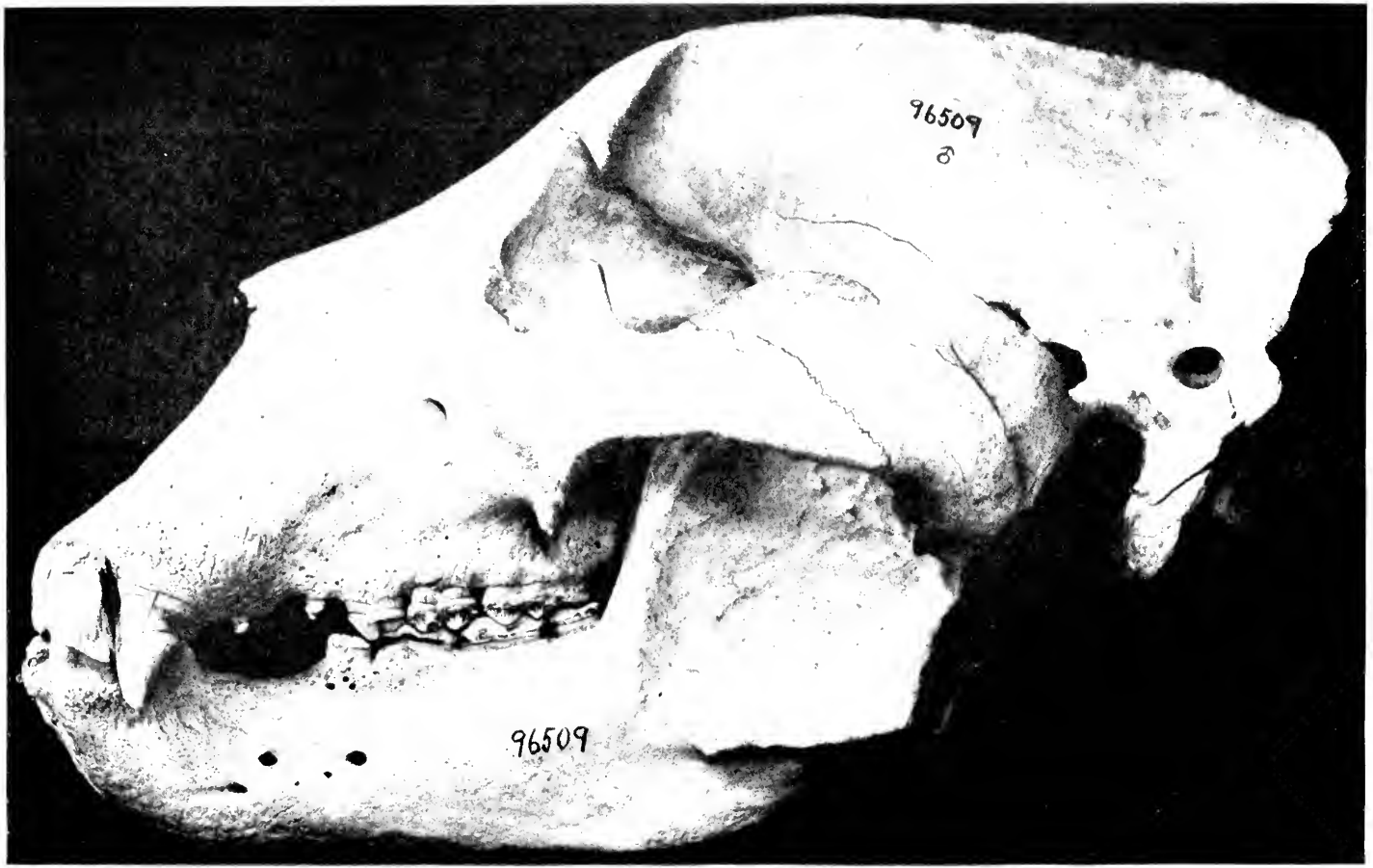
Skull measurements.—Young-adult female (type): Basal length, 268; occipito-nasal length, 255; palatal length, 148; zygomatic breadth, 181; interorbital breadth, 70.

Tooth measurements.—PI^4, 17 x 14; M^1, 22.5 x 17; M^2, 35.5 x 19; $PM_{\overline{4}}$, 14 x 8; $M_{\overline{1}}$, 24.5 x 12; $M_{\overline{2}}$, 27 x 17; $M_{\overline{3}}$, 21 x 16; upper molariform series, 73; upper molars, 59; lower molars, 72; diameter of lower canine, 13; upper incisors (series), 40.

PLATE II.

SKULL OF URSUS GYAS

Old ♂ from Bear Bay, Alaska Peninsula. No. 91690. (Seven-sixteenths natural size.)



SKULL OF URSUS MIDDENDORFFI.

Old ♂ from Chiniak Point, Kodiak Island, Alaska. No. 96509. (Seven-sixteenths natural size.)

SKULL OF URSUS KENAIENSIS.

Old ♂ from Kenai Peninsula, Alaska. No. 210291. (Seven sixteenths natural size.)

SKULL OF URSUS SHELDONI.

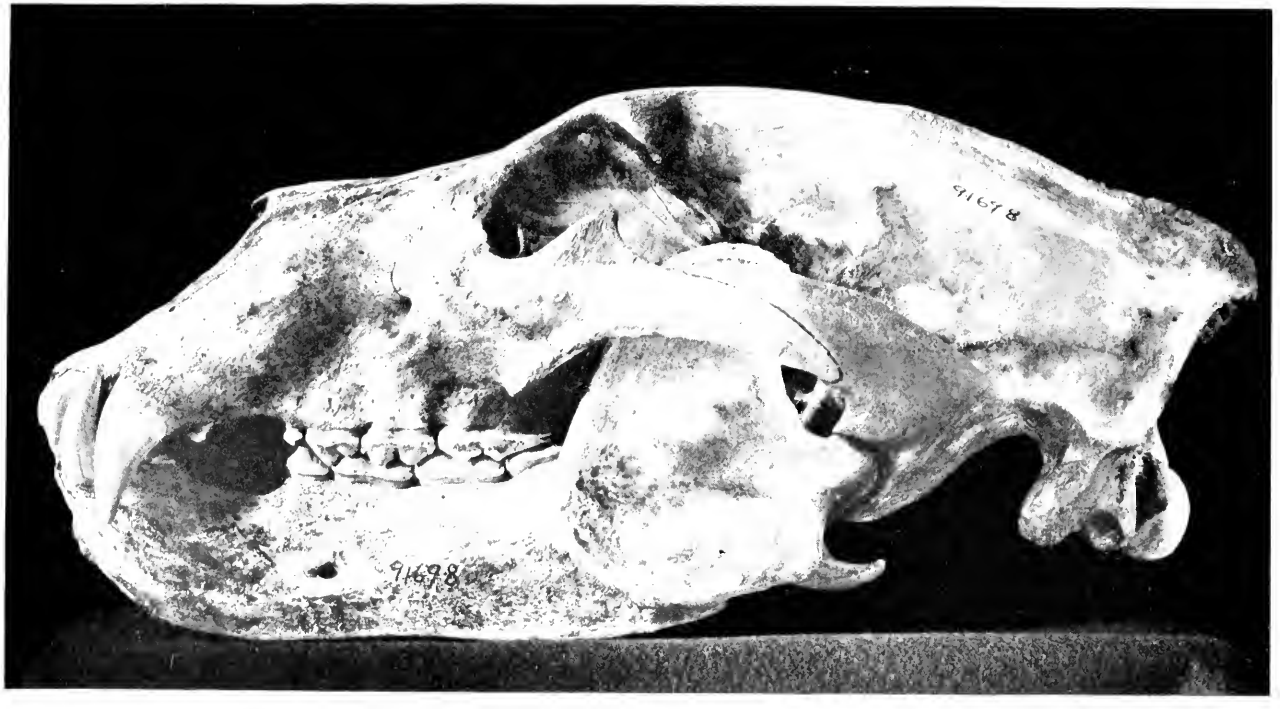
Adult ♂ from Montague Island, Prince William Sound, Alaska. No. 137318 (type). (Seven sixteenths natural size.)

SKULL OF URSUS SHIRASI.

Old ♂ from Admiralty Island, Alaska. No. 203080 (type). (Seven-sixteenths natural size.)

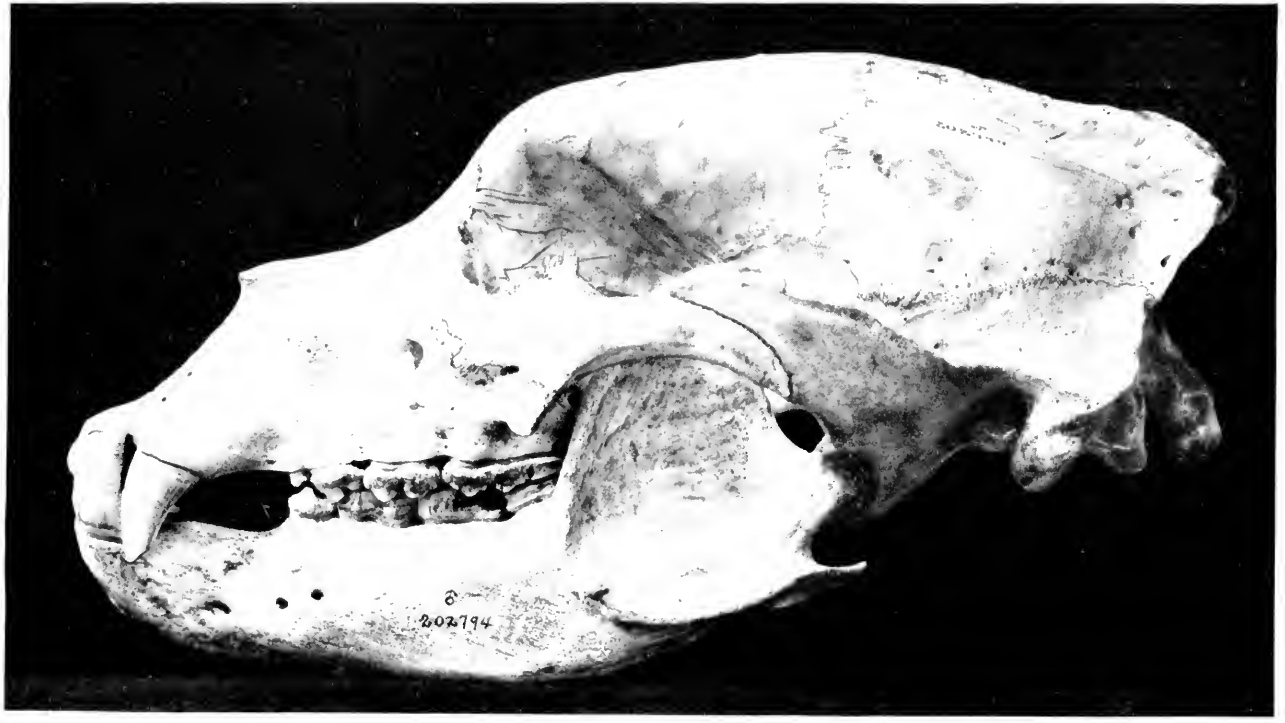
SKULL OF URSUS INNUITUS.

Old ♂ from Golofnin Bay, Alaska. No. 179780 (type). (Seven-sixteenths natural size.)



SKULL OF URSUS KIDDERI KIDDERI.

Old ♂ from Belkofski, Alaska Peninsula. No. 91698. (Seven-sixteenths natural size.)

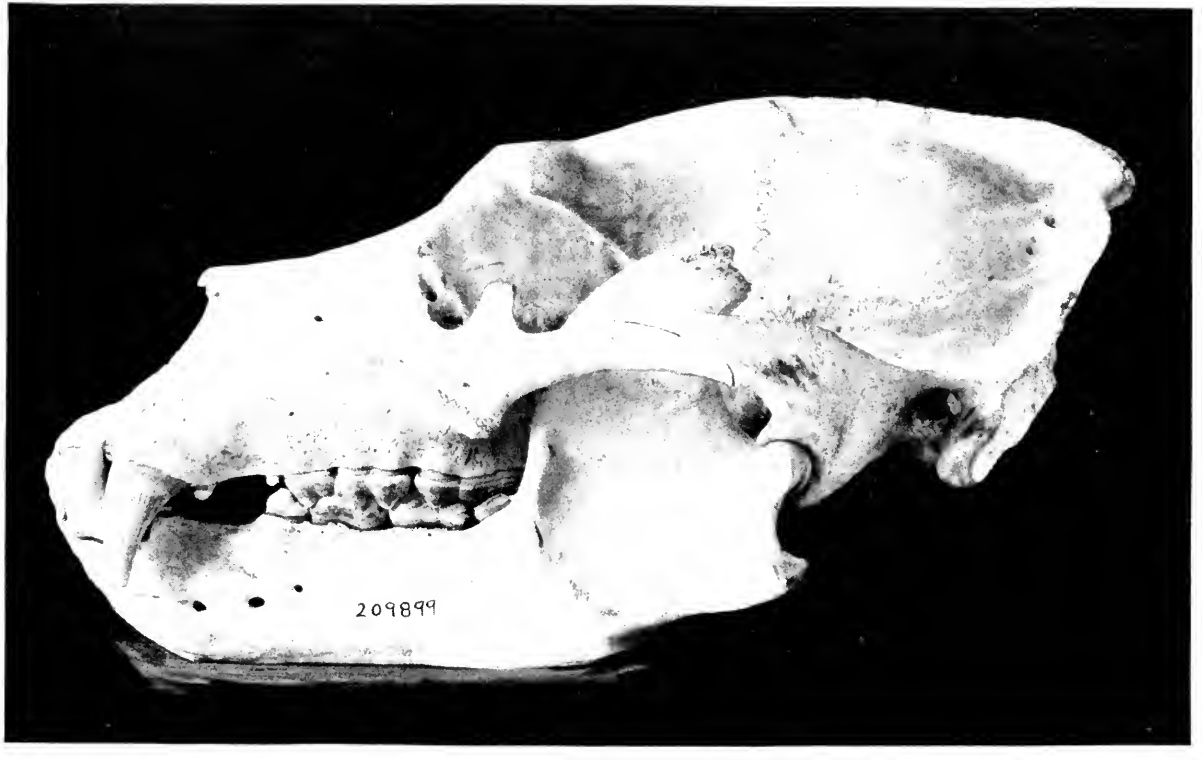


SKULL OF URSUS STIKEENENSIS.

Adult ♂ from Tatletuey Lake, near head of Skeena River, British Columbia. No. 202794 (type). (Seven-sixteenths natural size.)

SKULL OF URSUS OPHRUS.

Old ♂ from eastern British Columbia. No. 210252 (type). (Seven-sixteenths natural size.)



SKULL OF URSUS RUNGIUSI RUNGIUSI.

Old ♂ from Indian Point Creek, near Barkerville, British Columbia. No. 209899. (Seven-sixteenths natural size.)

SKULL OF URSUS ALASCENSIS.

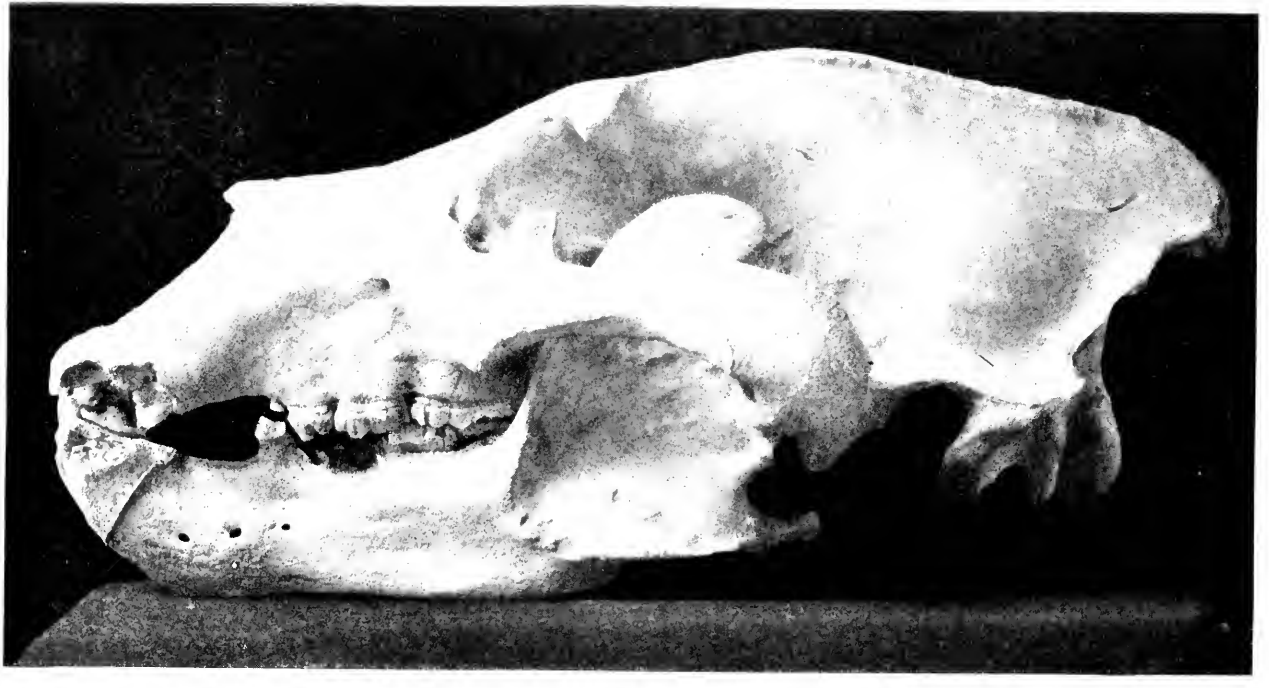
Old ♂ from Unalaklik River, Alaska. No. 76466 (type). (Seven-sixteenths natural size.)

SKULL OF URSUS NORTONI.

Old ♀ from Yakutat, Alaska. No. 178763 (type). (Seven-sixteenths natural size.)

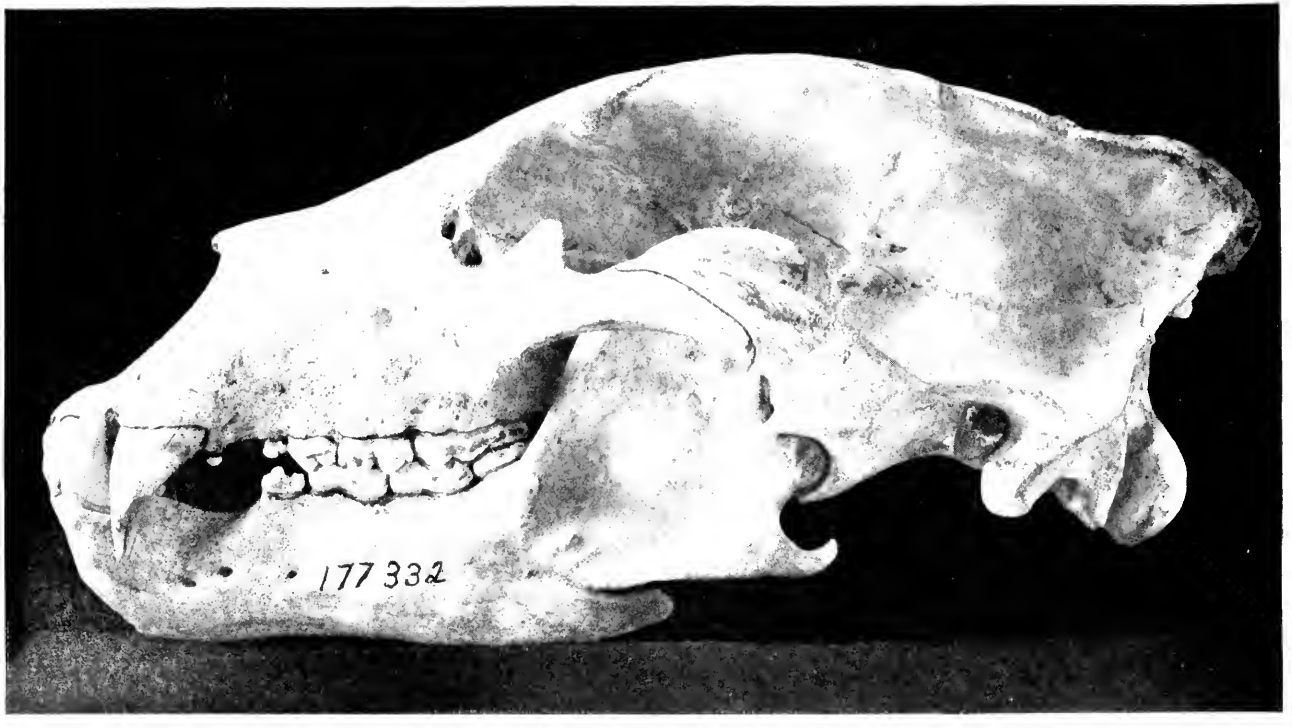
SKULL OF URSUS HORRIBILIS HORRIBILIS.

Old ♂ from Missouri Breaks, eastern Montana. No. 202739. (Seven-sixteenths natural size.)



SKULL OF URSUS HORRIÆUS.

Old ♂ from Coppermines, New Mexico. No. 990 (type). (Seven-sixteenths natural size.)



SKULL OF URSUS ARIZONÆ.

Adult ♂ from Escudilla Mountains, Apache County, Arizona. No. 177332 (type). (Seven-sixteenths natural size.)

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[New species in bold-faced type; synonyms in *italics*; principal references in bold-faced figures.]

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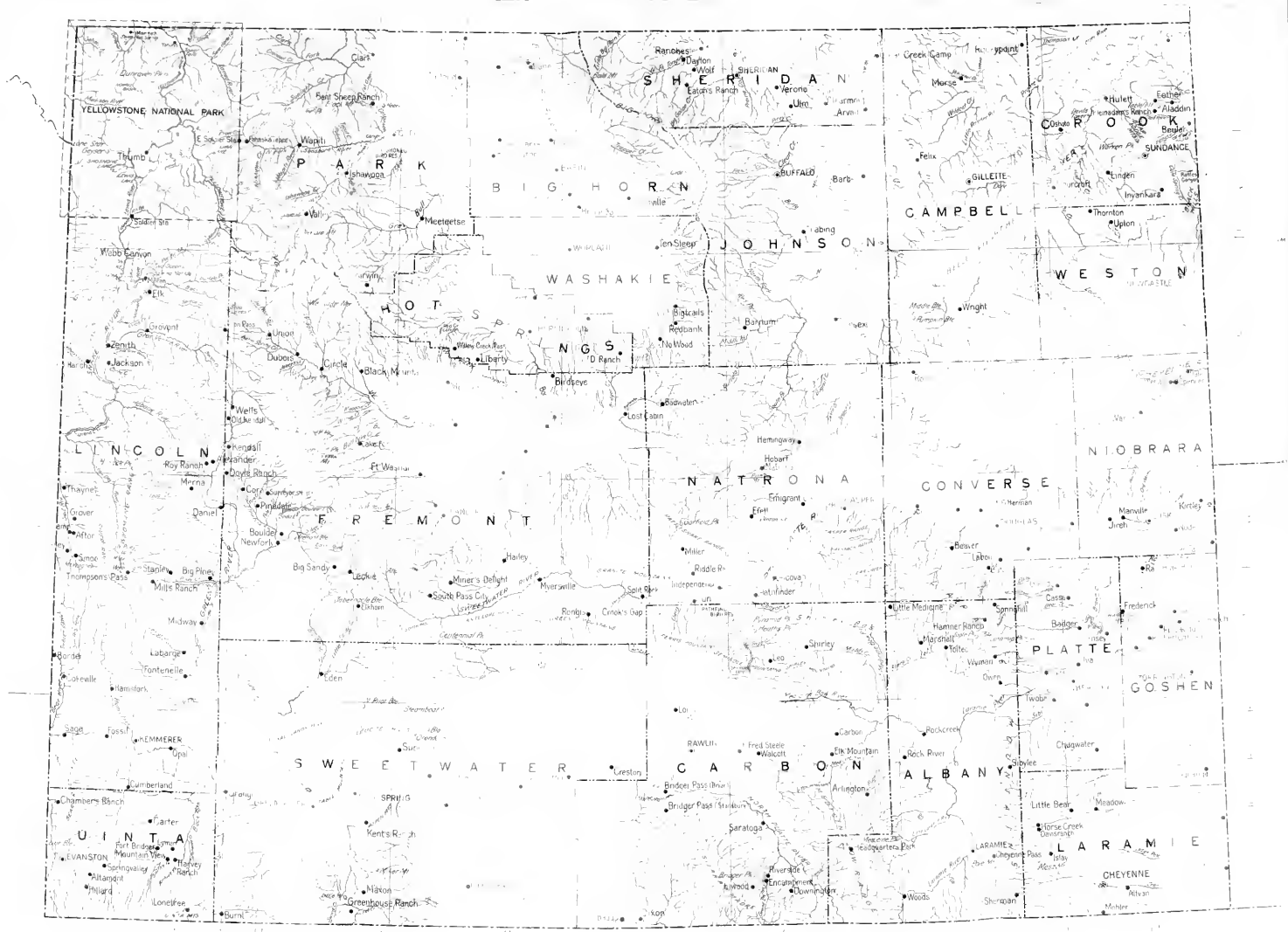


ARCTIC ALPINE ZONE
HUDSONIAN ZONE
CANADIAN ZONE
TRANSITION ZONE
UPPER SONORAN ZONE

LIFE ZONES OF WYOMING

BY MERRITT CARY ASSISTANT BIOLOGIST

BIOLOGICAL SURVEY, U.S. DEPARTMENT OF AGRICULTURE

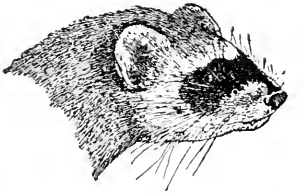
ACCOMPANYING REPORT ON LIFE ZONES OF WYOMING
NORTH AMERICAN FAUNA No 42
1917

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
E. W. NELSON, *Chief*

NORTH AMERICAN FAUNA

No. 42

[Actual date of publication, October 3, 1917]



LIFE ZONE INVESTIGATIONS IN WYOMING

BY

MERRITT CARY

ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., November 23, 1916.

SIR: I have the honor to transmit for publication as North American Fauna No. 42, a report on life zone investigations in Wyoming, by Merritt Cary, Assistant Biologist of the Biological Survey. The report is based on the results of natural history explorations conducted in recent years by Survey field parties in all the important physiographic areas of the State. The first section characterizes the five transcontinental life zones represented in Wyoming, defines their extent and limits, and discusses their economic possibilities. The second consists of notes on the distribution and abundance of conspicuous trees and shrubs observed during the progress of the survey. Of particular importance in connection with this report, as well as with others yet to be made on the distribution of the birds and mammals of Wyoming, is the accompanying map, which shows in detail the extent and boundaries of the life zones which traverse the State.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

Hon. DAVID F. HOUSTON,
Secretary of Agriculture.

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No. 42. NORTH AMERICAN FAUNA. Oct., 1917.

LIFE ZONE INVESTIGATIONS IN WYOMING.

By Merritt Cary.

INTRODUCTION.

Wyoming is among the foremost of our States in its wealth of natural scenery, culminating in the grandeur of Yellowstone National Park, one of the wonders of the world. In addition to this distinction it posseses vast open plains and lofty mountains whence flow the headwaters of mighty river systems emptying far away to the west into the Pacific Ocean, to the southeast into the Gulf of Mexico, and to the southwest into the Gulf of California. The various slope exposures of its mountain ranges, the fertility of its intervening valleys or basins, and the aridity of its desert spaces present a study of geographic and vertical distribution of wild life that is in many particulars unique.

The study of geographic and vertical distribution of life with the governing factors and attendant problems is valuable as a matter of scientific research and in the attainment of practical knowledge. The Biological Survey has been making detailed investigations of the transcontinental life belts, or zones, of North America for some years, and this work has been carried on with special reference to their practical value. It has become increasingly evident that life zones furnish a fairly accurate index to average climatic conditions and, therefore, are useful as marking the limits of agricultural possibilities, so far as these are dependent upon climate. The knowledge thus gained has been published and made available as the investigations have progressed and the life zones have been mapped.[1]

The opening up to agriculture of the arid and semiarid West through irrigation and efficient methods of conserving the natural

[1] For detailed discussion and classification of the life zones of North America see Merriam, C. Hart, Life Zones and Crop Zones of the United States (Bull. 10, Biological Survey, U. S. Dept. Agr., 1898); also Bailey, Vernon, Biological Survey of Texas (North Amer. Fauna No. 25, 1905); Fourth Provisional Zone Map of North America, prepared by the Biological Survey, 1910; Cary, Merritt, Biological Survey of Colorado (North Amer. Fauna No. 33, 1911); and Bailey, Vernon, Life Zones and Crop Zones of New Mexico (North Amer. Fauna No. 35, 1913).

rainfall offers a favorable field for the practical application of this knowledge. A wide range of altitude and a correspondingly varied climate and physiography include from two to six of the major life zones in each of the several States, and the zonal boundaries are on the whole well marked by reason of the usually rapid or abrupt changes in elevation. New areas are continually being reclaimed, while in practically all the Western States large districts await future development. This is especially true of the Rocky Mountain States, where general agriculture has been least developed.

In Wyoming, agriculture has made rapid strides during the past few years, but it has not yet advanced much beyond the experimental stage, and the possibilities are somewhat limited by a cool climate due to high average base level. It appears unlikely that crop production will in future greatly exceed the local demand. There are, however, certain restricted areas of low elevation and moderate climate where a variety of crops and some of the hardier fruits have proved decidedly successful. A special value attaches to these low-lying districts inasmuch as they are immediately surrounded or bordered by extensive nonagricultural areas where mining, lumbering, and stock raising are the principal industries. The melting snows of Wyoming mountains furnish an unfailing supply of water for irrigation purposes, and Federal and private irrigation projects have already reclaimed considerable sections. Much valuable agricultural land in the valleys and basins awaits future development. Useless experimentation might be avoided or a more favorable location secured if the prospective as well as the resident agriculturist, and especially the horticulturist, would become familiar with the groups of native species of mammals, birds, reptiles, and plants which have proved to be closely associated with the areas of successful production of particular crops in other parts of the arid West.

Natural history explorations carried on in recent years by the Biological Survey in all the important physiographic areas of Wyoming warrant the present report on the life zones with the accompanying map (Pl. I). Sufficient material has been gathered also for inclusion of notes on the distribution of conspicuous trees and shrubs and for later reports on the mammals and birds of the State.[1]

[1] The present report combines the results of field investigations for the Biological Survey conducted at various times by Dr. C. Hart Merriam, Vernon Bailey, B. H. Dutcher, J. Alden Loring, Edward A. Preble, Alexander Wetmore, H. E. Anthony, Stanley G. Jewett, and D. D. Streeter, jr.; besides those made by the author since 1909 (see map of Wyoming, showing routes of field parties, fig. 1). Lists and other publications bearing on the distribution of the Wyoming fauna and flora, although few in number, have been freely consulted. For identification of many of the plants collected in the survey the author is indebted to Dr. J. N. Rose and Paul C. Standley, of the U. S. National Herbarium, and to F. V. Coville, curator of the National Herbarium, who has named the *Ribes*. The few reptiles and amphibians collected have been identified by Dr Leonhard Stejneger, of the U. S. National Museum.

PHYSIOGRAPHY AND CLIMATE.

In common with other States of the Rocky Mountain region, Wyoming has a varied physiography and climate and great natural resources. The surface features may be classified broadly as mountains, plains, and valleys or basins.

The continental watershed formed by the main chain of the Rockies enters the State through Yellowstone Park near the midwestern boundary of the forested plateau and maintains a general southeasterly trend along the lofty crests of the Absaroka and Wind River Ranges, lowering in the Red Desert region to arid plains and

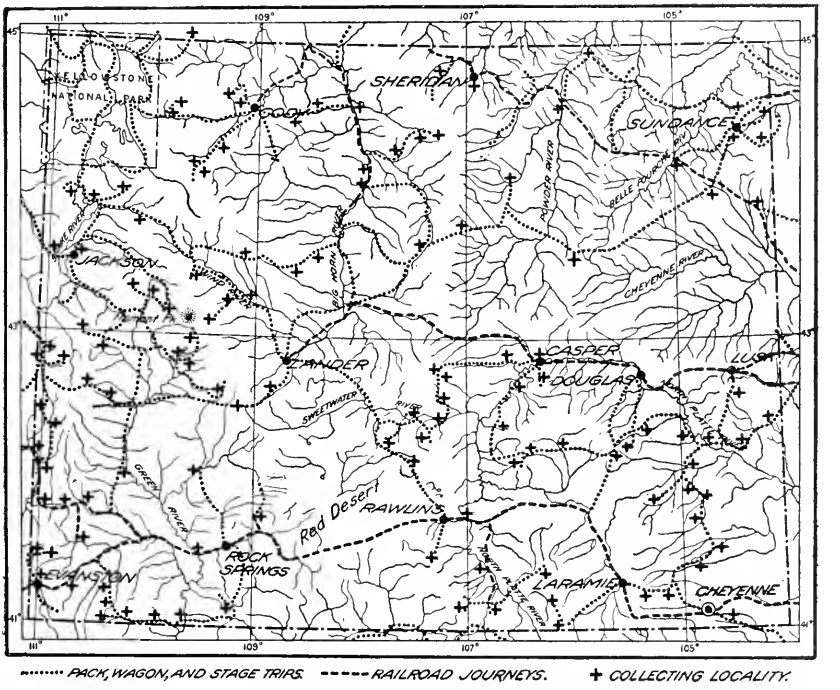

FIG. 1.—Map of Wyoming showing routes and collecting localities of Merritt Cary and other members of the Biological Survey, mainly from 1909 to 1915.

alkaline basins at 7,000 feet elevation, but again rising to the summits of the Sierra Madre, where it crosses the southern boundary of the State near its middle point. This watershed divides the Great Plains from the Great Basin, and on its slopes in northwest Wyoming rise the headwaters of the Colorado in Green River, the Columbia in Snake River, and the Missouri in Yellowstone and Madison Rivers.

The mountains of Wyoming, massed largely in the northwest, occupy approximately a fourth of the total area. Chief among them are the Absaroka, Wind River, Gros Ventre, and Teton Ranges in

the northwest; the Bighorn Mountains in the central northern portion; and the Sierra Madre and the Medicine Bow Ranges at the south. Most of these are heavily forested groups of great elevation, whose summits and crests reach far above timberline and are usually snow capped even in midsummer. All belong to the Rocky Mountain system except the Bighorn Mountains, which alone are detached from the main chain. Gannett Peak in the Wind River Mountains, at 13,785 feet, is the highest point in the State, exceeding the height of its close neighbor, Fremont Peak (13,730 feet); and of the Grand Teton (13,747 feet) in the Teton Range.

The Ferris, Green, Seminole, Shirley, and Rattlesnake Ranges are small separated groups along the upper Platte and Sweetwater Valleys and in the northern borders of the Red Desert, lying a little east of the continental watershed but indicating the general course of the Rockies. These differ greatly in configuration, but are usually characterized by densely forested northern slopes and summits and abrupt barren southern exposures facing the desert. In this region also are the huge bare granite heaps and domes rising from the sandy plain north of the Sweetwater, known collectively as the Granite Mountains. Together, these small ranges are a pleasant relief to a generally barren landscape.

The southwest corner of Wyoming is much broken by the northern timbered shoulders of the Uinta Mountains and by barren elevated ridges and mesas on either side of Green River and east of Bear River. In the southeast the Laramie Mountains are a foothill spur of the Medicine Bows continuous north to the Laramie River Gap and thence in more broken formation extending to the Platte Valley near Casper. Conspicuous groups of outlying hills at the east and northeast are the pine-clad Hartville Mountains north of Guernsey and the densely forested Black Hills and Bear Lodge Mountains.

Although well supplied with mountains, Wyoming is perhaps better known for its vast open plains. These are either level or rolling, lying mainly between 4,500 and 7,000 feet elevation, and are distinguished by characteristic types of vegetation, as the sage plains of the high, arid, interior plateaus; and the grassy plains to the east and northeast, which are part of the Great Plains. These treeless expanses were ranged long before historic times by great bands of buffalo, and, succeeding these, by countless herds of cattle and sheep, and their great grazing value is well attested by the long and bitter warfare for their possession between cattle barons and flockmasters which marked the days of the open range. At present dry farming is greatly restricting the cattle range on the Cheyenne and Lusk Plains and elsewhere along the eastern edge of the State. The extensive arid sage plains farther west, however, are mainly utilized for sheep grazing, to which they are peculiarly adapted.

The numerous valleys of Wyoming are well watered, and with their rich soils and low elevations (chiefly below 5,000 feet) include the areas of greatest agricultural importance and promise. Most important are those of the North Platte, Laramie, Cheyenne, Belle Fourche, Powder, Bighorn, Wind, Sweetwater, and Green Rivers.[1] The Bighorn and Wind River Valleys are extensive basins of low altitude and mild climate, well suited to the production of certain fruits and other crops. The more elevated valleys of the Sweetwater and Green Rivers are mainly devoted to stock raising.

The Red Desert is an extensive barren alkaline plain or basin of great aridity lying mainly west of the continental watershed in the southern part of the State. Without perennial streams and with soils strongly alkaline, it would appear to have no agricultural future. Alkali-resistant desert shrubbery and the moderate winter climate of this region nevertheless combine to furnish an excellent winter range for sheep, and it has long been thus utilized by flock-masters.

Wyoming's lowest elevation is in the extreme northeast, and its highest is in the northwest. Plains and plateaus occupy much of its southern half. The altitudinal extremes are 3,100 feet (approximate), where the Belle Fourche River crosses the eastern boundary; and 13,785 feet, on the summit of Gannett Peak in the Wind River Range.

The climate of the State is mainly arid, the rainfall ranging from 12 to 15 inches in the semiarid eastern Great Plains area to under 10 inches in the extreme arid central desert region (Bighorn Basin[2] and Red Desert). A heavier precipitation in the Bear Lodge and Black Hills districts at the northeast (15 to 20 inches) admits of tolerably successful agriculture without irrigation. The high timbered mountain ranges receive a great deal of moisture, not only as winter snows, but also during summer as frequent heavy, dashing rains.[3]

The elevated base level of Wyoming (about 6,000 feet) insures a generally cool climate. Warm summers (mean summer temperature about 65° F.) with a long growing season and moderate winters with light snowfall are the rule only at the lower levels in the north and east. The high interior valleys, plains, and plateaus are marked by short, cool summers (mean summer temperature about 55° F.), with prevalent late spring frosts, and by long winters with tolerably heavy snowfall and frequent cold winds. The snowfall is excessive in the mountainous country of the northwest, where occasionally very

[1] Most of the valleys are treated in some detail under their respective zones.

[2] The lowest parts of the Bighorn Basin often receive less than 6 inches of annual rainfall.

[3] The precipitation usually given for the mountains is over 18 inches, but data are lacking for the higher altitudes, where it must be much greater.

low temperatures are recorded,[1] but the winter season as a whole is perhaps less severe than on the high wind-swept plains.

For a State with an arid climate Wyoming is exceptionally well watered, and among its natural resources none is more essential to its future development than its rivers and streams. The Snake, Yellowstone, Bighorn, and Green Rivers rise in the mountains of the northwest; the Tongue, Powder, Belle Fourche, and Cheyenne Rivers, with their numerous tributaries, head in the Bighorn Mountains and the elevations of the northeast; while the North Platte and Laramie Rivers, which describe long, circuitous courses in the southeastern part of the State, have their sources in the high ranges of Colorado.

LIFE ZONES OF WYOMING.

Wyoming has a generous representation of animal and plant life. This is largely due to the varied climate resulting from a difference in altitude within its borders of nearly 10,700 feet; and in a lesser degree to a difference in latitude of 4 degrees, and a wide range of local physiographic conditions.

The life zones range from Upper Sonoran (the western arid subdivision of the Upper Austral Zone) at the lowest and warmest elevations, through the Transition, Canadian, and Hudsonian, to the Arctic-Alpine Zone on the crests of the highest mountain ranges. Of the seven North American transcontinental life zones, only the Lower Sonoran and the Tropical are unrepresented; and the Upper Sonoran Zone, while covering large areas, is represented only by its upper, cooler part.

The five zones present in Wyoming are briefly characterized as follows: *Upper Sonoran*, the zone of broad-leaved cottonwood, juniper, saltbush, and yucca, occupying most of the valleys and low plains; *Transition*, the zone of yellow pine, narrow-leaved cottonwood, and pure sagebrush, embracing the high plains, the basal slopes of the mountains, and all except the highest foothills; *Canadian*, the Boreal forest belt of spruce, fir, lodgepole pine, and aspen, covering the middle mountain slopes and highest foothill ranges; *Hudsonian*, the narrow zone or belt of white-barked pine and dwarfed spruce and fir, in the timberline region; and *Arctic-Alpine*, the treeless zone, on mountain crests and peaks above timberline.

Zonal boundaries and sequence usually are well marked on ranges rising abruptly from a low base, as on the western slope of the Bighorn Mountains, where a vertical interval of about 9,500 feet may be traversed in 15 or 20 miles; and on the Wind River Range southwest of Lander. Under gradual change in altitude, however,

[1] —45° F. is sometimes recorded in Jackson Hole, and though data are lacking, still lower temperatures undoubtedly are reached on the high ranges.

as on the open plains, the passage from the Upper Sonoran to the Transition Zone is often scarcely noticeable, and in mapping zones generally the limits in many places must be more or less arbitrarily fixed. In a survey of native mammals, birds, reptiles, and plants made at a given locality, a marked preponderance of characteristic species of a zone decides the zonal position; while a nearly equal representation, or a marked absence, of species peculiar to two adjoining zones is indicative of an intermediate position, or the approximate boundary.

The several zones occupy areas of great irregularity in Wyoming owing to the very broken configuration, and their vertical boundaries are subject also to the usual variation resulting chiefly from differences in latitude, base level, and slope exposure. In general, zone levels are lowest in the north because of lower base and higher latitude, and highest in the south where the base level is more elevated.[1]

UPPER SONORAN ZONE.

The arid subdivision of the Upper Austral Zone, the Upper Sonoran, occupies nearly a third of Wyoming (about 30,000 square miles), and covers all the lower levels. Fully half this area lies below 5,000 feet altitude in the eastern and northern sections, and most of it is well characterized. On the high plains and deserts of the south the Sonoran element is present between 5,500 and 6,500 feet elevation, mainly in dilute form. Low altitude, a warm climate and long growing season, and extensive open, level, or gently rolling areas of rich soils combine to make the Upper Sonoran the chief zone of crop production, dependent as in other sections of the arid West upon careful conservation and distribution of the natural water supply. All areas adapted to any extent to horticulture lie within this zone and, because of its agricultural importance, the limits and characterization are somewhat detailed.[1]

The Upper Sonoran areas of Wyoming are mainly broad extensions of the zone from lower elevations on the south, east, and north. Those entering from the south comprise a narrow strip of desert valley along both sides of Green River north nearly to Labarge; and in the Red Desert a broad region of barren plains and alkaline depressions which reaches eastward to include a small area in the upper Platte Valley both north and south of Fort Steele. The above areas are narrowly connected along Bitter Creek, and more broadly over the Snake River Valley in northwest Colorado, and together they form the northernmost extensions of the important Green River Upper Sonoran area.

[1] For detailed boundaries of the zonal areas of Wyoming see the zone map (frontispiece).

Two large tracts of Upper Sonoran country in the east are part of the Great Plains area. The southernmost of these is approximately bounded on the west by the 5,000 to 6,000 foot basal plains flanking the Laramie and Hartville Mountains, and extends north to the narrow strip of Transition Zone along the northern escarpment of the Lusk Plains. In the North Platte Valley the zone continues narrowly through the canyons above Guernsey, then in greater width to Casper, and in dilute character to the Seminole Mountains and to Splitrock in the Sweetwater Valley. North of the Lusk Plains the Upper Sonoran Zone includes most of the Cheyenne River drainage lying between the pure sage plains of the northern central section and the yellow pine country of the Black Hills. The Belle Fourche Valley in the northeast also carries a narrow Upper Sonoran strip around the northern and western bases of the Bear Lodge Mountains, which widens above Moorcroft and extends nearly to the Pumpkin Buttes.

A broad band of this zone entering the State from the north along the Bighorn River and Clarks Fork covers a large extent of low-altitude country in the arid Bighorn and Wind River Basins below 5,500 or 6,000 feet elevation. These two areas, of which the Bighorn Basin is the larger and agriculturally the more important, are narrowly connected through the canyon south of Thermopolis, but are otherwise separated by the elevated Transition Zone ridge of the Owl Creek Mountains. East of the Bighorn Mountains, the valleys of the Tongue, Powder, Little Powder, and Little Missouri Rivers carry narrow tongues of Upper Sonoran Zone some distance into the State, separated more or less widely by low, open or pine-clad Transition Zone watersheds.

In Wyoming, as in other States traversed by the continental watershed, the Upper Sonoran Zone is best treated under its two main subdivisions, the *Great Plains* and the *Great Basin*.

Great Plains Division—Upper Sonoran Zone.

Great uniformity of surface features and characterization marks the Great Plains area from the Dakotas to Texas and west to the eastern foothills of the Rocky Mountains. It is a vast level or undulating region of abundant grasses and moderate rainfall, entirely open except along streams, which are usually fringed with deciduous trees and shrubbery, and also in the rougher parts near the foothills where

[1] The subdivisions are based upon differences in climate, configuration, and native species, and are not to be confused with the physical Great Plains and Great Basin areas as generally understood and with which they are not coextensive. The imperfect characterization of the Great Basin division in Wyoming, particularly as regards its mammal and bird life, is due to high altitude, and in the Red Desert region in part to the infusion of Great Plains species as a result of the continuity of the Sonoran areas on either slope of the Continental Divide.

junipers and pines often occur in scattered growth. Areas of firm soils alternate with tracts of sandhills or rolling sandy country, and as the foothills are approached there are scattered areas of rough bad lands, the bluffs along streams become rocky, while numerous talus ridges, and clay, chalk, or rock buttes of usually irregular but in some places of strikingly symmetrical outline, stand up from the plain (Pl. II). The important streams of the Great Plains have their sources in the Rocky Mountains and course through valleys usually shallow and often sandy, which show little erosion. This type of country is well marked along the eastern edge of Wyoming as far north as Lusk.

The greatest elevation of the Upper Sonoran Zone is in the south, where on the firm-soil plains of the Cheyenne region it becomes dilute at 5,500 feet elevation, and its upper limits are indicated at approximately 6,000 feet, chiefly by absence of characteristic species. Exact delimitation is difficult on these open grassy plains, which extend on a gradual incline to the 7,000-foot base of the Laramie Mountains. The Cheyenne Plains descend steadily northward to the Platte Valley at a little over 4,000 feet, the surface meanwhile becoming broken and the soil sandy. The Sonoran element is very pronounced in the warm valleys of the Platte drainage, as in the Chugwater Valley below Bordeaux; in the Laramie Valley at Wheatland, Jetsam, and Uva; in Rawhide Valley below Patrick; in Goshen Hole; and along the North Platte below Guernsey; and agriculture under irrigation in these districts is correspondingly successful and varied.

North of the Platte Valley, and jutting squarely against the eastern bases of the Hartville Mountains and the Rawhide Butte, is an extensive grassy plateau with an elevation of from 4,800 to 5,000 feet, extending east into Nebraska and breaking sharply at the north toward the Cheyenne River. Upper Sonoran species predominate up to 5,000 feet, but the region is near the upper edge of the zone, since rocky buttes, ridges, gulches, and cool northern declivities carry a scrubby growth of yellow pine, Rocky Mountain juniper, red currant, mountain mahogany, and other Transition Zone vegetation. This plateau, often known as the Lusk Plains, is characterized mainly by its luxuriant growth of nutritious grasses and has long been noted as choice cattle range. Extensive areas on both the Cheyenne and Lusk Plains are now utilized in dry farming, to which the soil and climate are well adapted.

Characteristic associations of Upper Sonoran species mark the lower portions of the Cheyenne and Lusk Plains and the North Platte Valley. Large groves of broad-leaved cottonwoods (chiefly *Populus occidentalis*) are on the North Platte and Laramie Rivers

and especially on Sibylee Creek, while in addition to cottonwoods the usual fringe along streams consists of willows, box elder, ash,[1] flowering currant, and wolfberry. Common shrubs or shrubby plants on dry flats, in gulches, and on rocky or gravelly slopes are saltbush, rabbit brush, narrow-leaved sagebrush, yucca (Pl. III), bush morning-glory, sand cherry, and skunk bush.

Some of the most conspicuous and characteristic flowering plants are *Eriogonum annuum*, *Rumex venosus*, *Abronia elliptica*, *Argemone intermedia*, *Cleome serrulata*, *Polanisia trachysperma*, *Lupinus plattensis*, *Astragalus crassicarpus* and *A. mollissimus*, *Psoralea* (spp.), *Petalostemon* (spp.), *Linum rigidum*, *Croton texensis*, *Mentzelia decapetala*, *Opuntia polyacantha*, *Mamillaria vivipara* and *M. missouriensis*, *Anogra albicaulis*, *Meriolix serrulata*, *Lithospermum gmelini*, *Lippia cuneifolia*, *Verbena hastata* and *V. bracteosa*, *Physalis lanceolata*, *Solanum rostratum*, *Pentstemon angustifolius*, *Plantago purshi*, *Liatris punctata*, *Grindelia squarrosa*, *Ratibida columnaris*, *Helianthus annuus* and *H. petiolaris*, *Hymenopappus filifolius*, *Carduus plattensis*, and *Lygodesmia rostrata*.

Mammals which especially mark this region as Upper Sonoran are the Kennicott ground squirrel, prairie-dog, Great Plains grasshopper mouse, prairie harvest mouse, Colorado bushy-tailed wood rat, Hayden field mouse, yellow pocket gopher, sage pocket gopher, Wyoming kangaroo rat, Kansas pocket mouse, Bailey cottontail, black-footed ferret, northern plains mole, and California bat.

Characteristic breeding birds of the plains are the mourning dove, burrowing owl, Arkansas kingbird, Bullock oriole, bronzed grackle, lazuli bunting, lark bunting, western grasshopper sparrow, western lark sparrow, white-rumped shrike, yellow warbler, long-tailed chat, western mockingbird, catbird, and brown thrasher.

Reptiles are poorly represented on the plains of eastern Wyoming. The few conspicuous snakes and lizards include the plains rattlesnake, prairie bull snake, hog-nosed snake, blue racer, garter snakes, desert horned lizard, sand swift, scaly lizard, six-lined lizard, and many-lined skink.

The Upper Sonoran area north of the Lusk Plains is open, but much rougher in configuration, and the shrubby type of vegetation becomes increasingly prominent, especially in the valleys below 4,500 feet elevation, where the Sonoran element is strongest. Grass and cactus flats alternate with tracts of sagebrush, rabbit brush, and greasewood over much of the drainage basin of Cheyenne River, and in the low Belle Fourche and Little Missouri Valleys in northeast Wyoming. The watersheds between the valleys are either ranges of rolling grassy hills or abrupt barren ridges of bad lands of about

[1] Uncommon.

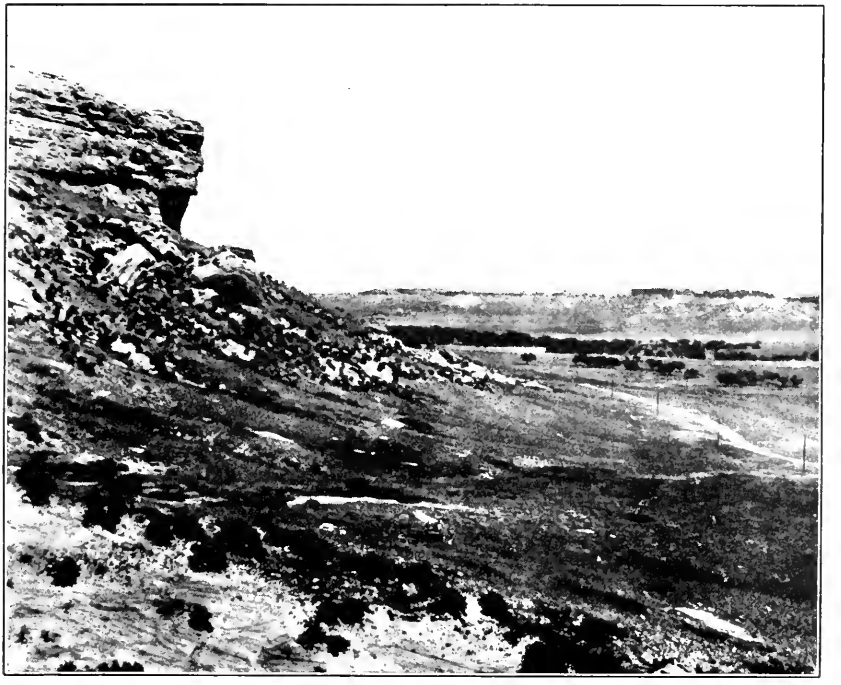

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FIG. 1.—CHUGWATER VALLEY BELOW CHUGWATER.

Juniper and mountain mahogany (*Cercocarpus parvifolius*) on bluffs, and box elders in valley.

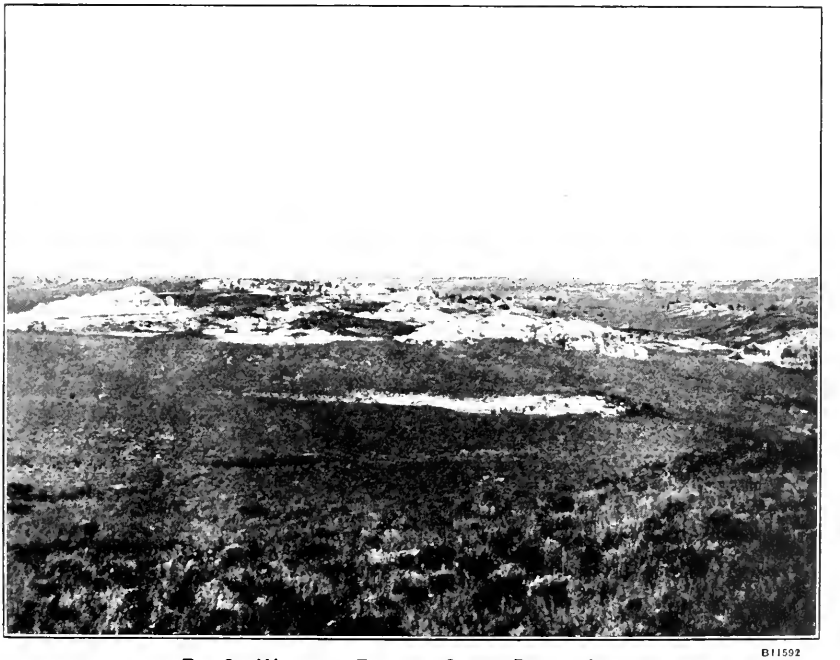

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FIG. 2.—WESTERN EDGE OF GREAT PLAINS AREA.

Scattered yellow pines and junipers in butte country southwest of Guernsey (4,800 feet).

B11594

FIG. 1.—PLAINS YUCCA (YUCCA GLAUCA) IN FLOWER IN CHUGWATER VALLEY NEAR BORDEAUX, JULY 1, 1909.

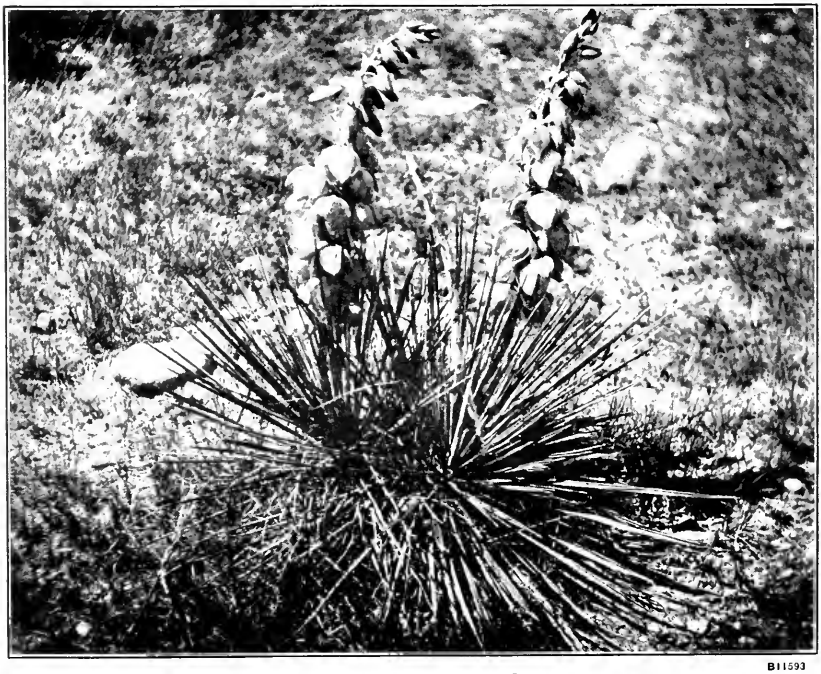

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FIG. 2.—NEARER VIEW OF SAME.

5,000 feet elevation. Extensive breaks with more or less yellow pine, juniper, and Transition Zone shrubbery margin the Cheyenne River basin, especially on the south, while the watercourses usually are bordered narrowly with gnarled cottonwoods, willows, box elders, and other deciduous trees and shrubs, as along plains streams generally.

Sagebrush country rapidly takes the place of grassy plains west of Lusk, varied in the upper valley of the Platte with greasewood, rabbit brush, saltbush, and other desert shrubbery, which becomes increasingly common westward. Shrubby Sonoran vegetation fills also most of the narrow extensions of the Yellowstone Valley Upper Sonoran Zone in the valleys of the Little Powder, Powder, and Tongue Rivers east of the Bighorn Mountains.

Although the shrubby type of desert vegetation, more barren surface, and greater aridity of the upper Platte Valley, and the Upper Sonoran areas between the Black Hills and Bighorn Mountains, would seem to place them with the Great Basin division of the zone, their mammals, birds, and herbaceous plants are mainly those of the Great Plains. Species which are absent or rare on the plains farther south include among plants the greasewood, black sagebrush, several species of rabbit brush, white sage, saltbushes, and stanleya; and among mammals, the Maximilian and Sweetwater pocket mice.[1]

Upper Sonoran areas of eastern Wyoming are within the semiarid region and receive in most sections a mean annual rainfall of from 12 to 15 inches. This is sufficient for a luxuriant growth of the best varieties of range grasses in all sections with suitable soils, but will not admit of agriculture apart from irrigation or dry-farming methods, except possibly around the base of the Black Hills, where the precipitation is a little greater. Under irrigation the rich alluvial soils of the valleys yield abundant crops, while the moderate returns from the soil secured most years in the dry-farming communities scattered over the plains are inducing a steadily increasing settlement of these districts.

Great Basin Division—Upper Sonoran Zone.

The Green River Valley, Red Desert, and the Bighorn and Wind River Basins have a barren surface which shows everywhere much erosion, especially along the larger streams, which in many places flow through rugged canyons. These open interior areas of from 4,000 to 6,500 feet elevation lie within the arid region of slight rainfall, and the scanty vegetation is of the shrubby, bunchlike,

[1] A number of mammals and birds and a few plants found commonly on the Lusk Plains and southward do not reach this region.

desert type so characteristic of the Great Basin region as a whole (Pl. IV, fig. 2), in marked contrast with the grassy plains of eastern Wyoming. A narrow fringe of scattering junipers usually marks the upper border of the zone on the rough lower margins of these desert valleys and basins, while considerable areas of junipers with scattering pinyons partly fill the upper part of the zone in lower Green River Valley, and in the extreme southwestern borders of the Red Desert.[1] The Great Basin division is better characterized in Wyoming by vegetation and climate than as a faunal region,[2] although a few Great Basin species of both mammals and breeding birds occur in the Green River Valley and on the Red Desert. The mammals and birds of the Wind River and Bighorn Basins are mainly those common to the Great Plains.

The great dearth of rainfall in these desert areas precludes ordinary agriculture and even dry farming. Effective agriculture is therefore possible through irrigation alone.

Green River Valley—Upper Sonoran Zone.

The Upper Sonoran area extending north along Green River nearly to Labarge is considered apart from the Red Desert, with which it is connected, on account of different topographic features and a stronger characterization in its lower part, near the Utah boundary, where the elevation is only 5,800 feet in the river valley. In this section it is a rough incised region of rocky, juniper-clad ridges and dry, open canyons or narrow valleys reaching gradually down to Green River from high, bordering Transition Zone hills and mesas; and of precipitous, brightly colored canyons whose various shades of red and yellow are in strong contrast with the intense black of the juniper ridges. The steep, hot, protected slopes of this broken canyon region carry the Upper Sonoran Zone regularly as high as 7,000 feet.

Its species are characteristic of the juniper and pinyon belt of the Great Basin, but are in less variety than in this part of the zone farther south, and some of them reach but a short distance into the State. Junipers, scattering pinyons, mountain mahogany, shadscale, syringa, and cactuses comprise the principal vegetation on ridges and dry slopes; saltbushes, grayia, yellow cleome, eriogonum, and cactuses are common shrubs and plants on the open sand or adobe flats in the valleys between the ridges; the skunk bush and flowering currant form characteristic shrubbery on the bluffs immediately along Green River; while extensive flats in the wider parts of the river valley are

[1] The belt of junipers and pinyons, which in regions farther south is usually present in good width and characterizes the upper part of this division of the zone, is but poorly indicated in Wyoming, where the zone is more often open throughout.

[2] See footnote, p. 14.

densely covered with greasewood (Pl. IV, fig. 1) and glasswort in damp, alkaline spots.

The gray titmouse, Baird wren, and pinyon jay are common birds in the juniper growth, and probably breed, as does also the sage sparrow, on the greasewood flats. Among the characteristic Upper Sonoran mammals of this region are the least and rock chipmunks, golden-breasted canyon mouse, True's cliff mouse, Green River pocket gopher, and Great Basin spotted skunk. The reptiles and amphibians include the plains rattlesnake, scaly rock lizard, Stansbury sand lizard, short-horned lizard, and the spadefoot toad.

North of the canyon region, which extends to within 15 or 20 miles of the town of Green River, the Upper Sonoran Zone spreads out in dilute form to include the lower valleys of the Black Fork and Big Sandy, connecting eastward through the Bitter Creek drainage with the larger area on the Red Desert.[1] As a narrowing strip along Green River it continues to the warm valley flats between Fontenelle and Labarge. This is an open, deeply eroded region of barren valleys and bench lands, of bare mesas and variously colored bad lands, buttes, and bluffs, whose zonal position is best defined by its conspicuous vegetation, chiefly that common to the Red Desert. Upper Sonoran species of mammals and breeding birds are comparatively few in number in this high part of the zone, where saltbushes, grayia, small brown sagebrush, rabbit brush, and other desert shrubbery, and such plants as yellow cleome and stanleya give way to the pure sage and rabbit brush plains of the Transition Zone at about 6,500 feet elevation.

The Green River Valley is rather bleak and inhospitable and does not seem to invite agricultural development. In character it resembles the Red Desert in many ways, but is less intensified, particularly in the aridity and the alkalinity of its soils. Owing to erosion, there is little valley land, and this little is partly used in the cultivation of forage crops. At the north a limited agriculture is possible, wherever lands can be brought under irrigation, on the small areas of bench lands which lie along Green River and its few permanent side streams. The rainfall is insufficient for a good growth of forage grasses, yet large numbers of sheep subsist upon the desert shrubbery and scanty grass. Sheep grazing appears to be the most practicable industry, and the rough character of lower Green River Valley, with its many sheltered canyons, warm protected slopes, and mild climate, peculiarly fits it for a winter range.

Red Desert—Upper Sonoran Zone.

Fairly constant surface features obtain over the open elevated region of undulating plains and alkaline depressions or basins, known

[1] See frontispiece (map).

as Red Desert, which is particularly characterized by great aridity, saline or other strongly alkaline soils, and dearth of permanent surface water. The only relief to the general monotony and barrenness is in scattering buttes, occasional ranges of low hills, bluffs along dry washes, or summits of distant bordering hills and mountains. The impression of barrenness is only intensified by the prevalent dull greenish gray or occasional light-gray hues of desert shrubbery.[1] The continental watershed extends across the north-central portion at an elevation of less than 7,000 feet where lowest, being crossed by the Union Pacific Railroad at Creston at 7,000 feet. Eastward the altitude decreases slightly toward the North Platte Valley (6,500 feet), and westward slopes through its only conspicuous drainage area, Bitter Creek Valley, to 6,000 feet on Green River. The climatic features are hot sunny days, cool nights, very slight rainfall during a short summer, and a long, moderately open winter. The heaviest snows are often in spring and are more beneficial to vegetation than summer rains, which are either largely lost through rapid evaporation or, in the case of the occasional heavier showers, quickly run off the barren slopes and fill the dry gulches with muddy torrents. Frosts are not uncommon during the height of the growing season.

Dilute Upper Sonoran Zone, poorly characterized apart from vegetation, covers the lower portion of the Red Desert to 6,500 or 6,800 feet altitude, a total area of between 5,000 and 6,000 square miles, including the North Platte Valley from the Platte Canyon to above Fort Steele. The conspicuous and dominant vegetation is Upper Sonoran desert shrubbery—the various species of saltbush, the white sage, greasewood, grayia, kochia, rabbit brush, the black sagebrush,[2] and low desert sages; with scattering desert junipers on many of the bluffs. A willow (*Salix fluviatilis*) is not uncommon on creeks of the Bitter Creek drainage. Such plants as prickly-pear cactus, yellow cleome, stanleya, many alkali-resistant members of the goosefoot family, and scattering grasses, conspicuous among which are wheat grasses and giant rye-grass, are abundant and characteristic.

The small striped ground squirrel, pocket mice, long-eared bat, least chipmunk, Green River pocket gopher, kangaroo rat, Bailey cottontail, and Great Basin spotted skunk are Upper Sonoran mammals inhabiting the Red Desert.

The variety of bird life is very limited, and few characteristically Sonoran birds breed here. The sage sparrow and western lark sparrow are perhaps most nearly restricted to the zone. Other birds found in abundance during the breeding season, the Brewer spar-

[1] The name "Red Desert," originally applied to a restricted area of reddish soil along the Union Pacific Railroad, does not convey a correct impression of this region as a whole, where desert vegetation instead of soil lends the characteristic colors.

[2] Abundant also in Transition Zone.

row, thick-billed redwing, western meadowlark, western nighthawk, sage thrasher, and white-rumped shrike, breed also on the surrounding sage plains of the Transition Zone.

This arid, barren waste is naturally unsuited to human habitation. Not only do the extensive alkaline deposits in the desert basins tend to make soil conditions over large areas unsuitable for crops, but even the underground water over practically the entire region is strongly alkaline and unfit for use. These conditions, combined with a deficient rainfall and absence of perennial streams, give no promise of an agricultural future. The few ranches are situated mainly along the skirts of the desert, where a number of small creeks coursing down from higher country furnish sufficient water for small fields and garden patches before being lost in the sand. Others are found at the few widely separated springs which rise in different parts of the desert. A ready and remunerative market for garden truck is furnished by the large coal-mining town of Rock Springs, and trucking is carried on in that district wherever there is sufficient water for irrigating a small garden patch.

The chief value of the Red Desert, aside from the extensive coal fields in its western part, is as a winter range for the hundreds of thousands of sheep which spend the summer on the higher plains and in the hills and mountains of central and western Wyoming. The abundant sagebrush, greasewood, and saltbushes, particularly the Nuttall saltbush (see Pl. IV, fig. 2) and other alkali-resistant shrubs and plants, afford an abundance of winter forage,[1] while plenty of water for stock is insured by the snows which drift before the frequent winds and permit browsing in the cleared spaces. Its peculiar adaptation to the winter feeding of sheep, long appreciated by the flockmasters, gives the Red Desert region a special importance as a necessary complement to one of Wyoming's great industries.

Wind River Basin—Upper Sonoran Zone.

The Upper Sonoran area drained by Wind River and its affluents lies mainly between 5,000 and 6,000 feet elevation. It extends from the southern escarpment of the Owl Creek Mountains to the northeastern base of the lofty Wind River Range, and at the east and southeast to the broad tract of high, rolling, sagebrush plains which separate it from the Upper Sonoran areas along the Platte and on the Red Desert. In its surface features, climate, vegetation, and animal life this region is generally similar to the Bighorn Basin, with which it is connected narrowly through the rugged canyon which cleaves the Owl Creek Mountains and carries the waters of the

[1] For a full discussion of the pasture value of the alkaline desert basins see Nelson, The Red Desert of Wyoming and its Forage Resources, Bull. 13, Div. of Agrostology, U. S. Dept. Agr., 1898.

Bighorn. The greater elevation of the Wind River Basin results, however, in a weaker characterization of the zone, while extensive areas of rough bad lands, which fill much of the upper (western) part between Wind River and the Owl Creek Mountains and form in many places the watersheds between streams elsewhere, greatly restrict the agricultural lands and confine them largely to the valleys. Owing to its proximity to the mountain mass of the Wind River Range, the western edge of this area receives more moisture than the central and eastern portions, where the rainfall seldom exceeds 10 inches.

The Upper Sonoran element is most pronounced in the lower valleys below Riverton, and on the plains and bad lands which jut against the southern bases of the Owl Creek Mountains. The vegetation on the sandy plain north of Shoshoni is typical of the lower elevations generally, consisting of saltbush, greasewood, rabbit brush, small brown sagebrush, spiny sagebrush, yucca, and prickly-pear cactus, with skunk bush and juniper on bluffs, and broad-leaved cottonwood, buffaloberry, flowering currant, and wolfberry along streams. Along the eastern base of the Wind River Range and on the barren slopes and gulches of the higher bad lands dilute Upper Sonoran Zone reaches to nearly 6,000 feet altitude, and here, as well as on the southern side of the Owl Creek Mountains, includes the fringe of scattering junipers which is more or less evident on the margins of the open basin. The effect of slope exposure on zone level is especially noticeable on the warm southern slopes of the Owl Creek Mountains, where the zone is carried regularly to 6,500 feet, at least 500 feet higher than on the cooler basal slopes of the Wind River Mountains, on the opposite side of the basin.

The generally weak character of the Upper Sonoran Zone over the Wind River Basin is evident from the paucity of characteristic zone species of mammals and breeding birds, which include, among mammals, the pale chipmunk, Great Plains grasshopper mouse, kangaroo rat, Bailey cottontail, Great Basin spotted skunk, and California bat; and among birds, the mourning dove, burrowing owl, Arkansas kingbird, Bullock oriole, western lark sparrow, white-rumped shrike, and long-tailed chat. The plains rattlesnake and the desert short-horned and scaly rock lizards are the most noticeable reptiles.

Extensive coal and oil fields are among the natural resources of the Wind River Basin. Agriculture is largely supplemental to cattle and sheep raising. Under irrigation the arable valley lands and some of the lower bench lands are producing fine crops of alfalfa and other forage, and also cereals. The growing season is short for tomatoes and tender vegetables, but most kinds do well and are raised extensively near Lander, Fort Washakie, Riverton, and elsewhere. Apple

growing has proved decidedly successful in certain protected valleys at the base of the mountains southwest of Lander, and small fruits are grown on a considerable scale at Lander and elsewhere. With an abundant supply of water in the Wind River Range, the reclamation and productiveness of considerable areas of both bench and valley lands await the construction of additional and especially higher irrigation canals.

Bighorn Basin—Upper Sonoran Zone.

The drainage basin of the Bighorn River is a large open area of 3,500 to 5,500 feet elevation lying between the high Bighorn and Absaroka Ranges in northwestern Wyoming; extending from the open Transition Zone ridge of the Owl Creek Mountains northward beyond the Montana line. It is a warm, protected section of low altitude and extreme aridity, but with an abundance of permanent streams, while the generally barren surface of its valley and low bench lands or scattered tracts of bad lands supports a scanty desert vegetation. The rainfall is often as light as 5 or 6 inches at Basin and Lovell, in the low central and northern sections, and less than 10 inches elsewhere. The Upper Sonoran Zone in this region covers an area of fairly regular outline about 100 miles in length from north to south by 60 miles in breadth, approximately 6,000 square miles. The zone is strongly characterized in the valleys and over the lower portions generally, reaching its upper limits at a little over 5,000 feet on the bordering sage slopes west and south, and eastward at anywhere from 5,500 to 6,000 feet on the abrupt hot slopes along the western bases of the Bighorn Mountains, where it includes an irregular belt of scattered junipers varying from 500 to 1,000 feet in vertical breadth.

The fauna and flora of the Bighorn Basin are derived alike from the Great Basin and Great Plains regions, and include few if any species not common to some of the other Sonoran areas of Wyoming. Over this region the Upper Sonoran Zone is variously characterized as to vegetation by a rank growth of broad-leaved cottonwood, willow, buffaloberry, skunk bush, and flowering currant along most of the streams; greasewood, rabbit brush, and *Suæda* on adobe river flats; saltbushes, rabbit brush, spiny sagebrush, prickly-pear cactus, and such plants as *Cleome lutea*, *Psoralea tenuiflora*, and *Plantago purshi* on firm-soil benches, with *Grayia spinosa*, *Polanisia trachysperma*, *Lupinus pusillus*, yucca, sand dock, and a small yellow-flowered *Malacothrix* added in sandy areas; and by a scattering growth of juniper and skunk bush on bad lands bluffs and on the rough southern and especially eastern margins of the basin. Extensive barren flats midway between Greybull and Cody have an

almost pure growth of prickly-pear cactus, while similar tracts near Frannie are likewise clothed with the Nuttall saltbush.

Representative breeding birds include the mourning dove, burrowing owl, Arkansas kingbird, Bullock oriole, bronzed grackle, western lark sparrow, sage sparrow, house finch, lazuli bunting, white-rumped shrike, yellow warbler, western yellow-throat, long-tailed chat, catbird, brown thrasher, and western marsh wren.

A few characteristic mammals of the Bighorn Basin are the pale chipmunk, black-tailed prairie-dog, Great Plains grasshopper mouse, Hayden field mouse, sage pocket gopher, kangaroo rat, Maximilian pocket mouse, Bailey cottontail, and the brown and California bats. Several reptiles, the prairie bull snake, plains rattlesnake, horned lizard, and scaly rock lizard, are common over much of the region.

This huge depression between lofty mountain ranges is a highly favored region of great promise. While physically and climatically the best suited to general agriculture of any of the low-altitude areas of western Wyoming, it is, perhaps, best known for its adaptation to horticulture and for the rapid strides already made in the successful production of high-grade apples and other fruits. The warm, sheltered valleys and hot Upper Sonoran slopes along the western bases of the Bighorn Mountains, especially toward the northern end of the basin, are highly favorable to fruit culture. It is in these situations that the older bearing orchards are chiefly located and the best results have thus far been obtained. Young orchards are now extensively planted throughout the lower open portions of the basin and, although more exposed than nearer the mountains, nevertheless give promise of handsome returns under proper care and due attention to local conditions.

The Bighorn River and its principal tributaries, the Shoshone and Greybull Rivers, and Shell, No Wood, and Owl Creeks, fed by the melting snows of high mountain ranges, carry an abundance of water, amply sufficient under proper storage control for watering all irrigable lands in their drainages (fig. 2). Private irrigation projects have already reclaimed considerable portions of the broad and fertile stream valleys, together with the lowest of the adjoining bench lands, and the Federal Shoshone project has opened large tracts in Shoshone Valley. The higher bench lands, at present utilized in sheep grazing, await the construction of more storage dams and higher irrigation canals before they can be made productive.

Characteristic Species—Upper Sonoran Zone.

The delimitation of life zones is based upon the combined ranges of characteristic species of mammals, breeding birds, reptiles, and

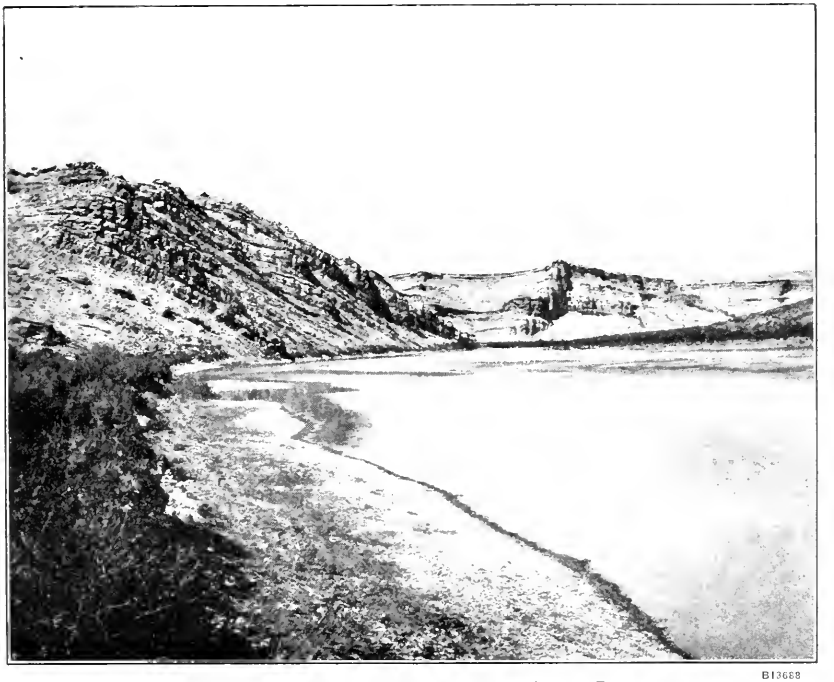

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FIG. 1.—BLUFFS ALONG GREEN RIVER NEAR UTAH BOUNDARY.

Dense growth of greasewood (*Sarcobatus vermiculatus*) at left.

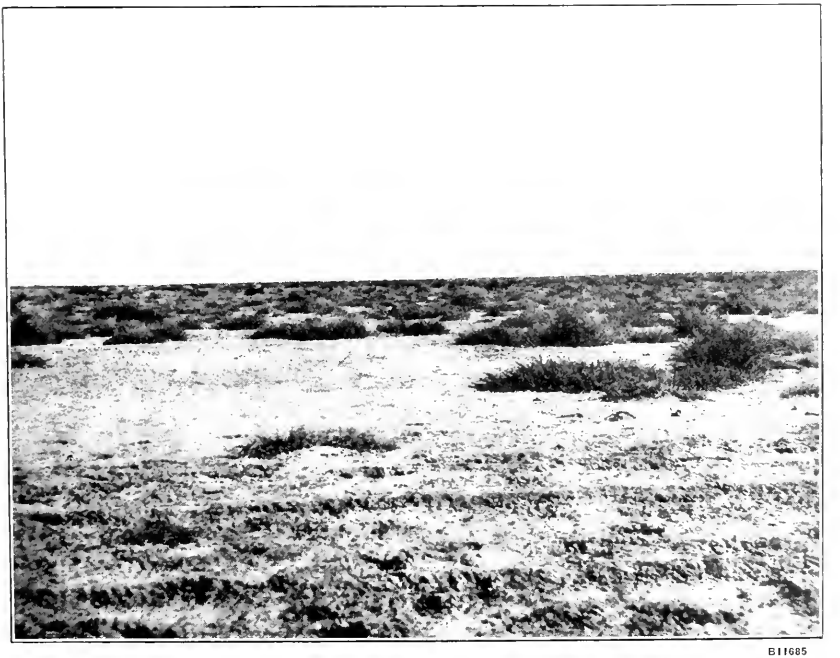

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FIG. 2.—DESERT VEGETATION, RED DESERT, SOUTH OF THE FERRIS MOUNTAINS.

Chiefly saltbush (*Atriplex nuttalli*).

B11621

FIG. 1.—YELLOW PINE FOREST NEAR SPRINGHILL, NORTHERN BASE OF LARAMIE PEAK (6,500 FEET).

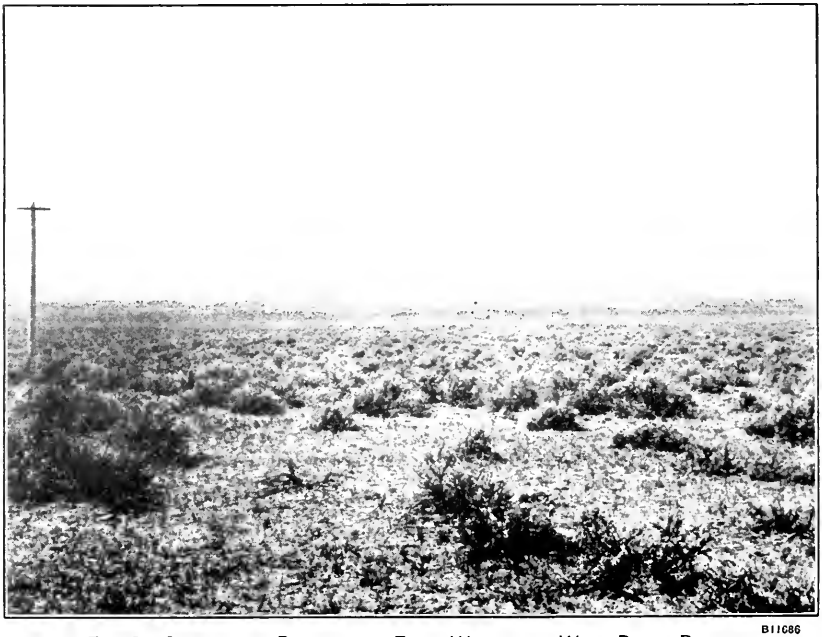

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FIG. 2.—SAGEBRUSH PLAIN NEAR FORT WASHAKIE, WIND RIVER BASIN.

plants.[1] Species which in Wyoming best mark the Upper Sonoran Zone throughout,[2] or in restricted areas of its Great Plains or Great

B11721

FIG. 2.—Irrigation canal traversing original sage plain on bench north of Burlington, in the Bighorn Basin.

Basin subdivisions, are included in the following lists. Many species of wide zonal dispersion occur commonly in the Upper Sonoran Zone in Wyoming, but as these give no definition to the zone they are not listed.

MAMMALS—UPPER SONORAN ZONE.

[Species marked *T.* occur also in the Transition Zone.]

Antilocapra americana americana, Antelope. *T.*

Eutamias pallidus pallidus, Pale Chipmunk. *T.*

Eutamias minimus minimus, Least Chipmunk.

Eutamias minimus pictus, Sagebrush Chipmunk.

Eutamias dorsalis utahensis, Utah Rock Chipmunk.

Callospermophilus lateralis wortmani, Wortman Mantled Ground Squirrel. *T.*

Citellus obsoletus, Kennicott Ground Squirrel.

Citellus tridecemlineatus pallidus, Pale Striped Ground Squirrel.

Citellus tridecemlineatus parvus, Small Striped Ground Squirrel.

Cynomys ludovicianus ludovicianus, Black-tailed Prairie-dog.

Onychomys leucogaster arcticeps, Great Plains Grasshopper Mouse.

Peromyscus maniculatus osgoodi, Black-eared White-footed Mouse. *T.*

Peromyscus maniculatus nebrascensis, Yellow White-footed Mouse.

Peromyscus crinitus auripectus, Golden-breasted Canyon Mouse.

Peromyscus truei truei, True's Cliff Mouse.

Reithrodontomys megalotis dychei, Prairie Harvest Mouse.

[1] Species of insects and other groups might be equally useful in the determination of zones if their ranges were better known.

[2] See frontispiece (map).

MAMMALS—UPPER SONORAN ZONE—Continued.

Neotoma cinerea orolestes, Colorado Bushy-tailed Wood Rat. *T.*
Microtus ochrogaster haydeni, Hayden Field Mouse.
Fiber zibethicus cinnamominus, Great Plains Muskrat. *T.*
Geomys lutescens, Yellow Pocket Gopher.
Thomomys ocius, Green River Pocket Gopher.
Thomomys talpoides bullatus, Sage Pocket Gopher.
Perodipus ordii luteolus, Wyoming Kangaroo Rat.
Perognathus hispidus paradoxus, Kansas Pocket Mouse.
Perognathus fasciatus fasciatus, Maximilian Pocket Mouse. *T.*
Perognathus fasciatus litus, Sweetwater Pocket Mouse.
Perognathus flavus piperi, Cheyenne Pocket Mouse.
Perognathus callistus, Red Desert Pocket Mouse.
Lepus californicus melanotis, Black-tailed Jack Rabbit.
Sylvilagus auduboni baileyi, Bailey Cottontail.
Sylvilagus floridanus similis, Nebraska Cottontail.
Canis nebracensis, Plains Coyote. *T.*
Vulpes velox velox, Kit Fox, Swift. *T.*
Procyon lotor lotor, Raccoon. *T.*
Taxidea taxus taxus, Badger. *T.*
Spilogale gracilis saxatilis, Great Basin Spotted Skunk.
Mustela nigripes, Black-footed Ferret.
Scalopus aquaticus caryi, Northern Plains Mole.
Myotis californicus californicus, California Bat.
Myotis evotis, Long-eared Bat.
Myotis longicrus interior, Long-legged Bat. *T.*
Eptesicus fuscus fuscus, Brown Bat. *T.*

BREEDING BIRDS—UPPER SONORAN ZONE.

[Species marked *T.* breed also in the Transition Zone.]

Querquedula discors, Blue-winged Teal. *T.*
Querquedula cyanoptera, Cinnamon Teal. *T.*
Botaurus lentiginosus, Bittern. *T.*
Ardea herodias, Great Blue Heron. *T.*
Nycticorax nycticorax navius, Black-crowned Night Heron. *T.*
Rallus virginianus, Virginia Rail.[1]
Porzana carolina, Carolina Rail, Sora. *T.*
Fulica americana, Coot. *T.*
Bartramia longicauda, Upland Plover. *T.*
Numenius americanus, Long-billed Curlew. *T.*
Zenaidura macroura carolinensis, Mourning Dove.
Archibuteo ferrugineus, Ferruginous Rough-legged Hawk. *T.*
Speotyto cunicularia hypugæa, Burrowing Owl.
Chordeiles virginianus henryi, Western Nighthawk. *T.*
Tyrannus tyrannus, Kingbird. *T.*
Tyrannus verticalis, Arkansas Kingbird.
Tyrannus vociferans, Cassin Kingbird.
Corvus brachyrhynchos hesperis, Western Crow. *T.*
Cyanocephalus cyanocephalus, Pinyon Jay.
Xanthocephalus xanthocephalus, Yellow-headed Blackbird. *T.*
Agelaius phœniceus fortis, Thick-billed Redwing. *T.*
Sturnella neglecta, Western Meadowlark. *T.*
Icterus bullocki, Bullock Oriole.
Quiscalus quiscula aneus, Bronzed Grackle.
Carpodacus mexicanus frontalis, House Finch.
Ammodramus savannarum bimaculatus, Western Grasshopper Sparrow.
Chondestes grammacus strigatus, Western Lark Sparrow.
Spizella breweri, Brewer Sparrow. *T.*

[1] Observed during breeding season.

BREEDING BIRDS—UPPER SONORAN ZONE—Continued.

Amphispiza nevadensis, Sage Sparrow.
Passerina amœna, Lazuli Bunting.
Spiza americana, Dickcissel.
Calamospiza melanocorys, Lark Bunting. *T.*
Lanius ludovicianus excubitorides, White-rumped Shrike. *T.*
Dendroica æstiva æstiva, Yellow Warbler. *T.*
Geothlypis trichas occidentalis, Western Yellow-throat. *T.*
Icteria virens longicauda, Long-tailed Chat.
Oreoscoptes montanus, Sage Thrasher. *T.*
Mimus polyglottos leucopterus, Western Mockingbird.
Dumetella carolinensis, Catbird.
Toxostoma rufum, Brown Thrasher.
Thryomanes bewicki bairdi, Baird Wren.[1]
Telmatodytes palustris plesius, Western Marsh Wren.
Baeolophus inornatus griseus, Gray Titmouse.[1]
Psaltriparus plumbeus, Lead-colored Bush-tit.[1]
Polioptila cærulea obscura, Western Gnatcatcher.[1]

REPTILES—UPPER SONORAN ZONE.

[Species marked *T.* occur also in the Transition Zone.]

Lizards.

Holbrookia maculata, Sand Swift.
Uta stansburiana, Stansbury Lizard.
Sceloporus consobrinus, Scaly Lizard.
Sceloporus graciosus, Scaly Rock Lizard.
Phrynosoma ornatissimum, Desert Short-horned Lizard. *T.*
Cnemidophorus sexlineatus, Six-lined Lizard.
Eumeces multivirgatus, Many-lined Skink.

Snakes.

Thamnophis sirtalis parietalis, Red-barred Garter Snake. *T.*
Thamnophis radix, Garter Snake. *T.*
Bascanion constrictor, Blue Racer.
Pituophis sayi, Prairie Bull Snake.
Liopeltis vernalis, Smooth Green Snake. *T.*
Heterodon nasicus, Hog-nosed Snake.
Crotalus confluentus, Plains Rattlesnake.

AMPHIBIANS—UPPER SONORAN ZONE.

[Species marked *T.* occur also in the Transition Zone.]

Toads and frogs.

Scaphiopus hammondi bombifrons, Spadefoot Toad.
Bufo lentiginosus woodhousei, Toad. *T.*
Bufo cognatus, Toad.
Rana pipiens, Leopard Frog. *T.*

Salamanders.

Ambystoma tigrinum, Tiger Salamander. *T.*

[1] Probably breeds.

PLANTS—UPPER SONORAN ZONE.

[Species marked *T.* occur also in the Transition Zone.]

Trees and shrubs.

Pinus edulis, Pinyon, Nut Pine.
Juniperus knightii, Desert Juniper.
Juniperus monosperma, One-seeded Juniper.
Populus occidentalis, Broad-leaved Cottonwood.
Populus acuminata, Lance-leaved Cottonwood.
Salix amygdaloides, Peach-leaved Willow.
Salix fluviatilis, Sand-bar Willow.
Ulmus americana,[1] Elm. *T.*
Acer negundo, Box Elder. *T.*
Fraxinus lanceolata, Ash. *T.*
Cercocarpus parvifolius, Mountain Mahogany. *T.*
Sarcobatus vermiculatus, Greasewood.
Atriplex canescens, Saltbush, Gray Shadscale.
Atriplex confertifolia, Spiny Saltbush.
Atriplex nuttalli, Nuttall Saltbush.
Atriplex pabularis, Nelson Saltbush.
Atriplex argentea, Silvery Saltbush.
Eurotia lanata, White Sage, Winter Fat.
Grayia spinosa, Grayia.
Kochia americana, Kochia, White Sage.
Philadelphus occidentalis, Western Syringa.
Ribes longiflorum, Flowering Currant.
Prunus americana, Wild Plum. *T.*
Prunus besseyi, Sand Cherry.
Amorpha canescens, False Indigo, Shoestring. *T.*
Amorpha nana, False Indigo.
Schmaltzia trilobata, Skunk Bush.
Schmaltzia glabra, Smooth Sumac. *T.*
Rhus rydbergi, Western Poison Ivy. *T.*
Vitis vulpina, Wild Grape. *T.*
Parthenocissus vitacea, Virginia Creeper. *T.*
Lepargyrea argentea, Buffaloberry. *T.*
Symphoricarpos occidentalis, Wolfberry. *T.*
Gutierrezia sarothræ, Rabbit Brush.
Chrysothamnus graveolens, Rabbit Brush.
Chrysothamnus plattensis, Rabbit Brush.
Chrysothamnus linifolius, Rabbit Brush.
Chrysothamnus stenophyllus, Rabbit Brush.
Tetradymia inermis, Rabbit Brush.
Tetradymia spinosa, Rabbit Brush.
Tetradymia nuttalli, Rabbit Brush.
Artemisia filifolia, Narrow-leaved Sagebrush.
Artemisia spinescens, Spiny Sagebrush, Budbrush.
Artemisia pedatifida, Small Brown Sagebrush.
Artemisia tridentata, Black Sagebrush. *T.*

Herbaceous plants.

Tradescantia occidentalis, Spiderwort.
Yucca glauca, Plains Yucca.
Eriogonum effusum, Eriogonum.
Eriogonum annuum, Eriogonum.
Eriogonum campanulatum, Eriogonum.
Eriogonum corymbosum, Eriogonum.
Eriogonum multiceps, Eriogonum.
Rumex venosus, Sand Dock.
Suæda diffusa, Sea Blite.
Suæda moquini, Shrubby Blite.
Endolepsis suckleyana.
Salicornia rubra, Glasswort. *T.*
Abronia fragrans.
Abronia elliptica.
Argemone intermedia, Prickly Poppy.
Argemone hispida, Prickly Poppy.
Stanleya tomentosa, Stanleya.
Stanleya integrifolia, Stanleya.
Cleome lutea, Yellow Cleome.
Cleome serrulata, Red Cleome, Honey Plant.
Polanisia trachysperma, Clammy-weed.
Lupinus plattensis, Lupine.
Lupinus pusillus, Small Lupine.

[1] Northeast Wyoming only.

PLANTS—UPPER SONORAN ZONE—Continued.

Herbaceous plants—Continued.

Astragalus crassicarpus, Buffalo Bean, Ground Plum.
Astragalus mollissimus, Milk Vetch.
Astragalus missouriensis, Milk Vetch.
Glycyrrhiza lepidota, Wild Licorice. *T.*
Psoralea tenuiflora, Psoralea.
Psoralea linearifolia, Narrow-leaved Psoralea.
Psoralea lanceolata, Psoralea.
Psoralea hypogea, Psoralea.
Psoralea esculenta, Psoralea.
Parosela enneandra, Dalea.
Petalostemon oligophyllus, White Prairie Clover.
Petalostemon candidus, Prairie Clover.
Petalostemon purpureus, Purple Prairie Clover.
Petalostemon villosus, Silky Prairie Clover.
Lathyrus ornatus, Wild Pea, Vetchling.
Linum rigidum, Wild Flax.
Euphorbia marginata, Snow-on-the-mountain.
Croton texensis, Croton.
Malvastrum coccineum, False Mallow.
Malvastrum dissectum, False Mallow.
Mentzelia decapetala, Loasa.
Mentzelia nuda, Loasa.
Mentzelia albicaulis, Loasa.
Mentzelia laricaulis. Yellow Loasa. *T.*
Mamillaria missouriensis, Ball Cactus. *T.*
Mamillaria vivipara, Ball Cactus.
Echinocereus viridiflorus, Green-flowered Petaya. *T.*
Opuntia polyacantha, Prickly Pear.
Opuntia rutila, Prickly Pear.
Anogra albicaulis, White Evening Primrose.
Galpinsia lavandulaefolia.
Meriolix serrulata.
Gaura coccinea.
Asclepias speciosa, Milkweed.
Asclepias pumila, Milkweed.
Ipomaea leptophylla, Bush Morning-glory.
Gilia polycladon.
Lithospermum angustifolium, Gromwell. *T.*
Lithospermum gmelini, Gromwell.
Orcocarya flava.
Lippia cuneifolia.
Verbena hastata, Blue Vervain.
Verbena bracteosa, Low Vervain.
Physalis lanceolata, Ground Cherry.
Solanum rostratum, Buffalo Bur.
Pentstemon albidus, Beard-tongue.
Pentstemon angustifolius, Beard-tongue.
Plantago purshi, Plantain.
Liatris punctata, Blazing Star.
Grindelia squarrosa, Gum Plant.
Sideranthus spinulosus.
Solidago mollis, Goldenrod.
Solidago canadensis gilrocanescens, Goldenrod.
Solidago rigida, Goldenrod.
Ratibida columnaris, Cone Flower.
Helianthus annuus, Sunflower.
Helianthus petiolaris, Sunflower.
Hymenopappus filifolius.
Carduus plattensis, Thistle.
Malacothrix sonchoides.
Lygodesmia juncea.
Lygodesmia rostrata.

Grasses.

Andropogon scoparius, Bluestem.
Andropogon halli, Bluestem.
Panicum virgatum, Panic Grass.
Aristida longiseta, Wire Grass. *T.*
Stipa comata, Feather Grass.
Stipa viridula, Feather Grass. *T.*
Oryzopsis micrantha, Rice Grass.
Eriocoma cuspidata, Indian Millet.
Muhlenbergia pungens, Dropseed Grass.
Sporobolus airoides, Fine-top Salt Grass.
Sporobolus cryptandrus, Bunch Grass.
Calamovilfa longifolia, Reed Grass, Sand Grass.
Schedonnardus paniculatus, Crab Grass.

PLANTS—UPPER SONORAN ZONE—Continued.

Grasses—Continued.

Spartina gracilis, Marsh Grass.
Bouteloua oligostachya, Grama Grass. *T.*
Bouteloua hirsuta, Grama Grass.
Atheropogon curtipendula, Tall Grama. *T.*
Bulbilis dactyloides, Buffalo Grass.
Munroa squarrosa, False Buffalo Grass.
Eatonia obtusata.
Distichlis spicata, Salt Grass.
Poa fendleriana, Spear Grass. *T.*
Poa sheldoni, Spear Grass. *T.*
Festuca octoflora, Fescue Grass.
Agropyron spicatum, Wheat Grass.
Agropyron smithi, Wheat Grass. *T.*
Sitanion longifolium, Long-bearded Rye Grass. *T.*
Sitanion hystrix. *T.*
Elymus canadensis, Wild Rye. *T.*
Elymus condensutus, Giant Rye Grass. *T.*
Elymus salinus, Desert Rye Grass.

Agricultural Utility of the Upper Sonoran Zone.

The growing of hay and forage crops as supplemental to stock raising and a limited planting of cereals and vegetables for ranch use long constituted the chief agricultural endeavors in even the most favored sections of Wyoming. The establishment of agriculture as a separate industry in this arid region is comparatively recent, the result of greatly increased irrigation facilities and of more efficient methods of conserving the rainfall in the less arid dry-farming districts.

The Upper Sonoran areas of Wyoming lie mainly in the upper and cooler parts of the zone and are therefore climatically unsuited to a variety of tender crops, and especially fruits, which are successfully grown elsewhere in its lower and warmer portions. They are proving well adapted, however, to most of the standard varieties of wheat, oats, rye, emmer, and other cereals, which yield abundantly under irrigation and moderately under dry farming. None but the early varieties of corn mature, and these are raised to a small extent only in the warmest parts, as in the lower Platte and Bighorn Valleys. Alfalfa, the staple forage crop, produces regularly two and at the lowest elevations often three or even four crops a year. Sugar beets are raised extensively in the Bighorn Basin, the lower Platte Valley, and near Wheatland. The sugar content of Wyoming beets is high, and with the construction of local sugar factories this crop should become one of the most important and profitable. Potatoes yield abundantly and are well adapted to the dry-farming districts along the eastern edge of the State, where they are produced on a large scale. Vegetables of most sorts thrive under irrigation, and trucking is profitably carried on in many valleys. The tender sorts usually succeed in the warmest localities, but can not be raised generally, because of the short growing season.

Fruit growing has been attempted on a commercial scale mainly the Bighorn Basin, near Lander, and in the Wheatland district, ıere many of the hardier varieties of apples, cherries, and plums, well as the small fruits, raspberries, strawberries, grapes, currants, oseberries, and dewberries, are moderately successful under irri- tion. Even in these sheltered and favored districts the physical d climatic conditions are so localized that successful horticulture ll perforce be limited to comparatively small areas where there is ıple protection and the greatest freedom from the destructive late osts, which kill so much of the fruit blossom in this zone through- t the Rocky Mountain region. Late-flowering and frost-resistant rieties succeed best.

TRANSITION ZONE.

Fully half of Wyoming, or about 50,000 square miles, is in the ansition Zone, the zone intermediate between the Boreal and Aus- al regions, which is here in its greater part open and treeless, and us less conspicuously characterized than in the southern Rocky Mountain region, where it is very generally marked by extensive for- ests of yellow pine. In Wyoming the zone comprises, broadly, vast interior sagebrush plains (see Pl. V, fig. 2) and watersheds, plateaus, and high-altitude basins in the central and southwest sections; and elevated grassy plains to the east and southeast. It also includes all except the higher summits of the pine-clad foothill ranges in the eastern part of the State, and the open basal sagebrush slopes of the high mountain ranges farther west. In greater detail,[1] the Transition Zone in Wyoming embraces the following important areas:

The Cheyenne Plains above 5,500 feet elevation; Lusk Plains above 5,000 feet; all of the Laramie Plains and Shirley Basin; upper valley of the North Platte above 6,500 feet; upper Green River Basin, Bear River region, and extensive tracts on the borders of the Red Desert above 6,500 feet; sage plains between Casper and Lander above 6,000 feet; Wind River Valley above 6,000 feet; mainly open borders of the Bighorn Basin, 5,500 to 7,000 or 7,500 feet; all open or partly timbered watersheds between the Bighorn and Bear Lodge Mountains above 4,500 feet; basal and middle slopes of Bear Lodge Mountains and northern Black Hills, 4,000 to 5,500 feet; and southern Black Hills region, 4,500 to 6,000 feet. Limited areas in Jackson Hole and Salt River Valley are eastward continuations of the Snake River Transition Zone, and narrow strips of the zone enter Yellowstone Park for a short distance along the Yellowstone,

[1] See zone map (frontispiece).

penetrating the valleys of the Gardiner, Lamar, and other tributa and also along the Gallatin, Madison, and Fall River valleys.

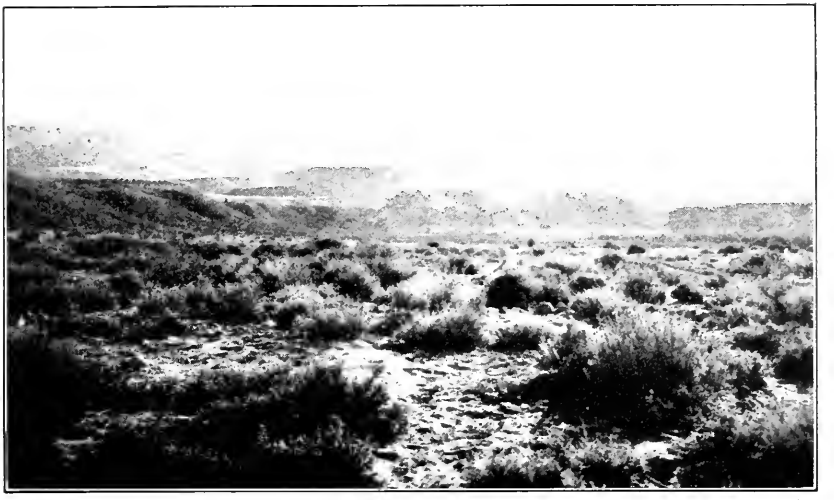
The foregoing well illustrates the effect of both base level latitude on the vertical position of the Transition Zone. A level of over 6,000 feet in the southwest elevates the zone i of the region contiguous to the Red Desert and Green River V to between 7,000 and 8,500 feet on warmest (southwest) slope 6,000 to 7,500 feet on coldest (northeast) slopes. In extreme eastern Wyoming, adjacent to the low-altitude northern Plains, the zone level attains only 4,500 to 6,000 feet on sou slopes and 4,000 to 5,500 feet on northeast slopes.[1] Much 2,000-foot variation in zone level results from difference in elevation, while probably 800 feet is normal depression in the east due to higher latitude. Locally, mountain slopes of unus exposure and warmth carry zones abnormally high, and if very steep and abrupt the horizontal contraction is also very marked. This is well shown in the Transition belt on the abrupt, hot, southwest slopes of the Bighorn Mountains east of Greybull and Ionia. Varied physical conditions, and, to a certain extent, deforestation, affect both the elevation and the horizontal as well as the vertical width of life zones, especially in mountainous districts. In the main, however, the Transition Zone is maintained in fairly uniform elevation and width along the bases of the Wyoming ranges.

Characteristic Species—Transition Zone.

The Transition Zone in Wyoming is conspicuously marked only along its upper border, where mostly open sage slopes give way to the aspen and coniferous forest belt of the Canadian Zone. Inconspicuous vegetation is characteristic of the lower part on the open plains, where the zonal position is further indicated by either the absence or a marked paucity of Sonoran species. As elsewhere in the Rocky Mountain region, its fauna and flora are fairly constant throughout, but include many species, both Boreal and Austral, from the adjoining zones.

Sagebrush, yellow pine, and grasses are prominent types of vegetation in the Wyoming Transition area. The sagebrush (Pl. VI), the most widely distributed shrub, usually occurs in pure growth, while the yellow pines are restricted largely to the lower mountains, foothills, and rough tracts in the eastern half of the State. Considerable Douglas spruce and scattering Rocky Mountain white pines

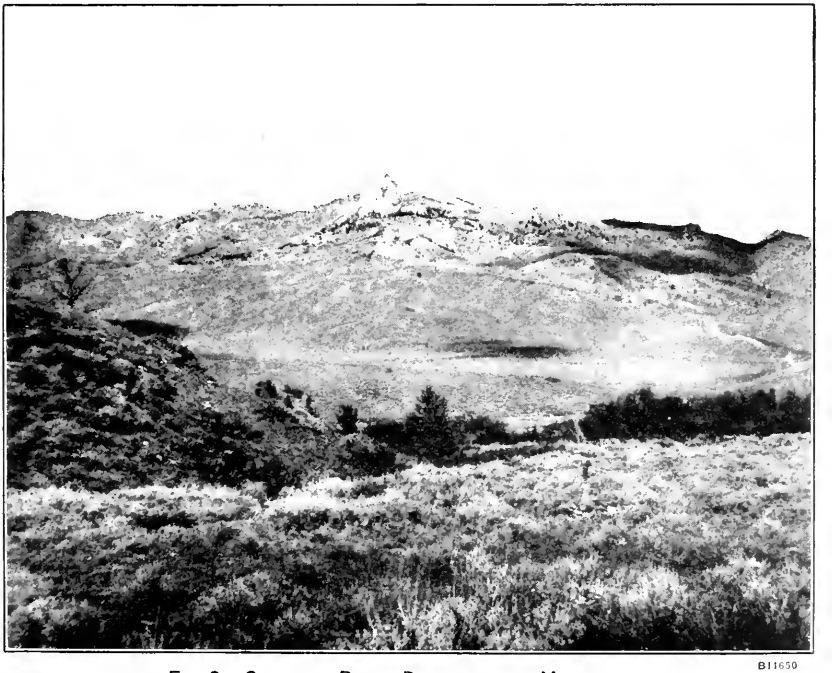
[1] On exposed slopes of mountains the difference in zone level on the warm and cold sides is usually as much as 1,000 feet. So much variation is not found in the low hill country of northeastern Wyoming.



B11701

FIG. 1.—SAGEBRUSH IN WIND RIVER VALLEY.

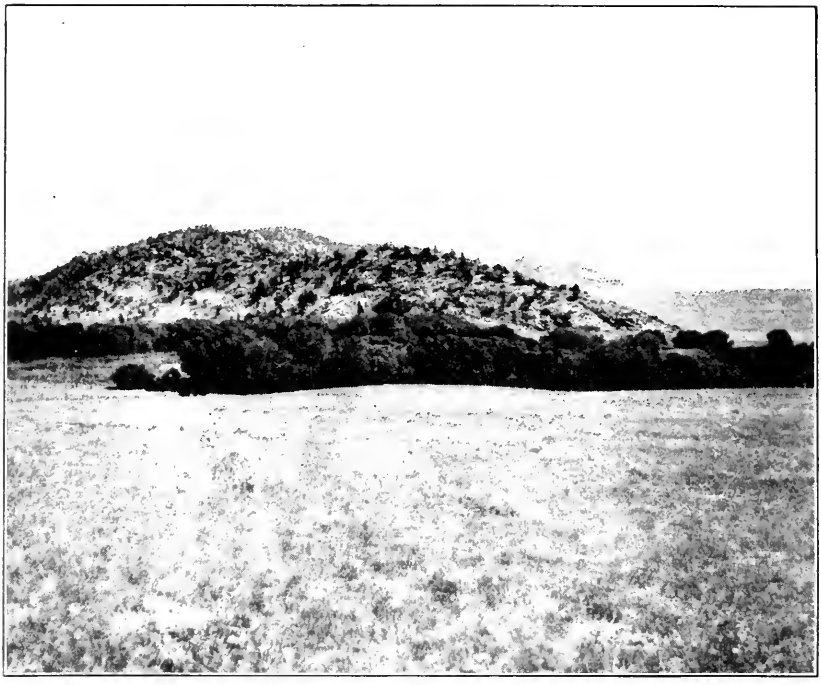
Lower part of Transition Zone, near Circle.



B11650

FIG. 2.—GARFIELD PEAK, RATTLESNAKE MOUNTAINS.

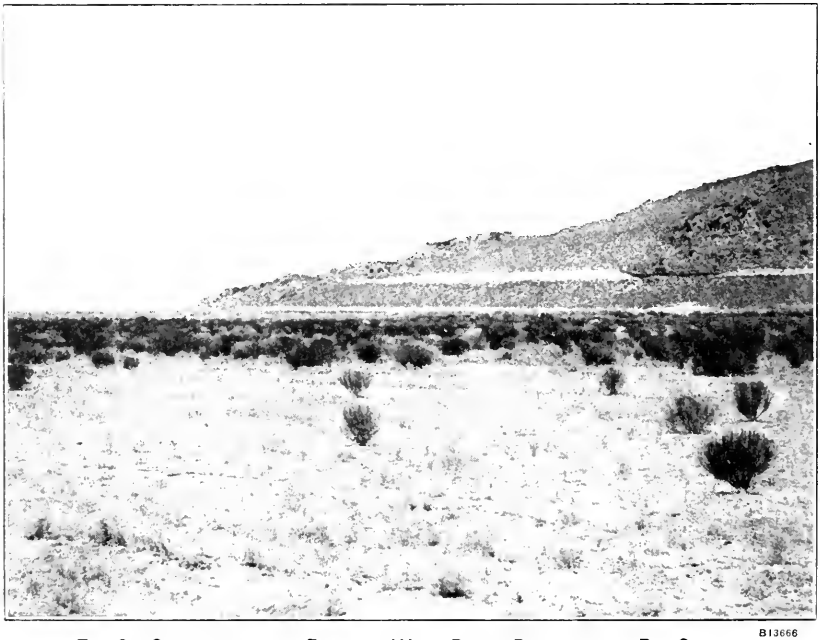
Sagebrush covers much of this barren 8,000 to 9,000 foot range.



B11619

FIG. 1.—RAWHIDE BUTTE, LOWER BORDER OF TRANSITION ZONE, AT EDGE OF GREAT PLAINS.

Narrow-leaved cottonwoods on Rawhide Creek, southern base of the butte, and yellow pines on hills (5,000 feet).



B13666

FIG. 2.—SOUTHWESTERN BASE OF WIND RIVER RANGE NEAR BIG SANDY.

Rabbit brush (*Chrysothamnus* and *Tetradymia inermis*) on the plain (7,500 feet).

occur in this zone in the mountains of western Wyoming, and the bur oak is a common tree on the Bear Lodge Mountains and elsewhere in northern Crook County. On streams along the bases of the mountains generally the zone is marked by narrow-leaved cottonwood (Pl. VII, fig. 1), diamond willow, and usually by a dense shrubbery of Rocky Mountain birch, black and red haws, cornel, wild gooseberry and currant, serviceberry, and silverberry; on foothill and lower mountain slopes both in the forest as undershrubs and in the open, by Rocky Mountain and creeping junipers, Bebb willow, barberry, wild red currant, mountain mahogany, kunzia, ninebark, wild cherry, mountain and large-toothed maples, mountain balm, bearberry, mountain snowberry, and several high plains species of sagebrush and rabbit brush (Pl. VII, fig. 2); and throughout by a great many herbaceous plants.

A considerable number of birds of both general and restricted breeding range within the zone characterize this area in Wyoming during the nesting season. Representative species are the sage hen, sharp-shinned hawk, saw-whet owl, Lewis woodpecker, white-throated swift, Wright flycatcher, magpie, pinyon jay, McCown longspur, white-winged junco, mountain song sparrow, arctic and green-tailed towhees, western tanager, plumbeous vireo, Macgillivray warbler, Rocky Mountain and pygmy nuthatches, and willow thrush.

Mammals wholly or chiefly restricted to the Transition Zone in different parts of Wyoming include the plains white-tailed deer; Black Hills red squirrel; Wyoming and Uinta ground squirrels; white-tailed prairie-dog; bushy-tailed wood rat; pygmy and Uinta field mice; Coues, Black Hills, Fort Bridger, and pygmy pocket gophers; Uinta pocket mouse; prairie jumping mouse; white-tailed jack rabbit; Black Hills cottontail; northern plains skunk; and long-legged bat.

The following reptiles and amphibians are apparently more abundant in the Transition than in the Upper Sonoran Zone in Wyoming: Western garter snake (*Thamnophis ordinoides vagrans*), a toad (*Bufo boreas*), and a frog (*Rana pretiosus*). Others of regular occurrence in at least the lower part of the zone include the horned lizard (*Phrynosoma ornatissimum*), scaly rock lizard (*Sceloporus graciosus*), garter snakes (*Thamnophis sirtalis parietalis* and *T. radix*), smooth green snake (*Liopeltis vernalis*), western toad (*Bufo lentiginosus woodhousei*), frogs (*Rana pipiens* and *Chorophilus triseriatus*), and tiger salamander (*Ambystoma tigrinum*).

MAMMALS—TRANSITION ZONE.

[Species marked *U.* occur also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Cervus canadensis canadensis, Elk. *C.*
Odocoileus virginianus macrourus, Plains White-tailed Deer.
Odocoileus hemionus hemionus, Mule Deer. *U.*, *C.*
Ovis canadensis auduboni, Bad Lands Sheep.[1] *U.*
Sciurus hudsonicus dakotensis, Black Hills Red Squirrel.
Glaucomys sabrinus canescens, Flying Squirrel.
Callospermophilus lateralis lateralis, Say Ground Squirrel. *C.*
Callospermophilus lateralis wortmani, Wortman Ground Squirrel. *U.*
Citellus richardsoni elegans, Wyoming Ground Squirrel. *U.*
Citellus armatus, Uinta Ground Squirrel. *C.*
Cynomys leucurus, White-tailed Prairie-dog. *U.*
Onychomys leucogaster brevicaudus, Idaho Grasshopper Mouse. *U.*
Onychomys leucogaster missouriensis, Northern Grasshopper Mouse. *U.*
Peromyscus leucopus aridulus, White-footed Mouse.
Neotoma cinerea cinerea, Bushy-tailed Wood Rat.
Neotoma cinerea orolestes, Colorado Bushy-tailed Wood Rat. *U.*
Microtus pennsylvanicus modestus, Saguache Meadow Mouse. *U.*
Microtus montanus caryi, Uinta Meadow Mouse.
Microtus pauperrimus, Pygmy Field Mouse.
Fiber zibethicus osoyoosensis, Rocky Mountain Muskrat. *C.*
Castor canadensis, Beaver. *C.*
Thomomys talpoides nebulosus, Black Hills Pocket Gopher. *C.*
Thomomys talpoides clusius, Coues Pocket Gopher.
Thomomys bridgeri, Fort Bridger Pocket Gopher.
Thomomys pygmæus, Pygmy Pocket Gopher.
Perognathus parvus clarus, Uinta Pocket Mouse.
Zapus hudsonius campestris, Prairie Jumping Mouse.
Erethizon epixanthum, Yellow-haired Porcupine. *C.*
Lepus townsendi campanius, White-tailed Jack Rabbit.
Lepus townsendi townsendi, Western White-tailed Jack Rabbit.
Sylvilagus nuttalli grangeri, Black Hills Cottontail.
Felis hippolestes, Mountain Lion. *C.*
Lynx uinta, Mountain Wildcat.
Canis nubilus, Buffalo Wolf. *U.*
Canis lestes, Mountain Coyote.
Taxidea taxus taxus, Badger. *U.*
Spilogale tenuis, Rocky Mountain Spotted Skunk.
Mephitis hudsonica, Northern Plains Skunk.
Mustela arizonensis, Arizona Weasel. *C.*
Mustela vison energumenos, Mink. *C.*
Ursus horribilis, Grizzly Bear.
Corynorhinus macrotis pallescens, Big-eared Bat. *U.*
Myotis longicrus interior, Long-legged Bat. *U.*

BREEDING BIRDS—TRANSITION ZONE.

[Species marked *U.* breed also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Colymbus nigricollis californicus, American Eared Grebe. *U.*
Anas platyrynchos, Mallard. *U.*
Chaulelasmus streperus, Gadwall. *U.*
Nettion carolinense, Green-winged Teal.
Steganopus tricolor, Wilson Phalarope. *U.*
Recurvirostra americana, Avocet. *U.*
Gallinago delicata, Wilson Snipe. *C.*
Catoptrophorus semipalmatus inornatus, Western Willet.

[1] Apparently nearing extinction.

BREEDING BIRDS—TRANSITION ZONE—Continued.

Podasocys montanus, Mountain Plover. *U.*
Pediœcetes phasianellus columbianus, Columbian Sharp-tailed Grouse.
Centrocercus urophasianus, Sage Hen.
Accipiter velox, Sharp-shinned Hawk. *C.*
Accipiter cooperi, Cooper Hawk.
Buteo swainsoni, Swainson Hawk.
Cryptoglaux acadica, Saw-whet Owl.
Otus asio maxwelliæ, Rocky Mountain Screech Owl. *U.*
Asio wilsonianus, Long-eared Owl.
Coccyzus erythropthalmus, Black-billed Cuckoo. *U.*[1]
Dryobates villosus monticola, Rocky Mountain Hairy Woodpecker. *C.*
Dryobates pubescens homorus, Batchelder Woodpecker.
Melanerpes erythrocephalus, Red-headed Woodpecker. *U.*
Asyndesmus lewisi, Lewis Woodpecker.
Phalænoptilus nuttalli nuttalli, Poorwill. *U.*
Aëronautes melanoleucus, White-throated Swift. *U.*
Stellula calliope, Calliope Hummingbird.[2]
Sayornis sayus, Say Phœbe. *U.*
Myiochanes richardsoni, Western Wood Pewee.
Empidonax minimus, Least Flycatcher.
Empidonax wrighti, Wright Flycatcher.
Empidonax hammondi, Hammond Flycatcher. *C.*
Otocoris alpestris leucolæma, Desert Horned Lark. *U.*
Pica pica hudsonia, Magpie.
Cyanocephalus cyanocephalus, Pinyon Jay. *U.*
Dolichonyx oryzivorus, Bobolink. *U.*
Euphagus cyanocephalus, Brewer Blackbird. *U.*
Calcarius ornatus, Chestnut-collared Longspur. *U.*
Rhynchophanes mccowni, McCown Longspur.
Poœcetes gramineus confinis, Western Vesper Sparrow. *U.*
Passerculus sandwichensis alaudinus, Western Savannah Sparrow. *U.*
Spizella passerina arizonæ, Western Chipping Sparrow.
Spizella breweri, Brewer Sparrow. *U.*
Junco aikeni, White-winged Junco.
Melospiza melodia montana, Mountain Song Sparrow.
Passerella iliaca schistacea, Slate-colored Fox Sparrow.
Pipilo maculatus arcticus, Arctic Towhee.
Oreospiza chlorura, Green-tailed Towhee.
Zamelodia melanocephala, Black-headed Grosbeak. *U.*
Piranga ludoviciana, Western Tanager.
Tachycineta thalassina lepida, Northern Violet-green Swallow. *C.*
Vireosylva gilva swainsoni, Western Warbling Vireo.
Lanivireo solitarius plumbeus, Plumbeous Vireo.
Dendroica auduboni, Audubon Warbler. *C.*
Dendroica nigrescens, Black-throated Gray Warbler.[3]
Seiurus aurocapillus, Oven-bird. *C.*
Oporornis tolmiei, Macgillivray Warbler. *C.*
Oreoscoptes montanus, Sage Thrasher. *U.*
Salpinctes obsoletus, Rock Wren. *U.*
Troglodytes ædon parkmani, Western House Wren. *U.*
Sitta carolinensis nelsoni, Rocky Mountain Nuthatch.
Sitta pygmæa, Pygmy Nuthatch.
Penthestes atricapillus septentrionalis, Long-tailed Chickadee. *U.*
Hylocichla fuscescens salicicola, Willow Thrush.
Planesticus migratorius propinquus, Western Robin. *C.*
Sialia currucoides, Mountain Bluebird. *C.*

[1] Observed during breeding season.
[2] Taken during breeding season.
[3] Probably breeds.

PLANTS—TRANSITION ZONE.

[Species marked *U.* occur also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Trees and shrubs.

Pinus scopulorum, Yellow Pine, Rock Pine.
Juniperus scopulorum, Rocky Mountain Juniper. *U.*
Juniperus sabina, Creeping Juniper, Trailing Savin.
Populus angustifolia, Narrow-leaved Cottonwood.
Salix bebbiana, Bebb Willow. *C.*
Salix cordata watsoni, Diamond Willow. *U.*
Salix mackenziana, Diamond Willow.
Salix scouleriana, Willow.
Betula fontinalis, Rocky Mountain Birch.
Quercus macrocarpa, Bur Oak.
Berberis aquifolium, Barberry, Oregon Grape.
Grossularia inermis, Gooseberry.
Ribes inebrians, Red Currant.
Ribes americanum, Currant.
Edwinia americana.
Cercocarpus ledifolius, Mountain Mahogany.
Cercocarpus intricatus, Mountain Mahogany.
Cercocarpus parvifolius, Mountain Mahogany. *U.*
Kunzia tridentata.
Holodiscus dumosus.
Opulaster monogynus, Ninebark.
Opulaster pubescens, Ninebark.
Opulaster malvaceus, Ninebark.
Rubus deliciosus, Flowering Raspberry.
Aclanchier alnifolia, Serviceberry.
Aclanchier elliptica, Serviceberry.
Aclanchier orcophila, Serviceberry.
Ataegus rivularis, Black Hawthorn.
Ataegus cerronis, Hawthorn.
Crataegus sheridana, Red Hawthorn.
Prunus melanocarpa, Chokecherry.
Prunus pennsylvanica, Wild Red Cherry. *C.*
Acer glabrum, Mountain Maple. *C.*
Acer grandidentatum, Large-toothed Maple.
Ceanothus velutinus, Mountain Balm.
Ceanothus fendleri, Wild Tea Bush.
Ceanothus mollissimus.
Elaeagnus argentea, Silverberry.
Cornus stolonifera, Cornel.
Cornus instolonea, Cornel.
Arctostaphylos uva-ursi, Bearberry.
Sambucus canadensis, Elderberry.
Sambucus melanocarpa, Mountain Black Elderberry. *C.*
Viburnum lentago, Sweet Viburnum.
Symphoricarpos rotundifolius, Snowberry.
Symphoricarpos orcophilus, Mountain Snowberry.
Symphoricarpos pauciflorus, Snowberry.
Lonicera glaucescens, Douglas Honeysuckle.
Chrysothamnus wyomingensis, Rabbit Brush.
Chrysothamnus pulcherrimus, Rabbit Brush.
Chrysothamnus parryi, Rabbit Brush.
Chrysothamnus frigidus, Rabbit Brush.
Artemisia tridentata, Black Sagebrush. *U.*
Artemisia cana, Gray Sagebrush. *U.*
Artemisia trifida, Sagebrush.
Artemisia arbuscula, Brown Sagebrush.
Artemisia frigida, Sagebrush.
Artemisia ludoviciana, Sagebrush. *U.*

Herbaceous plants.

Calochortus gunnisoni, Mariposa Lily.
Calochortus nuttalli, Mariposa Lily.
Zygadenus venenosus, Poison Camas. *U.*
Iris missouriensis, Blue Flag.
Corallorhiza multiflora, Coral Root. *C.*
Humulus lupulus, Wild Hop.
Lewisia rediviva, Bitter Root.
Arenaria congesta, Sandwort. *C.*
Clematis ligusticifolia, White Virgin's Bower.
Clematis douglasi, Purple Virgin's Bower.
Clematis occidentalis, Virgin's Bower.

PLANTS—TRANSITION ZONE—Continued.

Herbaceous plants—Continued.

Anemone cylindrica, Anemone. *U.*
Cyrtorhyncha ranunculina, Nuttall Buttercup.
Physaria didymocarpa, Double Bladder-pod.
Drymocallis glandulosa, Glandular Cinquefoil. *C.*
Potentilla effusa, Cinquefoil.
Thermopsis rhombifolia, Yellow Thermopsis.
Lupinus argenteus, Silvery Lupine.
Astragalus succulentus, Ground Plum. *U.*
Astragalus drummondi, Drummond Milk Vetch.
Astragalus hypoglottis, Milk Vetch. *U.*
Astragalus flexuosus, Milk Vetch. *U.*
Astragalus nitidus, Milk Vetch.
Astragalus calycosus, Milk Vetch.
Aragallus lamberti. U.
Psoralea argophylla, Silvery Psoralea.
Hedysarum cinerascens, Hedysarum.
Hedysarum uintahense, Uinta Hedysarum. *C.*
Vicia americana, Vetch. *U.*
Geranium fremonti, Geranium. *C.*
Geranium richardsoni, Geranium. *C.*
Linum lewisi, Wild Flax.
Opuntia fragilis, Small-jointed Cactus. *U.*
Echinocactus simpsoni, Simpson Ball Cactus. *C.*
Pachylophus montanus, Evening Primrose. *U.*
Harbouria trachypleura, Water Hemlock. *C.*
Aralia nudicaulis, Wild Sarsaparilla.
Gentiana affinis, Gentian. *C.*
Apocynum androsæmifolium, Indian Hemp.
Phlox depressa, Wild Phlox.
Phlox hoodi, Wild Phlox.
Gilia congesta, Gilia.
Phacelia linearis, Phacelia.
Phacelia heterophylla, Phacelia.
Orcocarya virgata, Orcocarya.
Monarda menthæfolia, Horse Mint. *U.*
Pentstemon laricifolius, Beard-tongue.
Adenostegia ramosa. U.
Scutellaria brittoni, Skullcap. *U.*
Mimulus floribundus, Monkey Flower.
Orthocarpus luteus, Yellow Orthocarpus.
Campanula rotundifolia, Harebell. *C.*
Antennaria reflexa, Everlasting.
Balsamorrhiza sagittata, Balsam Root.
Balsamorrhiza incana, Balsam Root.
Chaenactis douglassi.

Grasses.

Savastana odorata, Holy Grass.
Stipa nelsoni, Feather Grass.
Muhlenbergia comata, Dropseed Grass.
Agrostis hiemalis, Bent Grass. *C.*
Kœleria cristata, June Grass. *U.*
Poa longipedunculata, Long-stalked Spear Grass. *C.*
Poa lucida, Spear Grass.
Panicularia nervata, Manna Grass.
Festuca ovina duriuscula, Fescue Grass.
Bromus marginatus, Brome Grass.
Bromus porteri, Brome Grass.
Agropyron pseudorepens, Wheat Grass. *C.*
Agropyron caninum, Wheat Grass.
Agropyron spicatum, Wheat Grass. *U.*

Agricultural Utility of the Transition Zone.

The elevated Transition area with its vast extent of grazing lands is now, as in the past, the center of the sheep and cattle industries of Wyoming, and there are also extensive coal and oil fields in various stages of development. The principal timberlands in the Transition Zone are of small extent and lie to the east and northeast. They comprise a moderate growth of yellow pine on the Laramie (see

Pl. V, fig. 1), Casper, and Bear Lodge Mountains, and heavy forests of this valuable timber on the western slopes of the Black Hills.[1]

The climate is cool but dry and healthful, with a rainfall varying from 10 to 12 inches in the arid parts, 12 to 15 inches in the east-central and southeast sections, and 17 to 21 inches in the Black Hills and Bear Lodge districts at the northeast where crops succeed moderately in all except the sagebrush lands. The snowfall is rather heavy throughout. This quantity of moisture, though not large, in a measure counterbalances the cool climate of the Transition Zone and, combined with the much greater area, gives this zone an agricultural value in Wyoming comparable to that of the warmer Upper Sonoran. Large areas of excellent grass land in the mountain valleys and on the higher plateaus in the upper part of the zone are ideal either as cattle range or for the summer grazing of sheep, while a fair growth of range grasses generally obtains even in the lower, more arid sections. The rich soils yield abundantly either under dry farming or irrigation wherever there has been a proper selection of hardy, quick-maturing crops adapted to a usually short growing season.

High-altitude farming has been thoroughly tested at the Wyoming Experiment Station at Laramie for a series of years. Very favorable results[2] were obtained with a great variety of vegetable and cereal crops and even certain fruits, in experiments conducted in the heart of the Transition Zone at over 7,000 feet elevation, where bleak winds are unusually prevalent. Apples and small fruits which are grown with considerable difficulty on the Laramie Plains succeed admirably in many localities with greater natural protection. Successful farming districts in the Wyoming Transition include sections of the Laramie Plains, the Platte Valley above Saratoga, Bear Valley and Fort Bridger region in Uinta County, Salt River Valley in Lincoln County, the eastern base of the Bighorn Mountains in Sheridan and Johnson Counties, and the Sundance region in Crook County. In most of these, oats and hardy cereals, alfalfa (two cuttings), field peas, potatoes, and hardy vegetables are raised to great perfection. Hay, forage, garden vegetables, and a limited crop of small grain are very generally grown on stock ranches even in the colder parts of the zone.

CANADIAN ZONE.

The Canadian Zone, the region of coniferous Boreal forest, is the most important of the Boreal transcontinental life areas. It extends far southward in the principal mountain masses of the Western

[1] Open sage country usually fills the zone on the basal slopes of the high ranges in western Wyoming. The growth of Douglas spruce along its upper border in this region is generally scattering, while the yellow pine is of rare occurrence.

[2] Discussed in bulletins of the Wyoming Experiment Station, which contain also valuable cultural and other data based on tests made at the station at Laramie and at the experimental farms at Sundance and Saratoga.

States, and over much of the Rocky Mountain region covers the middle slopes of the high ranges and the summits and upper slopes of mountains of medium elevation. It is uniformly and conspicuously characterized from Montana to Colorado by forests of spruce, fir, lodgepole pine, and aspen, and by a large variety of Boreal undershrubs and plants.

In Wyoming the greatest extent of Canadian Zone country is in the mountainous northwest. Here the zone includes most of the extensive undulating forested plateau of Yellowstone Park; large rolling or hilly tracts of mixed forest and open country on the borders of Jackson Hole (Pl. VIII, fig. 1), in the basin of Hoback River, at the head of Green River, and on the southern end of the Wyoming Range; and the forested slopes of the Wind River, Absaroka, Teton, Gros Ventre, Salt River, Snake River, and Wyoming Ranges (Pl. VIII, fig. 2) from near their bases to the upper limit of large tree growth at 9,000 to 10,000 feet elevation. Elsewhere the Bighorn and Medicine Bow Ranges and the Sierra Madre are extensively Canadian, and the Laramie Mountains and Casper Range have considerable areas on their summits. Elevations of medium altitude which are capped with Canadian Zone forests and also have small areas on their cool slopes are the Black Hills, the Bear Lodge, Rattlesnake, Green, Ferris, Seminole, and Shirley Mountains, the northern shoulders of the Uinta Mountains, and high plateaus along the southern boundary of the State between Green River and the Red Desert. Traces of the zone, indicated usually by aspens and lodgepole pines, or merely by dense, scrubby thickets of aspens, are on the upper, cool slopes of the Aspen Mountains, the Bear River Divide, a few desert peaks along the continental watershed between South Pass and Steamboat Mountain, on Heart Mountain north of Cody, and on Pyramid and Heaths Peaks along the upper Platte.

The lofty Wind River Range of comparatively straight axis presents a graphic view of the Canadian forest belt, which is maintained usually at uniform elevation and in full vertical width (about 2,000 feet) on both slopes, its lower border sharply defined where the forests meet the open basal sagebrush country of the Transition Zone.[1] The upper border of the Canadian Zone is obscure in these mountains, as elsewhere, the change from heavy forest growth to the narrow Hudsonian timberline belt of dwarfed forest being gradual and almost imperceptible.

The main forest composition on the Wyoming mountains is very uniform, with forests of lodgepole pine and aspen in the lower half of the zone and a heavy stand of Engelmann spruce, or more often

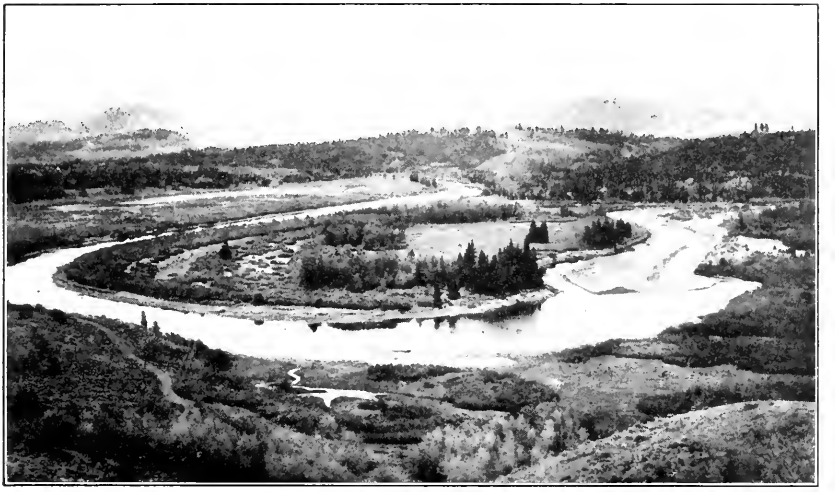
[1] The lower edge of the Canadian Zone is less clearly marked on the eastern slopes of the Bighorn Mountains and elsewhere in eastern Wyoming where forests of yellow pine fill much of the upper Transition.

a mixed forest of spruce and fir, higher up. Other trees of less extensive growth and more restricted distribution are the Douglas spruce in the lower part of the zone, chiefly in the northwestern mountains; the blue spruce and balsam poplar fringing streams along the lower edge of the zone in the south and west, and in the northwest, respectively; and the canoe birch in the Black Hills and Bear Lodge Mountains. Fire-swept tracts usually are first covered with a dense growth of young aspens, which are of more rapid growth than conifers. In the Sierra Madre the fresh growth on burned-over areas is occasionally of fir over original lodgepole pine forest.

In the lower part of the Canadian forest belt are considerable areas of partly open mountain meadows and parks, and more rarely, of open slopes. Characteristic tracts are the 8,000-foot watershed between the Hoback and Green Rivers, where groves of aspen intermixed with a little lodgepole pine and fir alternate over a gently rolling country with open parks covered with low matted sagebrush, *Frasera*, and *Balsamorrhiza*, or with beautiful grassy meadows brilliantly colored in summer with flowers of shrubby cinquefoil, larkspur, lupine, geranium, iris, and painted cup; the grassy meadows and bordering sage benches of the Du Noir Valley at the head of Wind River; extensive willow-grown meadows and flats at the northern end of Jackson Hole and in Yellowstone Park; and open grass or sage slopes on the western side of the Bighorn Mountains between 8,000 and 9,000 feet elevation. On the moderately inclined eastern side of the Wyoming Range southwest of Bigpiney are unusually open mountain slopes. Here grass and sage country extend in many places on ridges and south slopes to the 10,000-foot crest of the range, alternating regularly with dense tracts of Douglas spruce, lodgepole pine, and Engelmann spruce forest on all north slopes and in gulches.

The usual factors of base level, latitude, slope incline and exposure, and, to a certain extent, air currents, affect in varying degree the altitude of the Canadian Zone. Base level appears to be more potent than latitude in Wyoming. The variation from 8,500 to 10,500 feet on southwest slopes and 7,500 to 9,500 feet on northeast slopes in the mountains along the southern boundary and bordering Green River Basin, to 8,000 to 9,500 feet on southwest slopes and 7,000 to 9,000 feet on northeast slopes in the northern mountains, is largely latitudinal. The depression to 6,000 feet on the cap of the Black Hills and Bear Lodge Mountains, however, is probably due to the low base level of the adjacent plains on the north and east.

The high level of the Canadian Zone (above 8,000 feet) on the warm western slope of the Bighorn Mountains east of Ionia is due to bold southwest exposure, which more than offsets the lowering



B11824

FIG. 1.—SNAKE RIVER VALLEY (6,500 FEET) NEAR MORAN, JACKSON HOLE.

Mixed forest conditions at lower edge of Canadian Zone are shown. Scattered groves of aspen, balsam poplar, and blue spruce on valley flats; aspen and lodgepole pine forests on hills.

B13670

FIG. 2.—HEAVY ENGELMANN SPRUCE FOREST WYOMING RANGE WEST OF MERNA (9,000 FEET).

B11804

FIG. 1.—SYLVAN LAKE, YELLOWSTONE NATIONAL PARK, IN THE ENGELMANN SPRUCE BELT.

B11664

FIG. 2.—HEAVY STAND OF LODGEPOLE PINE, NORTH SLOPE OF FERRIS MOUNTAINS (8,500 FEET).

influence of the low altitude of the Bighorn Basin at their western bases. The Ferris and Green Mountains, small isolated ranges on the northern border of the Red Desert, show graphically the effect of slope exposure on zone level. The Ferris Range, of 9,500 feet elevation, is narrow and sharp-crested, with very abrupt southwest slopes facing the desert. These hot, exposed slopes are open Transition Zone, and crowd the Canadian element above 9,000 feet, where it is indicated just below the summit by thickets of aspen and lodgepole pine in gulches, and by Rocky Mountain white pine on exposed slopes and ridges. Just over the 9,500-foot crest on the cool exposure are the Engelmann spruces and firs of the Canadian Zone, somewhat dwarfed at first but soon encountered in large and dense growth. The spruces and firs, with lodgepole pines and aspens lower down, form a heavy forest on the northeast slopes down to 7,800 feet, while descending tongues in gulches along cold streams extend 500 feet lower. The Canadian Zone on the Ferris Range thus exhibits about the maximum variation in zone level due to slope exposure—fully 1,500 feet.

In Jackson Hole, the Yellowstone Valley, along both forks of the Shoshone River, and at the heads of many other narrow valleys deeply penetrating the mountain mass of northwest Wyoming the Canadian element reaches a low elevation, and on cold slopes is often unmixed with Transition species at 6,000 feet. Over this region the mean summer temperature is low, the cold air of the surrounding mass of Boreal country settling into the valleys and canyons at night, and frequent frosts occur during the warmest months. Furthermore, these mainly steep-walled valleys receive a minimum of sunlight, and many slopes are shaded during the warmest part of the day. Under these conditions the zone occasionally has a vertical breadth of nearly 3,000 feet, since the factors which cause the abnormal depression of its lower boundary do not appreciably affect the upper limit.

The cooling influence of cold streams and of descending cold air currents which flow down gulches and canyons regularly carries narrow tongues of Canadian Zone far below the average level on mountain slopes. This is very noticeable on some of the streams at the southwestern base of the Wind River Range. The clear icy waters of Pine Creek, the outlet of Fremont Lake, carry a broad fringe of lodgepole pines, aspens, and a pure Canadian undergrowth almost to its junction with the New Fork at 7,000 feet elevation, fully 1,000 feet below the mean lower border of the zone on the southwest slope of these mountains. The waters of the Big Sandy, 40 miles to the southeast, also carry Canadian species far down into open Transition sagebrush country. Streams which break out of the steep northern escarpment of the Casper Range through deep, shaded gulches are

heavily fringed with aspen groves and Canadian undershrubs on the otherwise open 6,000-foot basal slopes, 1,000 feet below the usual altitude of these species on the northern slopes of this range.

The Canadian Zone is marked in Wyoming as a cool region of considerable humidity, but the percentage of bright sunny days throughout the year is high. Much of the precipitation is in the form of frequent sharp showers in summer and heavy snows in winter, but there are occasional rains of greater duration in spring and fall. The chief value of this zone is its natural adaptation, in abundant forest and plant cover and cool summer temperature, to moisture retention.[1] The extensive forests, its greatest natural resource, are now largely under Federal control. These are of great value, especially the forests of lodgepole pine and Engelmann spruce (Pl. IX), but large areas are as yet inaccessible. Winter temperatures are low, occasionally reaching —45° F., and in the small areas physically adapted to agriculture the prevalent summer frosts preclude the growing of more than a few of the hardiest crops and vegetables for ranch use.

Characteristic Species—Canadian Zone.

A rich fauna and flora uniformly characterize the Canadian Zone in Wyoming. Forest species predominate, many of them identical with or closely related to Boreal types of transcontinental range from Labrador to Alaska; others are peculiar to the Rocky Mountain region; and a small number have a restricted range. The canoe birch, beaked hazelnut, Douglas honeysuckle, northern chipmunk, and a few other species of wide Boreal dispersion occur only in the outlying Black Hills and Bear Lodge Mountains at the northeast, and the northern varying hare only in the Bighorn Mountains, but elsewhere the characteristic species are very uniformly distributed in the different mountain ranges. With the exception of many of the breeding birds, which merely make their summer home in the Canadian Zone, all are species adapted to a region of long, cold winters and short, cool summers.

Mammals—Canadian Zone.

[Species marked *T.* occur also in the Transition Zone; those marked *H.*, also in the Hudsonian.]

Cervus canadensis canadensis, Elk. *T, H.*

Alces americanus shirasi, Shiras Moose.

Sciurus fremonti fremonti, Fremont Spruce Squirrel.

Sciurus hudsonicus baileyi, Bighorn Red Squirrel.

Sciurus hudsonicus ventorum, Rocky Mountain Red Squirrel.

Glaucomys sabrinus bangsi, Rocky Mountain Flying Squirrel.

Eutamias borealis, Northern Chipmunk.

Eutamias operarius, Colorado Chipmunk.

[1] See pp. 52–53.

MAMMALS—CANADIAN ZONE—Continued.

Eutamias umbrinus, Uinta Chipmunk.
Eutamias luteiventris, Buff-bellied Chipmunk. *T.*
Callospermophilus lateralis lateralis, Say Ground Squirrel. *T.*
Callospermophilus lateralis caryi, Wind River Mantled Ground Squirrel.
Callospermophilus lateralis castanurus, Chestnut-tailed Ground Squirrel.
Marmota flaviventris nosophora, Golden-mantled Marmot. *H.*
Marmota flaviventris luteola, Park Marmot. *H.*
Marmota flaviventris dacota, Black Hills Marmot. *T.*
Peromyscus maniculatus artemisiæ, Sagebrush White-footed Mouse. *T.*
Peromyscus maniculatus rufinus, Tawny White-footed Mouse.
Phenacomys orophilus, Mountain Phenacomys.
Evotomys gapperi galei, Gale Red-backed Mouse.
Evotomys brevicaudus, Black Hills Red-backed Mouse.
Microtus mordax mordax, Rocky Mountain Meadow Mouse.
Microtus longicaudus, Long-tailed Meadow Mouse. *T.*
Microtus richardsoni macropus, Big-footed Meadow Mouse.
Microtus nanus nanus, Dwarf Field Mouse. *T, H.*
Castor canadensis, Beaver. *T.*
Thomomys fossor, Colorado Pocket Gopher.
Thomomys uinta, Uinta Pocket Gopher. *H.*
Thomomys fuscus fuscus, Brown Pocket Gopher.
Thomomys talpoides caryi, Bighorn Pocket Gopher. *H.*
Zapus princeps princeps, Rocky Mountain Jumping Mouse.
Erethizon epixanthum, Yellow-haired Porcupine. *T.*
Lepus americanus americanus, Northern Varying Hare.
Lepus bairdii bairdii, Snowshoe Rabbit.
Felis hippolestes, Mountain Lion. *T.*
Lynx canadensis canadensis, Canada Lynx.
Vulpes macrourus, Mountain Red Fox.
Mustela arizonensis, Arizona Weasel. *T.*
Mustela cicognanii leptus, Dwarf Weasel.
Martes caurina origenes, Rocky Mountain Marten.
Lutra canadensis canadensis, Otter. *T.*
Gulo luscus, Wolverene.
Ursus americanus, Black Bear. *T.*
Ursus imperator, Yellowstone Park Grizzly Bear. *T.*
Ursus washake, Washakie Grizzly Bear, Silver-tip. *T.*
Sorex personatus personatus, Masked Shrew. *H.*
Sorex obscurus obscurus, Rocky Mountain Shrew. *H.*
Sorex vagrans dobsoni, Dobson Shrew.
Neosorex palustris navigator, White-bellied Water Shrew.
Nycteris cinerea, Hoary Bat. *T.*
Lasionycteris noctivagans, Silver-haired Bat. *T.*
Myotis lucifugus carissima, Little Brown Bat. *T.*

BREEDING BIRDS—CANADIAN ZONE.

[Species marked *T.* breed also in the Transition Zone; those marked *H.*, also in the Hudsonian.]

Pelecanus erythrorhynchos, White Pelican.
Mergus americanus, Merganser. *T.*
Clangula islandica, Barrow Golden-eye. *H.*
Charitonetta albeola, Buffle-head.
Branta canadensis, Canada Goose. *T.*
Olor buccinator,[1] Trumpeter Swan. *T.*
Dendragapus obscurus richardsoni, Richardson Dusky Grouse. *T.*
Picoides arcticus, Arctic Three-toed Woodpecker.

[1] Probably no longer breeding in Wyoming.

BREEDING BIRDS—CANADIAN ZONE—Continued.

Picoides americanus dorsalis, Alpine Three-toed Woodpecker. *H.*
Sphyrapicus varius nuchalis, Red-naped Sapsucker. *T.*
Sphyrapicus thyroideus, Williamson Sapsucker.
Selasphorus platycercus, Broad-tailed Hummingbird. *T.*
Nuttallornis borealis, Olive-sided Flycatcher.
Empidonax difficilis, Western Flycatcher. *T.*
Cyanocitta stelleri annectens, Black-headed Jay.
Perisoreus canadensis capitalis, Rocky Mountain Jay. *H.*
Carpodacus cassini, Cassin Purple Finch.
Loxia curvirostra minor, Crossbill.
Spinus pinus, Pine Siskin.
Zonotrichia leucophrys, White-crowned Sparrow. *H.*
Junco hyemalis mearnsi, Pink-sided Junco. *H.*
Junco phæonotus caniceps, Gray-headed Junco. *H.*
Melospiza lincolni, Lincoln Sparrow.
Wilsonia pusilla pileolata, Pileolated Warbler. *H.*
Cinclus mexicanus unicolor, Dipper, Water Ouzel. *T.*
Nannus hiemalis pacificus, Western Winter Wren.
Sitta canadensis, Red-breasted Nuthatch.
Penthestes gambeli, Mountain Chickadee. *T.*
Regulus satrapa, Golden-crowned Kinglet. *H.*
Regulus calendula, Ruby-crowned Kinglet.
Myadestes townsendi, Townsend Solitaire. *T.*
Hylocichla ustulata swainsoni, Olive-backed Thrush. *T.*
Hylocichla guttata auduboni, Audubon Hermit Thrush.
Sialia currucoides, Mountain Bluebird. *T.*

PLANTS—CANADIAN ZONE.

[Species marked *T.* occur also in the Transition Zone; those marked *H.*, also in the Hudsonian.]

Trees and shrubs.

Pinus murrayana, Lodgepole Pine.
Pinus flexilis, Rocky Mountain White Pine. *T*, *H.*
Picea engelmanni, Engelmann Spruce.
Picea parryana, Blue Spruce.
Abies (concolor?), White Fir.
Pseudotsuga mucronata, Douglas Spruce. *T.*
Juniperus sibirica, Low Juniper. *H.*
Populus tremuloides, Aspen.
Populus balsamifera, Balsam Poplar.
Salix pyrifolia obscura, Willow.
Salix nelsoni, Nelson Willow. *H.*
Betula papyrifera, Canoe Birch.
Betula glandulosa, Dwarf Birch.
Corylus rostrata, Hazelnut. *T.*
Alnus tenuifolia, Alder.
Ribes petiolare, Mountain Black Currant.
Ribes wolfi, Blue Currant.
Ribes lacustre, Currant.
Ribes viscosissimum, Currant.
Spiræa lucida, Meadowsweet. *T.*
Rubus parviflorus, Thimbleberry.
Rubus strigosus, Red Raspberry. *T.*
Dasiphora fruticosa, Shrubby Cinquefoil. *H.*
Rosa sayi, Rose. *T.*
Sorbus scopulina, Mountain Ash.
Pachystima myrsinites.
Rhamnus alnifolia, Buckthorn.
Lepargyrea canadensis, Canadian Buffaloberry.
Ledum glandulosum, Labrador Tea.
Menziesia ferruginea.
Vaccinium oreophilum, Mountain Blueberry.

PLANTS—CANADIAN ZONE—Continued.

Trees and shrubs—Continued.

Vaccinium erythrococcum, Red Bilberry. *H.*
Vaccinium occidentale, Blueberry.
Vaccinium cæspitosum, Blueberry.
Sambucus microbotrys, Red Elderberry.
Lonicera glaucescens, Douglas honeysuckle.
Lonicera involucrata, Involucred Fly-honeysuckle.
Lonicera utahensis, Honeysuckle.

Herbaceous plants.

Veratrum tenuipetalum, White Hellebore.
Zygadenus elegans, Beautiful Camas. *H.*
Calochortus pavonaceus, Yellow Mariposa.
Erythronium parviflorum, Dog-tooth Violet. *H.*
Streptopus amplexifolius, Twisted-stalk.
Disporum trachycarpum. *T.*
Limnorchis borealis, Bog Orchid.
Calypso bulbosa, Calypso.
Rumex paucifolius, Dock. *H.*
Claytonia rosea, Spring Beauty. *H.*
Actæa arguta, Baneberry.
Actæa rubra, Baneberry.
Aquilegia cærulea, Blue Columbine.
Aquilegia flaveseens, Yellow Columbine.
Aquilegia orcophila, Columbine. *H.*
Anemone lithophila, Anemone.
Aconitum columbianum, Monkshood.
Clematis pseudalpina, Purple Virgin's Bower.
Ranunculus inamœnus, Crowfoot.
Thlaspi glaucum, Penny Grass. *H.*
Parnassia fimbriata, Grass-of-Parnassus.
Heuchera parvifolia, Alum Root. *H.*
Micranthes arguta, Saxifrage.
Fragaria pauciflora, Strawberry. *T.*
Sieversia ciliata, Mountain Avens.
Astragalus alpinus, Milk Vetch.
Trifolium rydbergi, Clover. *T.*
Trifolium anemophilum, Clover. *T.*
Geranium parryi, Geranium.
Geranium cæspitosum, Geranium. *T.*
Viola canadensis rydbergi, Violet.
Viola bellidifolia, Violet. *H.*
Epilobium spp.
Heracleum lanatum.
Pyrola secunda, Wintergreen.
Pyrola uliginosa, Wintergreen.
Pyrola chlorantha, Wintergreen.
Pyrola elliptica, Wintergreen.
Pyrola picta, Painted Wintergreen.
Pterospora andromeda, Pinedrops. *T.*
Chimaphila umbellata, Pipsissewa.
Moneses uniflora, One-flowered Wintergreen.
Gentiana forwoodi, Closed Gentian.
Gentiana elegans, Mountain Fringed Gentian.
Frasera speciosa, Frasera.
Pentstemon glaucus, Beard-tongue.
Pentstemon fruticosus, Beard-tongue. *T.*
Mimulus langsdorfii, Monkey Flower.
Mimulus lewisi, Crimson Monkey Flower.
Elephantella grandiflora, Elephant-head. *H.*
Pedicularis racemosa, Purple Lousewort.
Castilleja sulphurea, Painted Cup.
Linnæa americana, Twinflower.
Valeriana aculiloba, Valerian. *H.*
Anaphalis subalpina, Pearly Everlasting.
Antennaria pulcherrima, Everlasting. *T.*
Wyethia amplexicaulis.
Arnica cordifolia, Heart-leaved Arnica.

PLANTS—CANADIAN ZONE—Continued.

Grasses.

Phleum alpinum, Alpine Timothy. *H.*
Alopecurus occidentalis, Mountain Foxtail.
Calamagrostis canadensis acuminata, Mountain Reed Grass.
Deschampsia cæspitosa, Tufted Hair Grass. *T.*
Danthonia intermedia, Mountain Oat Grass.
Poa reflexa, Mountain Bluegrass. *H.*
Festuca thurberi, Thurber Fescue.
Agropyron violaceum, Wheat Grass. *H.*
Elymus glaucus, Rye Grass. *T.*

HUDSONIAN ZONE.

On the high mountain ranges of the Western States the Canadian forest belt is fringed along its upper edge by the narrow Hudsonian strip of dwarfed forest and depauperate vegetation, which gives way to bare Alpine slopes along a sharply defined climatic boundary known as timberline, corresponding to the transcontinental limit of trees at the southern edge of the Arctic tundras. The Hudsonian Zone occupies a relatively small area in Wyoming. It encircles the Alpine summits and crests of the northwestern ranges, including the Bighorn Mountains, and small areas cap all ranges or isolated peaks which approximate timberline altitudes. A belt bounds the Alpine cap of the Snowy Mountains at the northern end of the Medicine Bow Range, and small, widely separated tracts or islands are on Bridger Peak and neighboring summits of the Sierra Madre, on Elk Mountain, and on Laramie Peak.

In the southern mountains the forests commence to dwarf almost imperceptibly at from about 10,000 to 10,500 feet altitude, according to slope exposure, the elevation decreasing with higher latitude to 9,000 or 9,500 feet in northern Wyoming. The vertical breadth of the Hudsonian belt varies with slope and soil conditions from a few hundred to 1,000 feet. The peculiar ruggedness and broken, incised character of many mountains greatly obscures this belt, while in places sheer, perpendicular cliffs and avalanches greatly contract it or even narrowly interrupt continuity. Avalanches sweep away every vestige of tree growth and in many places replace the original soil with extensive fields of slide rock. The result is not a climatic change, however, and can not be considered in delimiting the zone. The Hudsonian strip is usually widest in cold gulches with abundant soil, and is narrow on exposed, scantily soiled ridges. In fact, soil conditions often counterbalance the elevating influence of slope exposure, and tree growth may be found as high on cold well-soiled slopes as on warm rocky inclines.

An almost Arctic climate prevails in the Hudsonian Zone, which in winter is buried under deep snow and in summer is flecked with huge drifts, many of which never entirely leave protected gulches. The deep-soiled slopes are thoroughly saturated in summer by

melting snow and frequent showers and squalls of snow or sleet, and bogs and small lakes abound in all level situations and natural basins. Exposed to high winds throughout the year, the conifers are in ragged, fantastic, and usually one-sided growth, and, along with the shrubs and many larger plants, evidence an adverse climate in stunted and otherwise deficient development. (Pl. X.) The middle of May found the timberline region on the Wind River Range near Dubois still in the grasp of wintry weather, with few plants in flower and the low willows and shrubby cinquefoil not yet in leaf; while on the Bighorn Mountains east of Hyattville the alpine willows had not put forth leaves by June 5. Many plants were past flowering, and herbaceous vegetation was partly dried up on the Wyoming Range at 10,400 feet altitude, August 9; and the timberline slopes on the Tetons were sere and brown on August 30 except for the hardy, late-flowering blue gentians.

Although the climate is rigorous for eight months of the year and myriads of mosquitoes greet one in summer, this highly interesting region well repays the arduous climb entailed to reach its confines. The gently rounding crests of the Wyoming Range south of Hoback Peak are peculiarly attractive. Grassy openings and parks mingle with scattered clumps and mats of Engelmann spruce and alpine fir; fields of scarlet painted cup, blue larkspur, white columbine, and purple lupine enliven a landscape flecked with white banks of melting snow; and a moderate incline adds to the beauty of the region. The Hudsonian area on the southwest side of the Wind River Range is of very different character. South of Fremont Peak (Pl. XI, fig. 1) it occupies a sloping granitic plateau a mile or two wide, and between 10,500 and 11,200 feet altitude, at the base of abrupt Alpine peaks of nearly 14,000 feet elevation. Its exceedingly rough surface of a seemingly endless succession of bare granite hummocks, studded with countless clear, snow-fed lakes in rocky basins, makes travel extremely arduous. Vegetation is scanty, and coniferous growth is very scattering over this unusually rocky region. Hudsonian vegetation is most abundant on deep-soiled slopes, as on Whiskey Mountain in the Wind River Range south of Dubois, and along the eastern slope of Needle Mountain in the Absaroka Range (Pl. XI, fig. 2).

Characteristic Species—Hudsonian Zone.

Trees of the timberline belt in Wyoming are the alpine fir, white-barked pine, and Engelmann spruce. The first two are characteristic Hudsonian trees, but the spruce extends up from the Canadian Zone. The spruces and firs, mainly on cool exposures, exhibit to a marked degree the depressed growth due to high altitude and are usually prostrate mats at extreme timberline. The white-barked pines of the northwest ranges show less dwarfing, but usually are very ragged

and one-sided as a result of the prevalent winds. They occur in scattering growth or as compact tongues push up warm exposed slopes and ridges, and even form forests of considerable size a little below timberline, as on Whirlwind Peak, in the Absaroka Range. The Rocky Mountain white pine, although a tree usually found only at a lower altitude, was found near timberline on the Bighorn Mountains, and also on the exposed 10,000-foot summit of Laramie Peak, where its characteristic growth is in depressed mats at the base of a low central bole 6 feet or more in height. Prostrate clumps of low juniper are common in slide rock at timberline on the Sierra Madre, on the Bighorn and Wind River Ranges, and elsewhere.

Although prominently characterized by depauperate vegetation, the grassy slopes between the scattered clumps of conifers are handsomely carpeted with a wealth of small flowering plants. Conspicuous flowers of spring and early summer, as observed on the Wind River and Bighorn Ranges, include globe flower, mountain cowslip, shooting star, columbine, spring beauty, and various mertensias, Jacob's ladder, forget-me-nots, buttercups, saxifrages, and drabas. In early autumn the timberline region on the Wyoming and Absaroka Ranges was brilliant with flowering mats of lupine, larkspur, painted cup, mountain heath, and mountain laurel, with the more scattering Parry primroses, harebells, gentians, phloxes, and rydbergias.

Many of the plants of the Hudsonian Zone and most of the birds and mammals occur also in the adjoining Canadian or Arctic-Alpine Zones. Comparatively few species are closely restricted to this narrow area.

Mammals—Hudsonian Zone.

Mammals having their center of abundance at or near timberline are the mountain sheep (*Ovis canadensis canadensis*), the timberline chipmunk (*Eutamias oreocetes*), marmots (*Marmota flaviventris nosophora* and *M. f. luteola*), and the pika, or coney (*Ochotona uinta*). A number of species range into this region from the Canadian Zone, or make their homes in both areas. Those occurring thus with some regularity are:

Sciurus hudsonicus ventorum, Rocky Mountain Red Squirrel.

Callospermophilus lateralis caryi, Wind River Mantled Ground Squirrel.

Erotomys gapperi galei, Gale Red-backed Mouse.

Microtus mordax mordax, Rocky Mountain Meadow Mouse.

Microtus nanus nanus, Dwarf Field Mouse.

Thomomys uinta, Uinta Pocket Gopher.

Thomomys talpoides caryi, Bighorn Pocket Gopher.

Lepus bairdii bairdii, Snowshoe Rabbit.

Canis lestes, Mountain Coyote.

Vulpes macrourus, Mountain Red Fox.

Martes caurina origenes, Rocky Mountain Marten.

Sorex obscurus obscurus, Rocky Mountain Shrew.

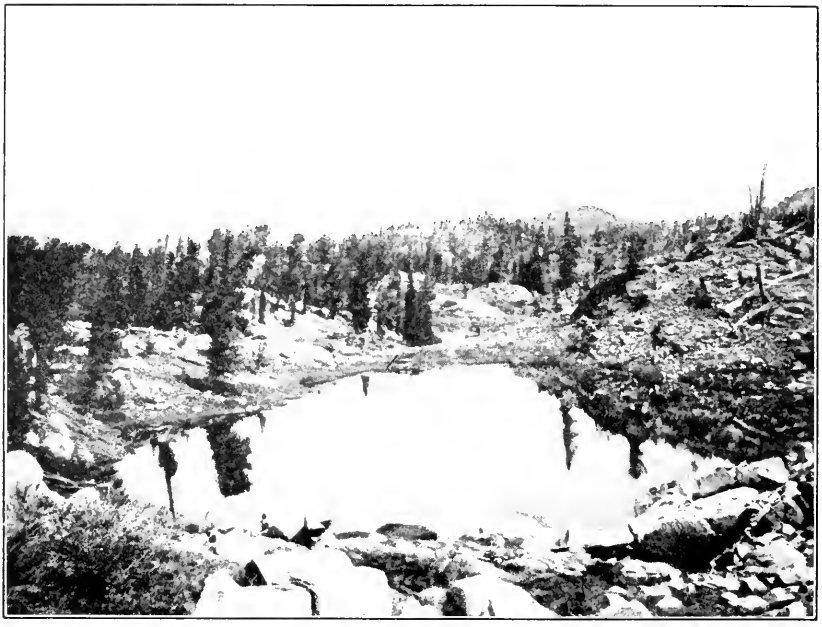
Sorex personatus personatus, Masked Shrew.

B11790

FIG. 1.—ENGELMANN SPRUCES AT TIMBERLINE, WEST SLOPE OF WHIRLWIND PEAK, ABSAROKA RANGE (10,000 FEET).

B11791

FIG. 2.—WHITE-BARKED PINES, SAME LOCALITY.



B13641

FIG. 1.—LOWER EDGE OF HUDSONIAN ZONE, WIND RIVER RANGE SOUTH OF FREMONT PEAK (10,500 FEET).

B11759

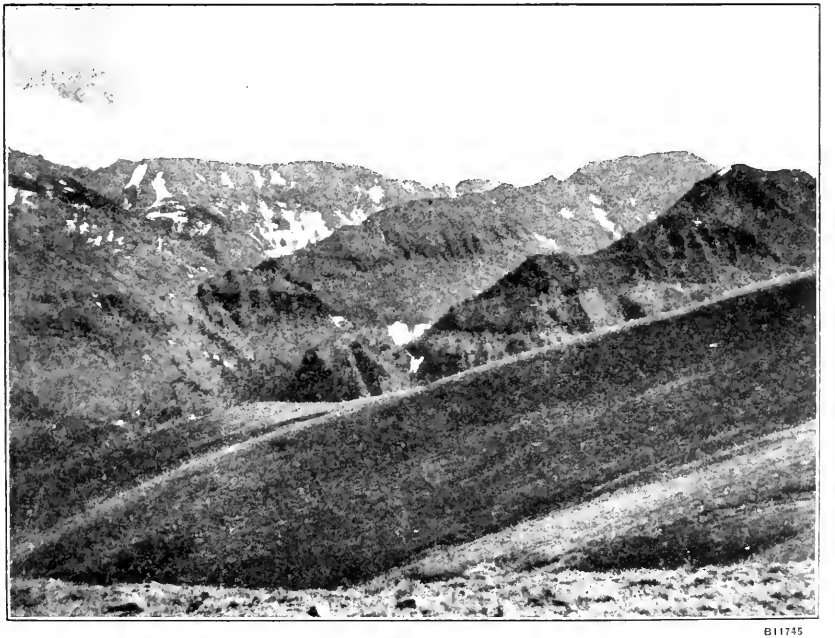
FIG. 2.—EAST SLOPE OF NEEDLE MOUNTAIN, ABSAROKA RANGE.

Growth of Engelmann spruce, alpine fir, and gray-leaved willow (*Salix glaucops*) at timberline (10,000 feet).

B13645

FIG. 1.—ARCTIC-ALPINE ZONE, WIND RIVER RANGE.

South of Fremont Peak, from 11,600 feet elevation, July 17, 1911.



B11745

FIG. 2.—ARCTIC-ALPINE ZONE, ABSAROKA RANGE.

Between the Greybull and the South Fork of Shoshone River, from east slope of Needle Mountain (10,500 feet), July 11, 1910.

Breeding Birds—Hudsonian Zone.

[Species marked *C.* breed also in the Canadian Zone.]

Picoides americanus dorsalis, Alpine Three-toed Woodpecker. *C.*
Perisoreus canadensis capitalis, Rocky Mountain Jay. *C.*
Nucifraga columbiana, Clark Nutcracker.[1]
Pinicola enucleator montana, Rocky Mountain Pine Grosbeak.
Zonotrichia leucophrys, White-crowned Sparrow. *C.*
Junco hyemalis mearnsi, Pink-sided Junco. *C.*
Junco phaeonotus caniceps, Gray-headed Junco. *C.*
Wilsonia pusilla pileolata, Pileolated Warbler. *C.*
Certhia familiaris montana, Rocky Mountain Creeper. *C.*
Regulus satrapa, Golden-crowned Kinglet. *C.*

Plants—Hudsonian Zone.

[Species marked *C.* occur also in the Canadian Zone; those marked *A.*, also in the Arctic-Alpine.]

Pinus albicaulis, White-barked Pine.
Picea engelmanni, Engelmann Spruce (dwarf). *C.*
Abies lasiocarpa, Alpine Fir (dwarf). *C.*
Juniperus sibirica, Low Juniper. *C.*
Salix glaucops, Gray-leaved Willow.
Salix chlorophylla, Willow. *C.*
Salix saximontana, Willow. *A.*
Ribes montigenum, Bristly Red Currant.
Rubus strigosus, Red Raspberry. *C.*
Polygonum bistortoides, Twisted Polygonum. *C.*
Claytonia rosea, Spring Beauty.
Calandrinia pygmæa, Alpine Bitter Root.
Cerastium beeringianum, Mouse-ear Chickweed.
Caltha leptosepala, Mountain Cowslip.
Trollius albiflorus, Globe Flower.
Aquilegia saximontana, Columbine.
Delphinium subalpinum, Larkspur.
Anemone toloensis, Anemone.
Anemone globosa, Anemone. *C.*
Ranunculus alpophilus, Buttercup.
Ranunculus calthæfolius, Buttercup.
Thlaspi glaucum, Penny Grass.
Draba lutcola, Whitlow Grass.
Clementsia rhodantha, Red Orpine. *A.*
Leptasea hirculus, Saxifrage.
Potentilla glaucophylla, Cinquefoil. *C.*
Drymocallis pseudorupestris, Avens.
Lupinus cæspitosus, Lupine. *C.*
Lupinus laxiflorus, Lupine. *C.*
Trifolium dasyphyllum, Dwarf Clover. *A.*
Trifolium parryi, Parry Dwarf Clover. *A.*
Hedysarum sulphurescens.
Angelica roseana.
Phyllodoce empetriformis, Mountain Heath.
Kalmia polifolia, Mountain Laurel.
Primula parryi, Parry Primrose.
Androsace subumbellata.
Dodecatheon radicatum, Shooting Star. *C.*
Gentiana calycosa, Gentian.
Gentiana strictiflora, Gentian.
Swertia congesta, *A.*
Swertia palustris, *C.*
Phlox cæspitosa, Phlox. *C.*
Polemonium viscosum, Jacob's Ladder.
Polemonium mellitum, Jacob's Ladder.
Phacelia sericea, Silky Phacelia. *A.*
Myosotis alpestris, Forget-me-not. *A.*
Mertensia tweedyi, Lungwort. *C.*
Pentstemon alpinus, Beard-tongue.
Veronica wormskjoldi, Alpine Speedwell.
Veronica serpyllifolia, Speedwell. *C.*
Castilleja spp., Painted Cup.
Campanula parryi, Parry Harebell.
Rydbergia grandiflora, Rydbergia. *A.*

[1] Young noted in summer.

PLANTS—HUDSONIAN ZONE—Continued.

Townsendia parryi, Parry Townsendia. *A.*
Senecio fremonti, Paintbrush. *A.*
Senecio crassulus, Paintbrush.
Antennaria reflexa, Everlasting.
Erigeron compositus, Fleabane. *C.*
Erigeron salsuginosus, Fleabane.
Chaenactis alpina, Alpine Chaenactis.
Trisetum subspicatum, Oat Grass.
Poa epilis, Bluegrass. *A.*
Phleum alpinum, Alpine Timothy. *C.*
Carex nigricans, Sedge.
Carex nova, Sedge.
Juncus subtriflorus, Rush.

ARCTIC-ALPINE ZONE.

The area above timberline on the highest mountains, the Arctic-Alpine Zone, corresponds in climate, and in plant species especially, to the barren grounds of the Arctic. It is not continuous from one range to another in Wyoming, for even in the mountainous northwest the areas are separated, often widely, by Canadian Zone valleys and forested divides of medium elevation.

A wide, almost unbroken stretch of this zone caps the massive Wind River Range for its entire length (Pl. XII, fig. 1), and there is a broken, irregular area of equal extent on the main crest and primary spurs of the rugged Absaroka Range (Pl. XII, fig. 2). The Gros Ventre Range is capped by a succession of Alpine plateaus sloping moderately toward the north, while the lofty peaks and jagged crests of the Tetons form a narrow strip of Alpine country. Broad Alpine areas on the Bighorn Mountains lie south of the gap at the head of Tongue River, and include all elevated summits of the Cloud Peak group. There are traces of the zone, too small for plotting on the map (see frontispiece), on a few mountains in the eastern and northwestern borders of Yellowstone Park. In southern Wyoming the Arctic-Alpine Zone is restricted to the lofty plateau on the Snowy Mountains, at the northern end of the Medicine Bow Range.

This high-altitude area is a bleak, wind-swept region of excessive snowfall in winter and frequent squalls of rain, sleet, or snow in the short summer, and arctic temperatures prevail throughout the year. On all the ranges snow fills the gulches and partly covers cold slopes and declivities even in the warmest months, while such massive, elevated ranges as the Wind Rivers, Absarokas, and Tetons carry extensive snow fields, and even a few perennial ice fields or glaciers in protected Alpine valleys.

The Arctic-Alpine Zone is conspicuously marked by the absence of tree growth, which ceases at its lower border. The altitude of timberline varies with latitude and slope exposure from 10,500 or 11,000 feet in the Sierra Madre and the Medicine Bow Range at the south, to 9,500 or 10,000 feet in the Bighorn Mountains and in the Yellowstone Park region.

Characteristic Species—Arctic-Alpine Zone.

The season of plant growth is from the middle of May until August, but during this brief period the bleak slopes and even the fields of slide rock for 1,500 or 2,000 feet above timberline are bedecked with a profusion of bright-hued Alpine flowers. A luxuriant growth of Alpine grasses and sedges obtains wherever there is any depth of soil, and furnishes rich pasturage for mountain sheep and a few other mammals which spend the summer in this usually forbidding region. In Wyoming plant growth rapidly decreases in size above 12,000 feet.

The low shrubby or matted growth usually extending from 500 to 1,000 feet above the limit of trees consists chiefly of dense thickets of willow (*Salix glaucops*) and copses of shrubby cinquefoil (*Dasiphora fruticosa*) which push up the bottoms and along the margins of wet gulches and basins; mats of mountain heath (*Phyllodoce empetriformis*) and alpine avens on rocky slopes and ridges; and spiny red currant (*Ribes montigenum*) and dwarfed raspberry (*Rubus strigosus*) in slide rock. Dwarf alpine willows mat the ground in places for an indefinite distance above timberline, and may even reach the highest summits with the mosses and lichens.

A large number of characteristic Arctic-Alpine herbaceous plants mark the zone in Wyoming, but only four species of breeding birds are peculiar to it, and no mammals.

Mammals—Arctic-Alpine Zone.

The few mammals found in the Arctic-Alpine Zone in Wyoming belong to lower zones. Among those attracted in summer to its grassy slopes and crests are the elk (*Cervus canadensis canadensis*), mountain sheep (*Ovis canadensis canadensis*), timberline chipmunk (*Eutamias oreocetes*), and Wind River mantled ground squirrel (*Callospermophilus l. caryi*). Marmots (*Marmota f. nosophora*), pocket gophers (*Thomomys uinta* and *T. f. fuscus*), meadow mice (*Microtus m. mordax*), coneys (*Ochotona uinta*), and rarely the Uinta spermophile (*Citellus armatus*), apparently are resident in the lower part of the zone in different localities. The coyote (*Canis lestes?*) and mountain red fox (*Vulpes macrourus*) range at various times into Alpine country in search of prey. On the Wyoming mountains mammals are rarely met with above 12,000 feet.

Breeding Birds—Arctic-Alpine Zone.

Lagopus leucurus leucurus,[1] White-tailed Ptarmigan.

Leucosticte australis,[1] Brown-capped Rosy Finch.

Leucosticte atrata,[2] Black Rosy Finch.

Anthus rubescens,[3] Pipit, Titlark.

Otocoris alpestris leucolæma,[4] Desert Horned Lark.

[1] On the Medicine Bow Range.

[2] On the Teton, Wind River, and Absaroka Ranges.

[3] Throughout the mountains.

[4] One of the few nesting birds of the Arctic-Alpine, but belonging chiefly to the Transition and Upper Sonoran Zones.

PLANTS—ARCTIC-ALPINE ZONE.

[Species marked *H.* occur also in the Hudsonian Zone.]

Salix petrophila, Rock Willow.
Salix tenera, Rock Willow.
Salix niralis, Alpine Willow.
Salix saximontana, Creeping Willow. *H.*
Oxyria digyna, Mountain Sorrel. *H.*
Polygonum viriparum, Alpine Knotweed.
Claytonia megarrhiza, Arctic Spring Beauty.
Spraguea multiceps.
Silene acaulis, Stemless Catchfly. *H.*
Alsinopsis obtusiloba, Sandwort.
Paronychia pulvinata, Whitlowwort.
Ranunculus adoneus, Buttercup. *H.*
Thalictrum alpinum, Alpine Meadow Rue.
Arabis lyalli.
Smelowskia americana.
Draba cana, Whitlow Cress.
Draba crassifolia, Whitlow Cress.
Draba densifolia, Whitlow Cress.
Parrya nudicaulis, Purple Parrya.
Rhodiola integrifolia, Rosewort.
Saxifraga cernua, Arctic Saxifrage.
Leptasea flagellaris, Saxifrage.
Boykinia heucheriformis, Saxifrage. Boykinia. *H.*
Dryas octopetala, Alpine Avens.
Sibbaldia procumbens, Sibbaldia. *H.*
Sieversia turbinata, Mountain Avens. *H.*
Lupinus monticola, Mountain Lupine. *H.*
Aragallus nanus, Loco.
Aragallus lagopus, Loco.
Buplcurum americanum, Thoroughwax.
Orcoxis alpina.
Androsace carinata.
Gentiana romanzovi, Dwarf Closed Gentian.
Polemonium confertum, Jacob's Ladder. *H.*
Eritrichium argenteum, Alpine Forget-me-not.
Merlensia brevistyla and others.
Pedicularis parryi, Parry Lousewort. *H.*
Besseya alpina.
Campanula uniflora, Arctic Harebell.
Solidago decumbens, Goldenrod.
Erigeron pinnatisectus, Fleabane. *H.*
Erigeron radicatus, Fleabane. *H.*
Tonestus pygmæus.
Achillea alpicola, Alpine Yarrow.
Artemisia scopulorum, Alpine Sagebrush.
Festuca brachyphylla, Alpine Fescue.
Poa arctica, Arctic Bluegrass.
Poa lettermanni, Bluegrass.
Poa alpina, Alpine Bluegrass. *H.*
Carex engelmanni, Sedge.
Carex albo-nigra, Sedge.
Carex nubicola, Sedge.
Carex atrata, Black Sedge.
Carex phæocephala, Sedge.
Juncoides spicatum, Wood Rush. *H.*

IMPORTANCE OF BOREAL ZONES TO WYOMING AND ADJOINING AREAS.

Climatically and physically unsuited to agriculture, the high altitude Canadian,[1] Hudsonian, and Arctic-Alpine Zones nevertheless are not only a valuable but an essential complement to the lower agricultural areas of Wyoming and most adjoining States. As the chief sources of three great river systems—the Columbia, the Missouri, and the Colorado—their importance is far from local. The great value of the Boreal zones lies in their peculiar adaptation to moisture conservation. This is accomplished climatically on the bleak and barren Alpine slopes and summits, and by plant and forest cover and climate combined in the Hudsonian and Canadian Zones.

[1] See p. 42.

B13494

FIG. 1.—TETON RANGE, MOUNT MORAN SOUTH TO GRAND TETON.

Photograph taken from foot of Jackson Lake, June 5, 1911, by Edward A. Preble.

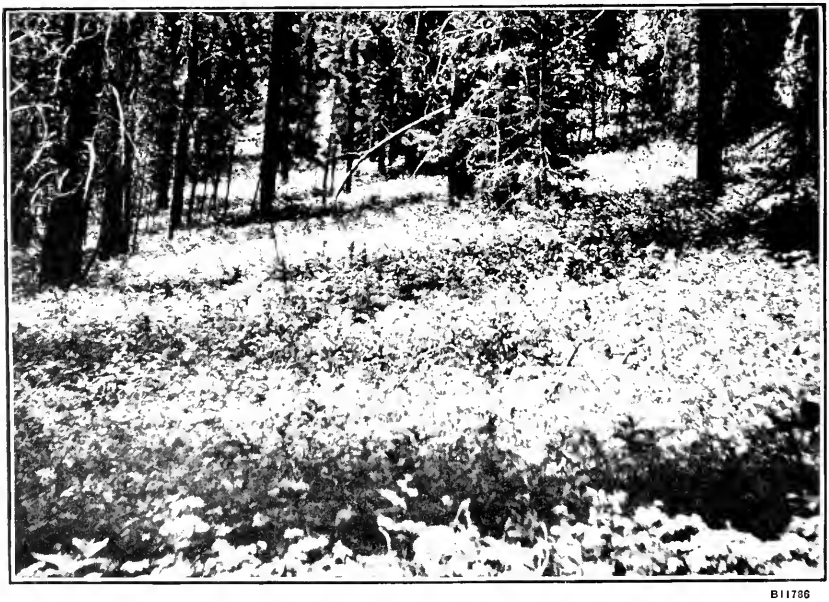
B13628

FIG. 2.—SNOW IN LOWER PART OF HUDSONIAN ZONE (10,800 FEET).

East slope of Bridger Peak, Sierra Madre, July 7, 1911.

B13671

FIG. 1.—HEAVY FOREST OF ENGELMANN SPRUCE, CANADIAN ZONE, WYOMING RANGE WEST OF MERNA (9,000 FEET).



B11786

FIG. 2.—RANK VEGETATION ON FLOOR OF CANADIAN ZONE FOREST, GRINNELL CREEK, ABSAROKA RANGE (7,500 FEET).

A heavy mantle of snow covers the entire Arctic-Alpine cap of the main ranges for seven or eight months of the year (Pl. XIII, fig. 1), while huge drifts and snow fields remain in protected spots throughout the summer. In the timberline region shaded gulches are banked with snow until August, and it is not uncommon to find snowdrifts in the forest depths of the Canadian Zone until midsummer (Pl. XIII, fig. 2), although most of the snow on the lower slopes goes off in flood in May and early June. The summer precipitation is heavy, consisting of rain in the forest belt, and frequent showers and squalls of rain, sleet, and snow on the peaks and higher slopes.

The rotting vegetation and mellow soil of the cool mountain forests are specially adapted to the retention of this moisture, much of which works down from the slowly melting snow banks in the Alpine area. The shaded, mossy forest floor soon becomes saturated, and the water, percolating through the leaves and loose soil, finds its way gradually through rock crevices into ravines and depressions, finally flowing clear and sparkling into the streams lower down. Thus is insured an abundance of pure mountain water to the arid but fertile valleys and plains, and, what is of greatest importance, a fairly uniform volume in the streams toward the end of the growing season, the period when most required by crops. The conversion through irrigation of portions of the valleys of the Snake, Yellowstone, Bighorn, Green, and North Platte Rivers in Wyoming, and especially in neighboring States, as well as of vast tracts as yet undeveloped, into rich agricultural districts is made possible through the combined agency of the climate and the forest and plant cover of the Boreal zones of Wyoming.

The Canadian Zone has large tracts of forest, mainly of lodgepole pine and Engelmann spruce (Pl. XIV, fig. 1), with considerable Douglas spruce on the lower slopes. While these are useful for lumber and other utilities, the intrinsic value is small in comparison with the permanent service they are naturally fitted to perform in connection with the agricultural utilization of the arid regions. Fortunately, most of the timberlands of the Canadian Zone in Wyoming are already included in national forests. Forest control with a view to their conservation is therefore most timely.

While the higher mountain slopes of Wyoming afford a rich pasturage during the summer months for many hundreds of thousands of sheep, careful regulation of sheep grazing is of the utmost importance, as the natural plant cover is a vital factor in catching and holding moisture. (Pl. XIV, fig. 2.) Once this is badly broken up or removed by overgrazing the rains go off with a rush, carrying much of the soil with them. This results in dry, barren slopes, dirty streams, and a greatly diminished flow of water in the lower country during much of the growing season, unless there are adequate water-

storage facilities. Mountains which have been extensively grazed include the Wyoming and Salt River Ranges, the southern end of the Wind River Range below the Big Sandy, Sierra Madre, and the mountains on either side of the Bighorn Basin at its southern end. The mountain meadows and parks with their luxuriant grasses constitute an ideal summer range for cattle, and are extensively utilized for this purpose.

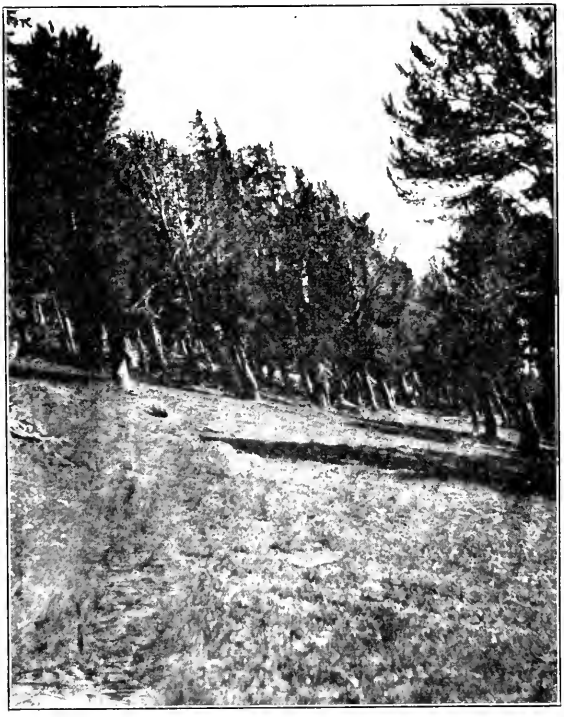
Wyoming offers many attractive regions to the tourist, the sportsman, and to those in search of health or recreation. As a permanent pleasure ground the mountainous region at the northwest is a valuable asset, and is perhaps unsurpassed in extent and rugged grandeur. Dashing trout-filled streams add to the attractiveness of a section full of wild charm and beauty, while the dense forests of Yellowstone Park and the northern end of Jackson Hole afford a safe retreat and breeding range, under Federal and State protection, for many thousands of elk and other large game animals, and insure the best of hunting in season in districts adjacent to these protected areas.

NOTES ON THE DISTRIBUTION OF CONSPICUOUS TREES AND SHRUBS OF WYOMING.

The following annotated list of Wyoming trees and shrubs, while very incomplete, includes principally the more conspicuous and characteristic zone species, and should add to the knowledge of their distribution within the State. It is based chiefly on notes and specimens collected by Biological Survey field parties.

Pinus albicaulis Engelmann. White-Barked Pine. (Fig. 3.)

The small white-barked pine in Wyoming is peculiar to the high altitudes of the northwest, where it is a characteristic tree of the Hudsonian Zone just below timberline. It occurs on all the lofty mountains, finding its southern limits in the main chain of the Rockies on the Wind River and Salt River Ranges. At timberline it is often the most abundant tree, especially on parts of the Absaroka Range, but usually shares this bleak region with dwarfed alpine firs and Engelmann spruces, pushing up dry slopes and crests of exposed ridges in ascending tongues, while the spruces and firs occupy wet gulches and the deeper-soiled slopes.



B11788

FIG. 3.—Forest of white-barked pine (*Pinus albicaulis*) just below timberline on west slope of Whirlwind Peak, Absaroka Range (9,800 feet).

Pinus flexilis James. Rocky Mountain White Pine.

The Rocky Mountain white pine has a general dispersion in upper Transition and Canadian Zones in all except the northeast corner of the State. It has its center of abundance with the Douglas spruce along the lower edge of the Canadian forest belt, occupying the ridges and dry slopes, while the spruces are in gulches and on steep, cold exposures. There are few gravel or rocky ridges on the high central and western plains and deserts that do not have more or less of this pine in scattered and usually somewhat ragged growth. In Wyoming it is a small tree, rarely attaining a height of more than 30 or 40 feet or a diameter above 1½ feet under most favorable conditions. Its usual

habit of growth is scattering and patchy, but in deep-soiled mountain districts it often produces groves of considerable extent.

Pinus scopulorum (Engelmann) Lemmon. Rocky Mountain Yellow Pine.

The distribution in Wyoming of the Rocky Mountain yellow pine, a well-known Transition Zone tree, is mainly west to the eastern slopes of the Bighorn Mountains and the region of the upper Platte, as follows: Black Hills, heavy open forest to 6,000 or 6,500 feet altitude; Bear Lodge Mountains, moderate growth with oaks, 3,500 to 6,000 feet; Colony, low ridges; throughout the borders of Cheyenne River drainage, in scattering pockets and fringe; watersheds between Belle Fourche and Tongue Rivers, in thin forest over roughest sections; lower eastern slopes of Bighorn Mountains, tolerably wide belt up to 6,000 or 7,000 feet; foothill region of Casper Mountains south throughout the length of the Laramies, including the Hartville group east of the Platte, in usually good growth; divide southeast of Efell; Pine Mountain south of Natrona; borders of North Platte Valley, between Alcova and Leo, and along north base of Shirley Mountains, scattering trees; Seminole Canyon on the Platte, heavier growth; Rock River, ridges; Woods, Medicine Bow Range, some at lower edge of coniferous forest; basal slopes of Sierra Madre south of Downington; and canyons near the mouth of Grand Encampment River. This pine was not found in western Wyoming, although doubtless there are scattering trees on the basal slopes of some ranges.

B11660M

FIG. 4.—Forest of Engelmann spruce (*Picea engelmanni*) on north slope of Ferris Mountains (9,000 feet).

The yellow pine yields valuable lumber mainly in the Black Hills, Bear Lodge and Bighorn Mountains, and on the Laramies in the region north of Laramie Peak. Elsewhere its growth is generally more or less scrubby.

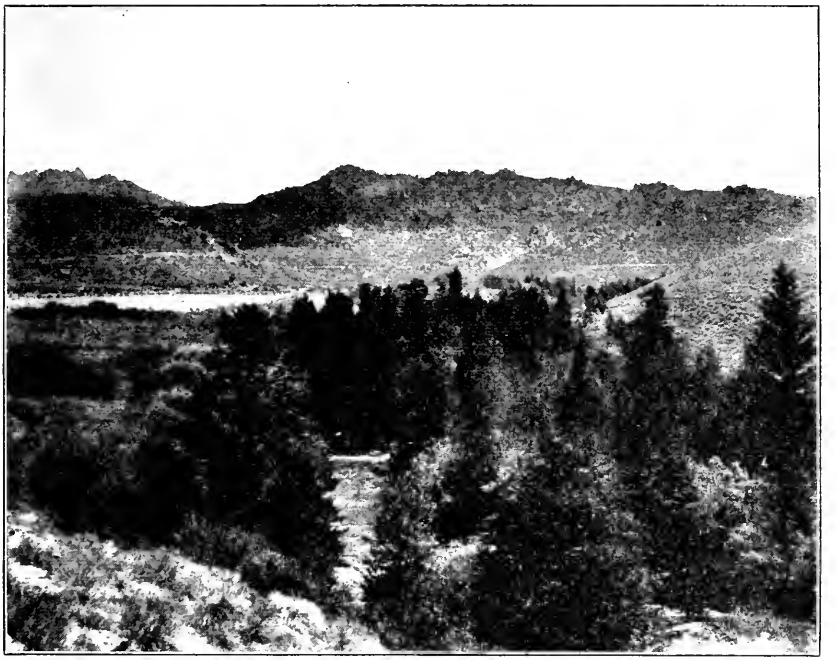
Pinus murrayana Balfour. Lodgepole Pine.

The coniferous element of the Canadian forest belt in Wyoming is chiefly of lodgepole pine and Engelmann spruce. The pines, although occurring throughout the full width of the Canadian Zone, reach their greatest abundance and heaviest and purest stand in its lower half. The best forests are on the main ranges, varying in elevation from 8,500 to 10,000 feet on the Sierra Madre at the south; 8,000 to 9,500 feet on the Wind River Range; and 7,000 to 9,000 feet in Yellowstone Park, the northern Absarokas, and on the eastern slopes of the Bighorns.

The lodgepole pine forests of Wyoming are of great value, but have been extensively levied upon for ranch fences, railroad ties, mine lagging, and lumber, and extensive tracts have been destroyed by fire. The deforested areas are now largely grown up with second-growth pine and aspen.

Pinus edulis Engelmann. Pinyon; Nut Pine.

The pinyon, a small representative of the Upper Sonoran Zone, barely enters Wyoming in the lower valley of Green River. Scattering trees were found at 7,000 feet elevation on the north face of a juniper ridge 3 miles north of the Utah boundary and the same distance east of Green River. The pinyon may possibly occur elsewhere in this rough juniper-clad ridge and



B13664

FIG. 5.—Fringe of blue spruce (*Picea parryana*) on the Big Sandy, southwest base of Wind River Range (7,500 feet).

mesa country, but it was not detected from Green River east to Red Creek, and thence north to Rock Springs.

Picea engelmanni (Parry) Engelmann. Engelmann Spruce. (Fig. 4.)

The Engelmann spruce is the principal conifer in the upper part of the Boreal forest belt on the high ranges of northwest Wyoming, and also on the Bighorn, Sierra Madre, and Medicine Bow Ranges. Next to the lodgepole pine it is the most abundant forest tree of Yellowstone Park. Although of regular occurrence at timberline in a dwarfed state, this spruce belongs to the Canadian Zone, attaining its maximum growth on cold, damp slopes and in bogs between 8,000 and 9,000 feet. It does not attain its best development in dry situations or on warm slopes, where it is found at a somewhat higher level.

Picea parryana (Andree) Sargent. Blue Spruce. (Fig. 5.)

The blue spruce occurs chiefly in western Wyoming north to Jackson Lake and the head of Wind River, but was also noted at Woods and in gulches south

of Sherman, and should be present elsewhere in the southern mountains. It inhabits the margins of cold streams in the lower border of the Canadian forest belt between 7,000 and 8,000 feet elevation (6,500 to 7,500 feet in Jackson Hole), forming usually a most attractive fringe of scattering symmetrical trees.

Abies lasiocarpa (Hooker) Nuttall. Alpine Fir.

The alpine fir has much the same distribution and vertical range as the Engelmann spruce, although generally less abundant and growing in scattered thicket formation, rarely forming a heavy forest. With the spruce it extends regularly to timberline on the Wyoming ranges, where it is the more common of the two and forms dense prostrate mats on the bleak, wind-swept slopes. This fir is partial to cold gulches, stream banks, and damp spots generally. It may be seen to best advantage in typical growth as dark scattered clumps in aspen woods. While usually a small tree, it attains large size in gulches and on streams in the higher portions of Yellowstone Park, where it forms forests of considerable extent above 8,000 feet altitude. It was observed on all the mountains except the Bear Lodge and Black Hills groups at the northeast.

B11631

Fig. 6.—Forest of Douglas spruce (*Pseudotsuga mucronata*), north slope of Ferris Mountains (8,500 feet).

Abies (concolor?) Lindley. White Fir.

The white fir (apparently *Abies concolor*) forms small forests below 9,000 feet elevation on the northern shoulders of the Uinta Mountains west of Lonetree, and is present also in fairly good stand with aspens on the summit of the plateau west of Maxon. Firs which were common at 8,000 feet on the western slopes of the Salt River Range near Afton also had smooth, dark-gray bark and were unquestionably distinct from the light-barked *A. lasiocarpa* on the upper slopes of the same mountains above 9,000 feet. Unfortunately no specimens were preserved from the above localities.

Pseudotsuga mucronata (Rafinesque) Sudworth. Douglas Spruce. (Fig. 6.)

The Douglas spruce has a wide distribution in upper Transition and lower Canadian Zones from the Laramie and Bighorn Mountains westward. It was not observed on the Black Hills or Bear Lodge Mountains. This spruce grows chiefly at the lower edge of the lodgepole pine belt on the main ranges of

western Wyoming, reaching down to open sagebrush slopes on their basal flanks, and on the Bighorns and Laramies, extending down into the upper part of the yellow pine belt. It varies locally as to abundance from a thin fringe of scattering trees and thickets on cool declivities and in gulches (which is usual), to a wide belt of heavy pure forest of lumber size.

Juniperus scopulorum Sargent. Rocky Mountain Juniper.

The most conspicuous and widely distributed juniper in the State is the Rocky Mountain juniper, occurring from the barren rocky ridges, canyons, gulches, and badlands bluffs on the Sonoran plains and deserts, up through the Transition Zone, where it mingles with yellow pines, Douglas spruces, and Rocky Mountain white pines on the lower mountain slopes. This juniper is of scattering growth along the bases of mountains and on the margins of the desert basins and valleys, and does not form a well-defined belt along the upper edge of the Upper Sonoran Zone as it often does in the southern Rocky Mountains.

Juniperus knighti A. Nelson. Desert Juniper.

The distribution of the desert juniper is imperfectly known, owing to very scattering field work in the difficult Red Desert region which it inhabits. The few localities from which there are specimens indicate a restricted range, mainly in the Upper Sonoran Zone. S. G. Jewett collected the species at Mountainview, on May 27, 1913, and it appears to be the dominant juniper at Rock Springs, near Carter, and in the badlands to the south and east of Lyman. On the Green River bluffs near the Utah boundary *Juniperus monosperma* is not uncommon, and on the higher borders of the Red Desert *J. scopulorum* is the common species. The desert juniper is usually of shrubby stature, branching from the base, and scarcely attains the dignity of a tree. Nelson found the species on the sandstone bluffs of the Bitter Creek drainage, and records specimens from Point of Rocks and Rock Springs.[1]

Juniperus monosperma Engelmann. One-Seeded Juniper.

The one-seeded juniper is found at the northern base of Owl Creek Mountains west and southwest of Thermopolis; at Hailey, southeast of Lander; along the Platte near Alcova in canyons and on dry slopes up to 6,300 feet elevation; and on the rough breaks along the lower Green River Valley, particularly on the east side between Sage Creek and the Utah boundary. It is tolerably common on the Snake River bluffs near Baggs and is probably the species which forms a considerable belt along the western bases of the Sierra Madre. It was noted only in the Upper Sonoran Zone, extending up to 7,500 feet on the hot slopes east of Green River near the State line.

Juniperus sibirica Burgsdorff. Low Juniper.

The low juniper, a graceful evergreen, is a characteristic undershrub in the Boreal forest belt throughout the Wyoming mountains. On most of the loftier ranges it extends to timberline, where it forms dense prostrate mats among rocks. Its center of abundance is in the Engelmann spruce and lodgepole pine forests of the Canadian Zone.

Juniperus communis Linnaeus. Mountain Juniper.

Not infrequent in mountain forests at lower elevations than the low juniper. The shrubby mountain juniper was noted as follows: Foothills west of Wheatland, 5,500 feet; Springhill; near Sundance; Wolf, north base of Bighorn Mountains, 6,700 feet; head of Pat O'Hara Creek, northwest of Cody.

[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 54, 1898.

Juniperus sabina Linnaeus. Creeping Juniper; Trailing Savin.

Mats of the creeping juniper, or trailing savin, are conspicuous on dry gravel ridges and exposed points and summits of high hills along the northern edge of Wyoming between the Bighorn and Bear Lodge Mountains. The species extends west at least to the eastern base of the Absaroka Range, but is of more general distribution in the northeast. It was not found in other sections of the State. The habitat of this species is in the Transition and lower Canadian Zones.

Populus tremuloides Michaux. Aspen Poplar. (Fig. 7.)

The Boreal aspen poplar is generally dispersed at suitable elevations, but does not, as a rule, reach large size in the Wyoming mountains. It commonly occurs in thickets 10 to 20 feet high on damp, cold slopes, as undergrowth in the coniferous forests, or as first growth on burned-over tracts. Low, scraggy thickets of aspen are on most of the cold slopes and draws above 7,500 feet altitude on barren elevations of the southwest, as the Aspen Mountains, Bear River Divide, and the high plateaus east of Green River near the southern boundary of the State. Beautiful aspen groves were noted, however, between 8,000 and 9,000 feet on the lower southern slopes of the Wind River Range east of Leckie, on the divide between Hoback and Green Rivers, and on the northern shoulders of the Uinta Mountains southeast of Hilliard. The aspen is perhaps the best characterizing tree of the Canadian Zone.

B11622

FIG. 7.—Grove of aspen poplar (*Populus tremuloides*) near Springhill, north base of Laramie Peak (6,000 feet).

Populus balsamifera Linnaeus. Balsam Poplar.

The balsam poplar inhabits the borders of many of the larger streams in the northwestern mountains, being largely confined to the Canadian Zone between 6,500 and 7,500 feet elevation. It occurs south in the Jackson Hole country at least to the Gros Ventre River. Scattering trees are found also in wet gulches at the southern base of the Bear Lodge Mountains near Sundance at about 5,000 feet elevation.

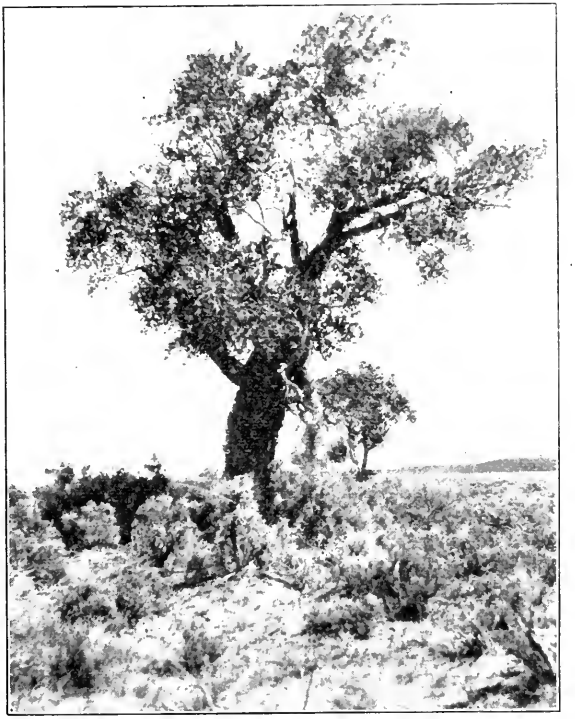
Populus occidentalis (Rydberg) Britton. Broad-Leaved Cottonwood.

The broad-leaved cottonwood, characteristic of the Upper Sonoran Zone, forms the principal fringe on the streams of eastern and northern Wyoming,

attaining perfection of growth in the lowest and warmest valleys. Large groves border the Bighorn, Belle Fourche, and especially the streams of the lower Platte drainage. There is a great deal of cottonwood growth on the Cheyenne River and other streams southwest of the Black Hills, but in this section the species grows in a very stunted state, low and irregular and very thick at the the base. In the Wheatland district it occurs in places in heavy growth with *Populus acuminata*, and along the base of the mountains generally meets and commingles with the narrow-leaved Transition species, *P. angustifolia*.

Populus acuminata Rydberg. Lance-Leaved Cottonwood.

On the Chugwater, Sibylee, and other tributary streams of the Laramie and North Platte Rivers east of the mountains the lance-leaved cottonwood forms in many places a heavy fringe with *Populus occidentalis*, though by no means so generally distributed as the latter species. A splendid growth of the lance-leaved cottonwood is on Sibylee Creek southwest of Wheatland. The species was not noted in northern Wyoming, but at the west scattering trees are on Green River, just north of the Utah line.



B11692

FIG. 8.—Large narrow-leaved cottonwood (*Populus angustifolia*) on sage flat in upper Wind River Valley.

Populus angustifolia James. Narrow-Leaved Cottonwood. (Fig. 8.)

The narrow-leaved cottonwood inhabits the borders of mountain streams in the Transition Zone, mainly at elevations from 6,000 to 7,500 feet at the west, extending down to 5,000 feet in the central districts, and to 4,500 feet at the eastern base of the Bighorn Mountains. It is apparently absent from the northeastern part of the State. Important streams bordered with good growth include the Bear, Green, Wind, and Greybull Rivers, the north and south branches of the Shoshone River above the forks, Snake River below the mouth of the Gros Ventre, and the upper North Platte down to 18 miles above Casper. Unusually fine groves are on Wolf and Big Goose Creeks, at the eastern base of the Bighorns.

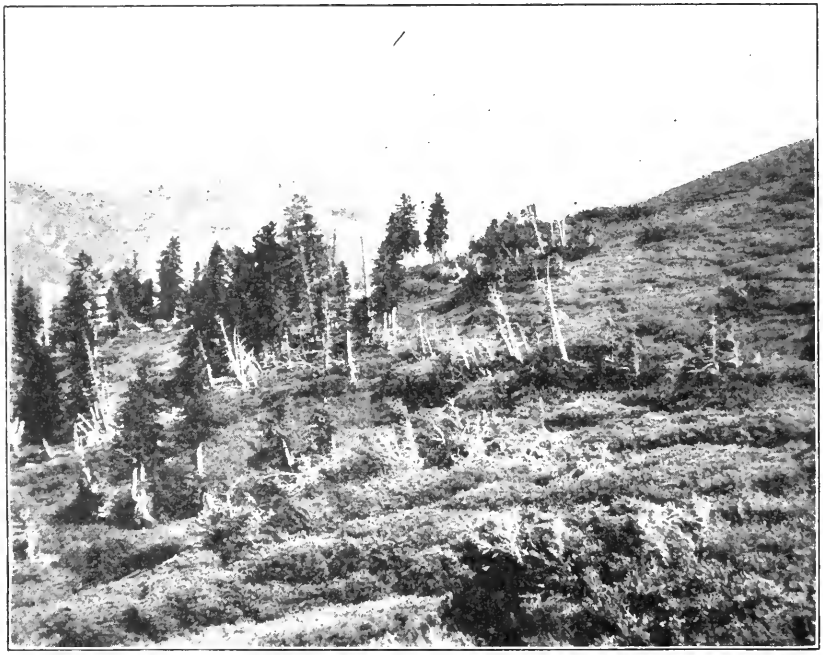
Salix amygdaloides Anderson. Peach-Leaved Willow.

The large peach-leaved willow occurs in scattered clumps along streams in the Upper Sonoran Zone, chiefly at the east and north, as follows: Chugwater Creek and affluents; Little Bear Creek northeast of Meadow; Sibylee Creek west of Wheatland; Rawhide Creek to base of Rawhide Butte; near Lusk; Hay

Creek east of Aladdin; Wind Creek northeast of Moorcroft; Sheridan; Arvada; Clear Creek, Clearmont to Buffalo; Bighorn River and tributaries near Thermopolis; and Green River near Utah boundary.

Salix bebbiana Sargent. Bebb Willow.

The Bebb willow is characteristic on foothill and lower mountain slopes up to about 9,000 feet altitude, and there are few if any ranges in Wyoming where it is not present. The usual growth is in scattered clumps about springs and bogs, but occasionally there is a heavier stand on the margins of mountain streams. The height attained seldom exceeds 12 or 15 feet, and 8 or 10 feet is usual. Specimens were taken on the Laramie, Bear Lodge, Bighorn, and Wy-



B11749

FIG. 9.—Terraced copses of gray-leaved willow (*Salix glaucops*) at timberline, Needle Mountain, Absaroka Range.

ening Ranges, and at Evanston, while it was observed at a wide range of localities. Nelson records it from Creston, on the open Red Desert.[1]

Salix pyrifolia obscura Anderson. Willow.

Another willow, *Salix pyrifolia obscura*, was collected in the upper forests on the Wyoming Range west of Merna, between 9,000 and 10,000 feet altitude, in the Canadian Zone. It is tolerably common at this locality.

Salix nelsoni Ball. Nelson Willow.

Vernon Bailey collected the Nelson willow along the Hudsonian crest of the Salt River Range at 10,000 feet elevation, August 20, 1911.

Salix glaucops Anderson. Gray-Leaved Willow. (Fig. 9; Pl. XI, fig. 2.)

The gray-leaved willow is a low species of Alpine bogs, growing in dense copses about 2 feet high near timberline on the Bighorn, Wind River, and

[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 59, 1898.

Absaroka Ranges, and doubtless elsewhere. On Whiskey Mountain, south of Dubois, a few blossoms were out on May 14, 1910, but the leaves had not unfolded. The species was not in leaf by June 5 at timberline on the Bighorn above Hyattville. It was very abundant on Needle Mountain, Absaroka Range, in beautiful terraced copse formation, and likewise on the Wind River Mountains south of Fremont Peak.

Salix petrophila Rydberg. Rock Willow.

The rock willow was collected on the Alpine slopes above timberline at the head of Bull Creek, Wind River Range, in August, 1893, by Vernon Bailey.

Salix tenera Anderson. Alpine Rock Willow.

Low dense mats of the Alpine rock willow, which is very abundant on Whirlwind Peak, in the Absaroka Range, cover portions of these slopes between 10,000 and 11,000 feet elevation.

Salix nivalis Hooker. Alpine Willow.

The dwarf alpine willow is tolerably common on the bleak slopes above timberline on the Wind River Range, occurring among the rocks in dense creeping mats a few inches high. It is abundant south of Fremont Peak from 11,500 feet upward.

Salix saximontana Rydberg. Net-Veined Willow.

More generally dispersed on the Wyoming ranges than the other Alpine willows, but similar in habit of growth, *Salix saximontana* occasionally extends a little below timberline. It is especially abundant at the northern end of the Teton Range, where the creeping mats are very extensive, and push down the cool Hudsonian slopes to 9,500 feet altitude.

Ostrya virginiana (Miller) Willdenow. Ironwood.

Vernon Bailey reports the ironwood as abundant in Sand Creek canyon above Benlah, at the northern base of the Black Hills. The species closely approaches the Wyoming boundary in northwestern Nebraska, 8 or 10 miles east of Kirtley, Wyo., where it is not infrequent in wooded canyons along the northern escarpment of Pine Ridge.

Corylus rostrata Aiton. Beaked Hazelnut.

The beaked hazelnut is abundant on the upper slopes of the Bear Lodge Mountains and Black Hills, forming dense undergrowth in aspen and birch thickets between 5,500 and 6,000 feet altitude. It appears to be absent from the main ranges in Wyoming.

Betula papyrifera Marshall. Canoe Birch. (Fig. 10.)

The canoe birch apparently reaches its southern limits on the Bear Lodge Mountains and northern Black Hills. Over this region it grows to medium size, and with the aspen occurs in dense thickets on cool, shaded slopes and in damp spots as low as 5,000 feet altitude, and on Sundance Creek scattering trees of good size are found at 4,700 feet. On the dry upper slopes of the Bear Lodge Mountains this birch becomes very scrubby. It is apparently absent from the Bighorn Mountains and the ranges of western Wyoming.

Betula fontinalis Sargent. Rocky Mountain Birch. (Fig. 11.)

The Rocky Mountain, or black, birch borders often in dense growth most of the streams on the basal slopes of the mountains, and under the cooling influence of the mountain water extends some distance out onto the plains. At the base of the Bear Lodge Mountains it is common at 4,000 feet altitude, but farther

west it is usually present between 6,000 and 7,500 feet. On warm exposed slopes of the Wind River Range north of Big Sandy it extends to 8,000 feet.

Betula glandulosa Michaux. Dwarf Birch.

The dwarf birch was noted only in the mountain valleys of the northwest, from Yellowstone Park (West Gallatin and Lewis River meadows) south to the Wyoming Range (South Piney canyon at 7,500 feet altitude), in the Canadian Zone. This little birch is especially abundant in the extensive willow bogs and swamps bordering Jackson Lake, where it occurs in dense thickets 3 or 4 feet high. Its leaves had mostly turned to a deep Indian red and a few were falling in Jackson Hole by September 13, 1910. It was noted also as follows: Head of Pacific Creek, near Two Ocean Pass; and Horse Creek meadows, at Merna, 8,000 to 9,000 feet.

B14338

FIG. 10.—Thicket of canoe birch (*Betula papyrifera*) in gulch near Sundance, Bear Lodge Mountains.

Alnus tenuifolia Nuttall. Alder. (Fig. 12.)

The alder is found in a growth of varying density on the upper reaches of cold mountain streams, and with many other Canadian Zone species follows the cold conditions on their margins down for some distance into the Transition Zone. It is most abundant in the mountainous northwest, and was not noted in the Bear Lodge Mountains or on the northern groups of the Laramie Range.

Ulmus americana Linnæus. Elm.

The elm penetrates Wyoming for a short distance in the low valleys at the northeast. It was common and growing to large size on Sand Creek to 10 miles above Beulah at the northern base of the Black Hills, and on Hay Creek west to Aladdin and Eothen, while it is reported at Hulett in the Belle Fourche Valley. Vernon Bailey found it on Little Powder River near Morse.

Quercus macrocarpa Michaux. Bur Oak.

The bur oak extends into Wyoming from the northeast and is found in abundance over a small area in Crook County, principally east of the Belle Fourche River and north of Linden and Inyankara. It occurs in scattered groves on the partially open basal flanks of the Bear Lodge Mountains and at the northern base of the Black Hills, extending to the dry Bear Lodge summits at 6,000 feet elevation, where Vernon Bailey found scrubby thickets 4 or 5 feet

high, loaded with acorns, in August, 1913. In some of the stream valleys the bur oak grows to large lumber size, notably on Sand Creek above Beulah, and many trees were there noted with clean straight trunks of good height from 3 to 4 feet in diameter at the base. The vertical range of this oak is about the same as that of the yellow pine, with which it usually commingles in this region. Vernon Bailey noted a little oak growth near the head of the Little Missouri River, apparently its western limit in the State.

Atriplex canescens James. Saltbush; Gray Shadscale.

The various saltbushes are characteristic Sonoran species of the arid Great Basin region, and barely enter the Great Plains area on some of the dry valley

B11637

FIG. 11.—Clumps of Rocky Mountain birch (*Betula fontinalis*) 15 feet high, at north base of Shirley Mountains.

flats at the eastern base of the foothills. They are mostly alkali-resistant and, with the possible exception of *Atriplex canescens*, furnish valuable winter forage for sheep in the central desert sections. Of the three principal shrubby species found in Wyoming, *A. canescens* is the least abundant. It is apparently absent from the Red Desert proper where *A. confertifolia* and *A. nuttalli* abound, but extends farther to the east than either of the foregoing. *Atriplex canescens* occurs in very dense growth 3 feet or more high on dry flats along the Chugwater at Bordeaux, and also in the sand along the Laramie at Uva, but is in scattering growth elsewhere.

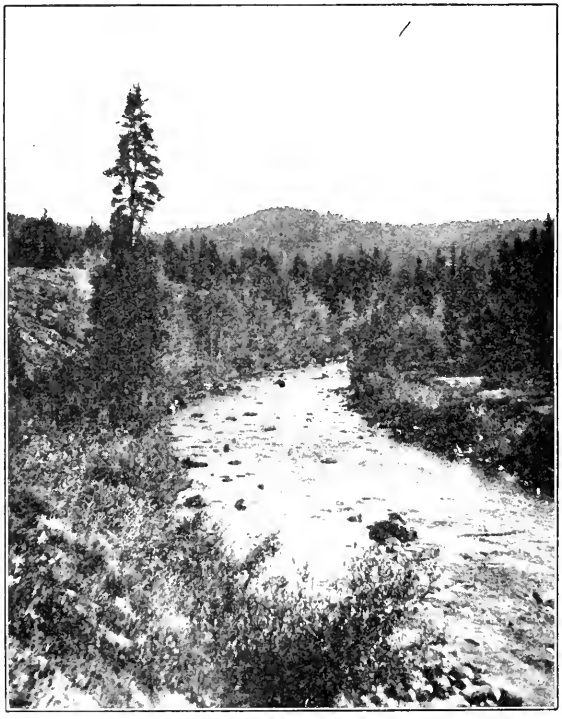
Atriplex confertifolia S. Watson. Round-Leaved Saltbush.

The round-leaved saltbush is a low stocky shrub 1 or 2 feet high, very abundant on sandy and alkaline soils up to 7,500 feet elevation on warm slopes east of Green River near the Utah line; bad lands south of Lyman, to 7,000 feet;

Bear River below Evanston, to 6,600 feet; Fossil; Bigpiney; Dubois; Trout Creek, north Shoshone Valley; Bighorn slopes above Hyattville, to 5,500 feet; north base of Rattlesnake Mountains, to 6,500 feet; Splitrock, Sweetwater Valley; east to Fort Steele, Shirley, Old Fort Fetterman, and Arvada.

Atriplex nuttalli S. Watson. Nuttall Saltbush. (Pl. IV, fig. 2.)

The Nuttall saltbush, a low-spreading species, commonly known as "salt sage" to the sheepmen, is of great economic value, as it affords the chief winter food to the flocks on the Red Desert. It has about the same range as *Atriplex confertifolia*, but is seldom found in sand, being partial to dry adobe and saline flats, where it forms often the dominant plant growth. Extensive flats at Frannie and elsewhere in the Bighorn Basin are covered with a pure and uniform growth of this saltbush. The observed eastern limits are Walcott; Little Medicine Bow River west of Marshall; Indian Creek at State line north of Kirtley; Newcastle; and Colony.



BII829

FIG. 12.—Fringe of alder (*Alnus tenuifolia*) on Pacific Creek below Two Ocean Pass.

Grayia spinosa Moquin. Grayia.

A characteristic spiny shrub of the Sonoran desert tracts from the Sweetwater Valley westward, especially abundant in sandy or adobe soils at the lowest levels. On the sandy hummocks between Frannie and Garland at the end of June dense clusters of flat, winged seeds were borne in great profusion on the grayia bushes. These varied from greenish to pink or purple-brown and lent a peculiar hue to the landscape. This shrub has considerable forage value, as its thick leaves and seeds, gathered into drift piles under the bushes, are eagerly eaten by sheep in winter.

Grayia spinosa was common from Independence to Splitrock; Dry Lake to Lorey; on first and second benches above the Platte at Fort Steele; Worland; Manderson; Bonanza; Greybull west nearly to Cody; Rock Springs region; Green River near Utah line; Carter to Lyman; bad lands south of Lyman; Cumberland; Fontenelle to Opal; and Green River flats north nearly to Labarge.

Sarcobatus vermiculatus Torrey. Greasewood. (Pl. IV, fig. 1.)

This common desert shrub is of wide dispersion in the more arid portions of the Upper Sonoran Zone and was noted at numerous localities. It

forms a very rank growth on the dry alkaline lake basins and flats of central Wyoming, especially in the Red Desert region, where its dark-green foliage and large size make it the most conspicuous of the alkali-resistant shrubs. The greasewood follows dry adobe valley flats to about 7,000 feet elevation.

Berberis aquifolium Pursh. Barberry; Oregon Grape.

The Oregon grape, a low undershrub, is characteristic of dry forested or partly wooded slopes throughout the State, mainly in the Transition Zone. It is commonly associated with the bearberry, with which it penetrates to the lower edge of the Canadian forest belt. On the Ferris Mountains it was noted at 8,700 feet altitude, and on the west side of the Salt River Range was common to 9,000 feet.

Ribes longiflorum Nuttall. Flowering Currant.

In early summer the brush fringe along streams at the lower elevations is enlivened by the yellow bloom of the flowering currant. This shrub is a characteristic Sonoran species, but is perhaps most conspicuous at the base of the mountains, where it penetrates the foothills for some distance in warm stream valleys. Its upper limits were observed as follows: Foothills west of Wheatland, to 5,300 feet altitude; eastern base of Bighorn Mountains; Greybull River at Meeteetse; Pat O'Hara Creek to 6,000 feet; south slope of Owl Creek Mountains to 7,000 feet; Bull Creek, Wind River Valley; streams of Salt River Valley; Evanston and west slope of Bear River Divide to 7,500 feet; Mountainview; and Henry's Fork of Green River to Burntfork P. O.

Ribes inebrians Lindley. Red Currant.

The red currant is widely distributed in the Transition Zone over most of Wyoming, extending regularly to the lower edge of the Canadian Zone. Flowering specimens were taken in the Laramie foothills west of Islay on June 16, 1909, and near Merna, Wyoming Range, at 8,000 feet altitude, as late as August 10, 1911. This species is partial to rocky situations.

Ribes montigenum McClatchie. Bristly Red Currant.

A high-altitude species, the bristly red currant has a general distribution on the higher Wyoming ranges. It is most abundant near timberline, where it occurs either as scattering bushes in slide rock, or in dense patches a foot or two high on deep-soiled slopes, as on the Wyoming Range west of Merna. It was in flower on the summit of Bridger Peak in the Sierra Madre, on July 7, 1911, and still so on the high Wind River Range south of Fremont Peak on July 18. The red, edible fruit was abundant and fully ripe in the timberline region on the Teton Range on August 30, 1910. It was found in abundance on the high ridge extending north from Needle Mountain, in the Absaroka Range, between 10,000 and 11,000 feet elevation; and also on the Salt River Range, above 9,000 feet.

Ribes lacustre (Persoon) Poiret.

This species occurs in Canadian Zone forests in northwestern Wyoming. It was still in flower near the upper end of Fremont Lake on July 15, 1911, but was bearing fruit on Grinnell Creek, Absaroka Range (8,000 feet altitude), July 30, 1910. Specimens were collected at both localities.

Ribes petiolare Douglas. Mountain Black Currant.

The mountain black currant, a wide-ranging Boreal species, was collected on the summit of the Bear Lodge Mountains on June 20, 1912, where it was not uncommon on the dry crests at 6,000 feet elevation. Flowering specimens were

also taken in the Canadian Zone forest near the upper end of Fremont Lake, Wind River Range, July 15, 1911, and fruiting specimens at Tower Falls, Yellowstone Park, August 11, 1910. It is especially abundant in the Yellowstone Park forests.

Ribes viscosissimum Pursh. Currant.

This currant is characteristic of the Canadian Zone forest belt in northern Wyoming. Flowering specimens were taken at 8,500 feet elevation on the head of Shell Creek, Bighorn Mountains, June 5, 1910; near the upper end of Fremont Lake, Wind River Range, July 15, 1911; and at 8,000 feet on Grinnell Creek, Absaroka Range, as late as July 30, 1910. Vernon Bailey collected the species on Wolf Creek, northern slope of the Bighorns, August 10, 1913.

Edwinia americana (Torrey and Gray) Heller. Edwinia.

The low flowering edwinia was found only on the crest of the Laramie Range east of Laramie, between 8,500 and 9,000 feet elevation. Its handsome white cymous bloom enlivened the rock ledges and cliffs on June 18, 1909.

Cercocarpus ledifolius Nuttall. Mountain Mahogany.

The mountain mahogany is a small evergreen tree or stout shrub peculiar to rocky plateaus and ridges and warm exposed basal slopes of mountains. In Wyoming a scattering distribution is indicated from the lower Green River Valley north to Jackson Hole, in the Transition Zone. Most of the rocky ridges adjacent to Green River near the Utah boundary are clothed up to 7,500 feet elevation with dense scrubby thickets from 3 to 6 feet in height. The species was not found farther north in the Green River country, but enters the State from the west along Snake River, and covers in good growth the more exposed of the lower western slopes of the Salt River Range east of Afton and Smoot up to 7,500 feet. Its upper limits in the Snake River drainage are reached apparently near Jackson, where Edward A. Preble found a considerable growth on a warm slope at 7,000 feet in a tributary gulch of Cache Creek.

Cercocarpus intricatus Watson. Mountain Mahogany. (Pl. XV, figs. 1 and 2.)

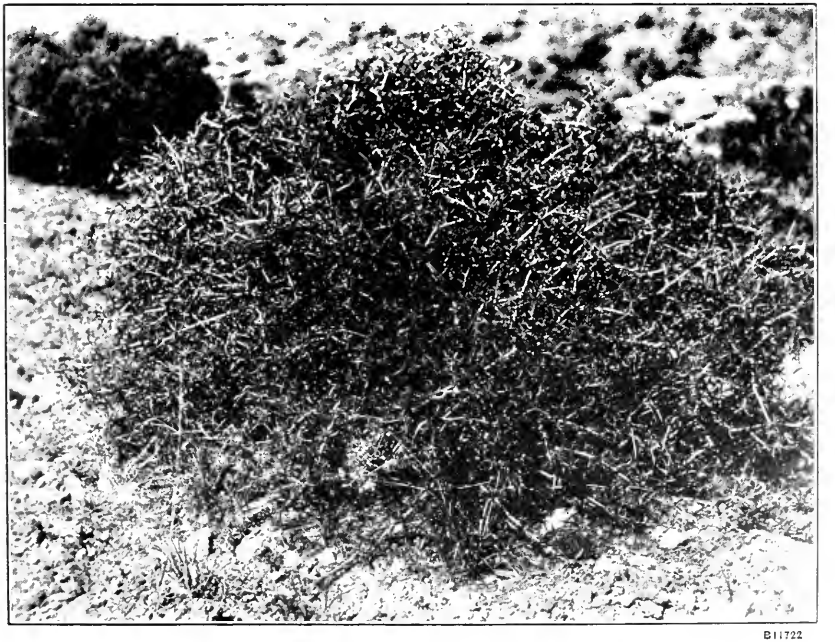
An abundant evergreen shrub on warm open slopes of the Bighorn Mountains. On the eastern side scattering bushes dot the bare Tongue River bluffs at Ranchester. The species forms dense thickets 3 feet high at about 5,000 feet altitude near Eaton's Ranch, and thence it ascends dry, rocky ridges to 6,500 feet on bare exposed points in the mountains south of Wolf. On the warm western side of the Bighorns above Hyattville *Cercocarpus intricatus* was not seen below 5,800 feet, but between 6,000 and 6,500 feet the dry, hot, reddish slopes were dotted with this intricately branched, steely gray shrub.

Cercocarpus parvifolius Nuttall. Mountain Mahogany. (Pl. II, fig. 1.)

This mountain mahogany occurs mainly in the Transition Zone in Wyoming, although in the southern Rocky Mountains its center of abundance is in the juniper and pinyon belt of the Upper Sonoran Zone. It is partial to warm, rocky situations, either partly open foothill slopes or outlying ridges and buttes on adjacent plains or deserts. The largest growth of mountain mahogany observed was fully 9 feet high, on the pine-clad foothills southwest of Wheatland, at 5,300 feet altitude. The usual height attained is from 4 to 6 feet. Unusually extensive thickets grow on open ridges paralleling the Horse Creek valley between Davis Ranch and Meadow. This shrub flowers early in June, but occasionally a little later. A flowering specimen from Steamboat Mountain was collected June 26, 1913. The distribution of *Cercocarpus parvi-*

B11723

FIG. 1.—MOUNTAIN MAHOGANY (CERCOCARPUS INTRICATUS).
West slope of Bighorn Mountains above Hyattville (6,000 feet).



B11722

FIG. 2.—NEARER VIEW OF SAME.

jolins as noted by Survey parties is entirely south of a line from Newcastle in the northeast to Evanston in the southwest.

Kunzia tridentata (Pursh) Sprengel. Antelope Brush.

The antelope brush is a common shrub on dry open Transition slopes in southern and western Wyoming, being especially abundant on arid hills, plateaus, and occasional sand ridges in the borders of the Red Desert at elevations between 7,000 and 8,500 feet. It was not noted north of the Wind River, Rattlesnake, and Casper Ranges, but it is not uncommon on dry slopes and sagebrush flats south of Buffalo Creek and the Gros Ventre River in Jackson Hole. With the sagebrush (*Artemisia tridentata*) this shrub regularly ascends warm slopes and occurs in dry parks and openings to the lower edge of the Canadian Zone. Its vertical range varies from 4,500 feet on ridges along the North Platte near Glendo to 9,000 feet on the summits of the Laramie and Ferris Ranges, and also on the warm southern slopes of the Wind Rivers north of Big Sandy.

Holodiscus dumosus (Nuttall) Heller.

Common locally on rocky slopes in some of the dry desert mountains and in the rougher borders of the Red Desert, mainly in the Transition Zone.

Opulaster pubescens Rydberg. Ninebark.

On dry, steep, basal mountain slopes at the head of Pat O'Hara Creek, northwest of Cody, the ninebark forms a low but exceedingly dense chaparral among partly dead Douglas spruce and white pine forests up to 6,500 feet elevation. Along the northern base of the Bighorn Mountains near Wolf it was likewise partial to dry slopes between 5,000 and 7,000 feet.

Opulaster monogynus (Torrey) Kuntze. Western Ninebark.

The western ninebark, a Transition Zone shrub, is tolerably common on the Laramie Mountains and on outlying ridges of the plains region to the eastward, at elevations between 5,000 and 7,000 feet.

Opulaster malvaceus (Greene) Kuntze. Ninebark.

This ninebark is very abundant and conspicuous on the warm western slopes of the Salt River Range near Afton, but was not found elsewhere. Its vertical range in these mountains is from their bases up to 7,100 feet in canyons and to 7,500 feet on warm slopes, and like the other Wyoming species of the genus it is mainly restricted to the Transition Zone.

Spiræa lucida Douglas. Meadowsweet.

The handsome flowering meadowsweet is sparingly present across Wyoming at the north in the lower part of the Canadian forest belt. Alexander Wetmore collected it at 7,000 feet elevation on the east side of Teton Pass on September 9, 1910, and I have observed it down to 5,800 feet in the Bighorn Mountains near Wolf, and in abundance on the Bear Lodge Mountains above 5,500 feet. Vernon Bailey reports a pink-flowered species, probably *Spiræa densiflora*, between 7,000 and 8,000 feet on the eastern slope of the Bighorns, above Wolf.

Dryas octopetala Linnæus. Alpine Avens.

The low alpine avens is restricted to Arctic and Alpine regions. In Wyoming I collected it on the Bighorn Mountains, where it was in characteristic prostrate matted growth on the rocky slopes above timberline at the head of Trapper Creek, being not yet in flower on June 10, 1910. Vernon Bailey collected it in August, 1893, on the high Wind River Range at the head of Bull Creek.

Rubus deliciosus James. False Raspberry.

The handsome false raspberry was abundant and still flowering on the pine-clad foothill ridges southwest of Wheatland on July 4, 1909, at elevations between 5,000 and 5,500 feet. This is probably near its northern limit, as it was not noted in the Laramie Peak region nor on any of the ranges farther west.

Rubus parviflorus Nuttall. Flowering Raspberry; Thimbleberry. (Fig. 13.)

The flowering raspberry is a tolerably common fruiting species in Canadian Zone woods on most of the Wyoming ranges, especially at the north. The large leaves, showy white flowers in June and early July, and in most years an abundance of handsome red berries in late August, make the thimbleberry very conspicuous in the woodlands between 7,000 and 9,000 feet elevation. The

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FIG. 13.—Flowering raspberry (*Rubus parviflorus*) in cool gulch, north base of Casper Mountains (6,500 feet).

large berries, which are pleasantly flavored, though somewhat dry and seedy, are eaten by many native birds and mammals.

Rubus strigosus Michaux. Red Raspberry.

The red raspberry is abundant at numerous localities in the mountain districts from the lower edge of the forest belt to timberline. Its observed vertical range is from 4,500 feet at Wolf, at the north base of the Bighorn Mountains, to 11,700 feet, above timberline, south of Fremont Peak, Wind River Range. It reaches its best growth and bears most abundantly on rocky, partially forested slopes in upper Transition and lower Canadian Zones on the northwestern ranges. In the heavy forests between 7,000 and 8,000 feet elevation on Grinnell Creek, in the Absaroka Range, the fruit was just ripening on August 1, 1910, while on the western slope of the Salt River Range the bushes were full

of berries on August 20, 1911. In the timberline region the species occurs in a dwarfed state, usually not over a foot high in fields of slide rock. Rock-strewn paths of avalanches throughout the mountains support more or less raspberry growth.

Dasiphora fruticosa (Linnæus) Rydberg. Shrubby Cinquefoil.

The low shrubby cinquefoil inhabits cold mountain bogs and meadows and is more common on the ranges along the western edge of the State than farther east. It is especially abundant in the cold stream meadows along the northern base of the Uinta Mountains, in the upper Green River Basin, and at the head of Wind River; in the willow swamps of Jackson Hole and Yellowstone Park; and in the timberline region on the Wind River and Absaroka Ranges. It extends above timberline on deep-soiled slopes, but at the higher altitudes is depauperate, from a few inches to a foot in height.

Amelanchier alnifolia Nuttall. Serviceberry.

Several species of serviceberry are characteristic of the Transition Zone of Wyoming, but *Amelanchier alnifolia* appears to be of widest range. On the less arid foothills and lower mountain slopes at the east and north, where it is most abundant, it is usually the only species present, but in the central and southern districts it occurs in places with *A. orcophila*, *A. elliptica*, and possibly others.[1] Typical specimens are from the Bear Lodge Mountains. It was noted at localities too numerous for inclusion.

Amelanchier elliptica A. Nelson. Serviceberry.

Taken only in the southwest, where it is the predominating species of *Amelanchier* in the western Transition borders of the Red Desert region at elevations up to 8,000 feet. It was observed at a number of points on the Bear River Divide from Hilliard north to Cokeville, and also in the badlands south of Lyman. S. G. Jewett collected flowering specimens at Spring Valley on June 9, 1912, and also on Steamboat Mountain on June 25.

Cratægus cerronis A. Nelson. Hawthorn.

Several species of hawthorn are represented in Wyoming, where they form a characteristic fringe on streams in the Transition Zone. *Cratægus cerronis* is apparently the predominating form in the Bighorn Mountains, and possibly east to the Black Hills. It was blooming profusely on June 6, 1912, in the heavy deciduous fringe along Wolf Creek, at the northern base of the Bighorns, up to 4,800 feet.[2] Flowering examples were collected at this point.

Cratægus rivularis Nuttall. Black Hawthorn.

The black hawthorn is common in southwestern Wyoming north to the Salt River Valley and Green River Basin and east at least to the upper Platte, at elevations from 6,000 to 8,000 feet.

Sorbus scopulina Greene. Mountain Ash.

In the Wyoming ranges the mountain ash is usually a low or medium-sized shrub 3 or 4 feet high, growing in scattered clumps or occasionally forming small thickets, although in the Shirley Mountains a few clumps 6 feet or more in height were noted. It is very generally distributed in the forests of the Canadian Zone up to 8,500 or 9,000 feet altitude.

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[1] Data collated under *Amelanchier alnifolia* may include some related to other species, being based mainly on field identifications. Unfortunately, few specimens of *Amelanchier* have been preserved.

[2] Vernon Bailey found the hawthorn up to 6,000 feet near Wolf.

Prunus americana Marshall. Wild Red Plum.

Scattered scrubby thickets of wild red plum are met with in gulches and on streams of the northeastern counties east of the Bighorn Mountains, the species being perhaps most abundant on the basal slopes of the Bear Lodge Mountains and at the northern base of the Black Hills.

Prunus pennsylvanica Linnæus f. Wild Red Cherry.

The wild red cherry is sparingly present in northern Wyoming from the upper slopes of the Black Hills and Bear Lodge Mountains west nearly to Yellowstone Park. On the dry, partially open summit of the Bear Lodge Mountains it grows in a dwarfed state. Shrubs not over 2 feet high were flowering profusely at 6,000 feet altitude on June 20, 1912, and considerable fruit was found by Vernon Bailey near Welcome late in August, 1913. Fruit was reddening at the end of July, 1910, on the North Fork of the Shoshone River.

Prunus melanocarpa (A. Nelson) Rydberg. Chokecherry.

The chokecherry is the predominating species of *Prunus*, being omnipresent in the foothills and mountains below 8,000 feet elevation, and on the Laramie Range reaching 9,000 feet. It is most abundant on dry, open, or partly forested Transition Zone slopes, where, however, it occurs usually in low scraggy thickets. It attains its perfection in damp gulches and along streams. The fragrant white bloom is conspicuous in May and early in June.

Amorpha canescens Pursh. False Indigo.

The low silvery false indigo, a shrub of the open Great Plains area, barely enters the State at the northeast in the Belle Fourche Valley. In June, 1912, it was common near Aladdin on open grassy slopes bordering Hay Creek valley.

Rhus rydbergi Small. Western Poison Ivy.

The western poison ivy was occasionally noted at the eastern base of the mountains: base to summit of Rawhide Butte, near Lusk; and Wolf Creek, Bighorn Mountains, below Eaton's Ranch.

Schmaltzia glabra (Linnæus) Small. Smooth Sumac.

The smooth sumac was noted by Vernon Bailey on the lower eastern slopes of the Bighorn Mountains near Wolf, August 10, 1913. It was sparingly present between 4,000 and 6,000 feet elevation in this locality, but has not been noted elsewhere in Wyoming by Survey field parties.

Schmaltzia trilobata (Nuttall) Small. Skunk Bush.

The skunk bush, characteristic of the Upper Sonoran Zone, fringes watercourses at the lower elevations up to 5,000 or 6,000 feet, and on especially warm slopes has been noted at a little over 7,000 feet. The heaviest growth is along streams, as at Greybull, where there are dense thickets 8 or 10 feet high in the cottonwood growth along the Bighorn. A scrubby growth clothes the hot slopes in the bad lands between Greybull and Ionia to a considerable elevation. On Horse Creek north of Cheyenne, and also near Wheatland and Cassa, it grows on valley flats with sagebrush. In the warm districts generally it occurs in scattering growth in dry gulches and on exposed faces of bluffs.

Pachystima myrsinites (Pursh) Rafinesque.

A low evergreen shrub of the Canadian forest belt in Wyoming, chiefly in the western and southwestern mountains. Its vertical limits are approximately 6,000 and 10,000 feet, but it is most abundant between 7,000 and 9,000 feet. On the Salt River Range near timberline it was growing abundantly in a

dwarfed state a few inches high. The small green flowers appear quite early, the flower buds being evident on a specimen collected at Jackson, May 4, 1911, by Edward A. Preble.

Acer negundo Linnaeus. Box Elder.

The box elder was noted chiefly along streams and in wet draws of the Great Plains area, but also at Bonanza in the Bighorn Basin, and between Dixon and Baggs along the southern boundary of the State.

Acer glabrum Torrey. Mountain Maple.

The handsome mountain maple inhabits cool slopes, gulches, and damp spots generally from the base of the mountains to 8,000 or 9,000 feet elevation, being most abundant in southeastern Wyoming. It was not noted in the Black Hills region, although found sparingly in cool north gulches at Squaw Butte, on the Wyoming-Nebraska line east of Kirtley. Its usual height is 5 or 6 feet in the mountains, and it rarely exceeds 8 feet even along streams.

Acer grandidentatum Nuttall. Large-Toothed Maple.

Scattered clumps of the large-toothed maple, 10 or 12 feet in height, are on the warm lower western slopes of the Salt River Range near Afton. The vertical range in these mountains is from their 6,300-foot bases up to 7,300 feet, in the Transition Zone, and it does not here attain its maximum growth. On the Salt River Range it is associated with the mountain maple, but does not occur as high as the latter.

Rhamnus alnifolia L'Heritier. Buckthorn.

The buckthorn reaches a short distance into Wyoming at the west, in the region contiguous to Snake River, but was not detected elsewhere. It is a conspicuous shrub on stream margins and in wet willow bottoms in the borders of Jackson Hole, and was abundant on Pacific Creek, 15 miles northeast of Moran. It was bearing its large ripe black berries in Webb Canyon in the Teton Mountains, at 6,700 feet elevation, September 1, 1910, and was collected by Alexander Wetmore on Trail Creek, near Teton Pass, late in September.

Ceanothus velutinus Douglas. Mountain Balm. (Fig. 14.)

Throughout the mountains one of the most characteristic shrubs is the mountain balm, in many places forming a dense chaparral 2 or 3 feet high on dry, open or partly forested slopes mainly in the Transition Zone. It was found in greatest abundance on dry summits of medium elevations, as the Bear Lodge, Casper, Shirley, Ferris, and Rattlesnake Mountains, on the 8,000-foot divide between the head of Salt River and Smiths Fork, and on Little Mountain, the elevated plateau between Maxon and the Green River Valley. The vertical limits are from 5,000 feet near Wolf, at the eastern base of the Bighorn Mountains, to 9,500 feet on Bridger Peak in the Sierra Madre. The white, sweet-scented flowers were conspicuous in Sierra Madre forests west of Grand Encampment between 8,500 and 9,500 feet, July 7, 1911, and the species was still in partial flower on the Wind River Range north of Big Sandy July 26, although past flowering near Fremont Lake on the same range by July 20.

Ceanothus fendleri Gray. Wild Tea Bush.

The low, much-branched wild tea bush is common on dry, warm slopes near Springhill, north of Laramie Peak. It was found in open yellow-pine forest up to 7,400 feet elevation, but was not noted elsewhere within the State.

Ceanothus mollissimus Torrey. Wild Tea Bush.

Vernon Bailey found this wild tea bush on Big Goose Creek, at the eastern base of the Bighorn Mountains. It is apparently rare in Wyoming.

Elæagnus argentea Pursh. Silverberry.

The silverberry occurs across Wyoming at the west, where it forms a scattering silvery fringe on stream banks mainly in the Transition Zone. It is especially abundant on streams of the upper Green River Basin and on tributaries of Wind and Snake Rivers. Elsewhere it was observed at Maxon, Lonetree, Cokeville, Meeteetse, on the South Fork of the Shoshone River, Pat O'Hara Creek, and on Gardiner River, near Mammoth Hot Springs.

Lepargyrea argentea (Nuttall) Greene. Buffaloberry.

While abundant locally on many streams at the base of the mountains, especially at the north, the buffaloberry is by no means generally distributed over the State, and was not detected in the southwest. The localities where it was

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FIG. 14. Mountain balm (*Ceanothus velutinus*) in flower, Sierra Madre, July 7, 1911 (9,000 feet).

found are mainly Upper Sonoran: Sibylee Creek, Casper, Belle Fourche River, Little Missouri River, Powder River, Clear Creek, streams near Sheridan and Ranchester, up Wolf Creek to 4,500 feet elevation, Alcova, Casper Creek, north slope Rattlesnake Mountains, Snake River at Baggs, Wind River Basin (mainly below 6,000 feet), and streams of Bighorn Basin.

Lepargyrea canadensis (Linnæus) Green. Canadian Buffaloberry. (Fig. 15.)

The Canadian buffaloberry is a characteristic and widely distributed undershrub in the forests of the Canadian Zone between 8,000 and 10,000 feet elevation. Although usually found on mountain slopes, it is abundant in balsam poplar growth along Snake River and other streams of Jackson Hole.

Phyllodoce empetriformis (Smith) Don. Mountain Heath.

The mountain heath, a characteristic evergreen of the Hudsonian Zone, was found locally abundant at widely separated localities in the high ranges of

northwestern Wyoming. Near Fremont Peak it was abundant in bogs and rocky situations from 10,500 feet altitude to a little above timberline, and occasional at 10,000 feet. On July 20 the dainty rose-colored flowers were still open on the Wind River Mountains, but on August 1 it was nearly through flowering on Whirlwind Peak, in the Absaroka Range. At timberline on the Tetons no flowers remained on the branches by August 30.

Menziesia ferruginea Smith. Rustyleaf.

This handsome and conspicuous shrub was observed only in the dense coniferous forests of Yellowstone Park, where it is common near Sylvan Pass,

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FIG. 15.—Canadian buffaloberry (*Lepargyrea canadensis*) in aspen woods, Wyoming Range near Merna (8,000 feet).

Lone Star Geyser, below Norris Basin, Thumb, Lewis River, and Snake River near Soldier Station.

Kalmia polifolia Wangenheim. Laurel.

The wet bogs and mossy margins of the numerous snow-fed lakes on the Wind River Range south of Fremont Peak were bright with pretty pink-purple flowering mats of laurel in mid-July, 1911. The species was in flower on July 18 in the Hudsonian Zone from 10,000 to 11,000 feet elevation, but was not detected above timberline. With *Phyllodoce empetriformis* it often formed dense mats, from a few inches to nearly a foot in height. Vernon Bailey collected the laurel in the timberline region on the Wind River Mountains above Bull Lake in 1893, and at the head of Raven Creek, in Yellowstone Park, in 1915.

Arctostaphylos uva-ursi (Linnaeus) Sprengel. Red Bearberry.

The low trailing red bearberry, with its leathery evergreen leaves, dainty rose-hued blossoms, and red berries, forms beautiful mats in the open yellow pine forests of the Black Hills, Laramie Peak region, and on the eastern slopes of the Bighorn Mountains. While most abundant in the Transition Zone, it occurs occasionally in the coniferous forests higher up, as on the upper slopes of Laramie Peak and on the Wind River Range south of Dubois. It is very abundant in the woodlands of Jackson Hole, and also on the Bear Lodge Mountains; at from 5,000 to 8,000 feet elevation on the eastern slope of the Bighorn Mountains near Wolf; and from 8,000 to 9,500 feet on their western slope above Hyattville; on the Rattlesnake, Shirley, and Green Mountains; south of Fremont Peak and on the head of the Big Sandy, Wind River Range: Needle Mountain and Grinnell Creek, Absaroka Range; Merna; Evanston; and north slopes of Uinta Mountains west of Lonetree.

Vaccinium oreophilum Rydberg. Mountain Blueberry.

The mountain blueberry reaches perfection of growth in the cool, damp forests of the Canadian Zone at about 8,000 feet elevation. In many localities it occurs with *Vaccinium erythrococcum*, but it is less abundant and usually not found so high up. It was observed on the Bear Lodge, Shirley, Casper, Ferris, and Bighorn Mountains; Grinnell Creek, Absaroka Range; forests of Yellowstone Park; Teton Pass and Moose Creek, Teton Range; wooded hills bordering Jackson Lake; head of Pacific Creek; Snake River west of Jackson; Salt River Range near Afton; and on the Wyoming Range near Merna.

Vaccinium erythrococcum Rydberg. Red Bilberry. (Pl. IX, fig. 2.)

The low, small-leaved red bilberry was noted on all the higher elevations of Wyoming. It is most abundant in the upper Canadian Zone, where it densely carpets the coniferous forest floor, and it is the only *Vaccinium* present in the Hudsonian belt of dwarfed forest higher up. In early August the small juicy red berries are greatly relished by dusky grouse and other forest birds.

Vaccinium occidentale Gray. Western Blueberry.

The shrubby western blueberry was encountered in northwestern Wyoming, from Lewis Lake, Yellowstone Park, south to Jackson Lake, and east on the Wind River Range to Fremont Peak. It attains a height of nearly 2 feet in Yellowstone Park, growing in dense clumps in lodgepole pine forests between 7,000 and 8,000 feet elevation. Its small blue berries were ripe south of Lewis Lake on August 18, 1910. South of Fremont Peak it was growing in bogs a little below timberline, at 10,500 feet.

Fraxinus lanceolata Borckhausen. Green Ash.

The green ash occurs sparingly in the low stream valleys of extreme eastern and northern Wyoming west to the base of the Bighorn Mountains. It was found at Newcastle; Sand Creek to 10 miles above Beulah; Hay Creek to Aladdin and Eothen; groves on the Belle Fourche flats at Devils Tower; Little Missouri River; gulches near Morse; Powder River near Montana boundary; Prairie-dog Creek; Sheridan; Big Goose Creek; Wolf Creek, to 4,500 feet elevation, near Eaton's Ranch.

Sambucus microbotrys Rydberg. Red Elderberry. (Fig. 16.)

The red elderberry is a characteristic shrub of the Canadian Zone coniferous forest on the main ranges of Wyoming. Usually it is the only elderberry present on the higher slopes, but lower down occurs with its black-fruited relative,

Sambucus melanocarpa. The red elder was not taken in the foothill ranges of eastern Wyoming nor in the Bighorn Mountains, but it has a general distribution from 7,000 to 9,500 feet elevation in the mountains farther west.

Sambucus melanocarpa Gray. Black Elderberry.

The black elderberry is of lower vertical range than the red species, occurring mainly in the Transition Zone, and from our observations was not so generally distributed. It was noted on Laramie Peak, north slope, rare at 8,000 feet elevation; Shirley Mountains, north escarpment, 7,600 feet to summit; Ferris Mountains, in dense coniferous forest, 8,000 to 9,000 feet; Salt River Range, 7,000 feet. Vernon Bailey found it bearing ripe berries on August 10, at 7,500 feet, on a southwest slope in the Bighorn Mountains near Wolf.

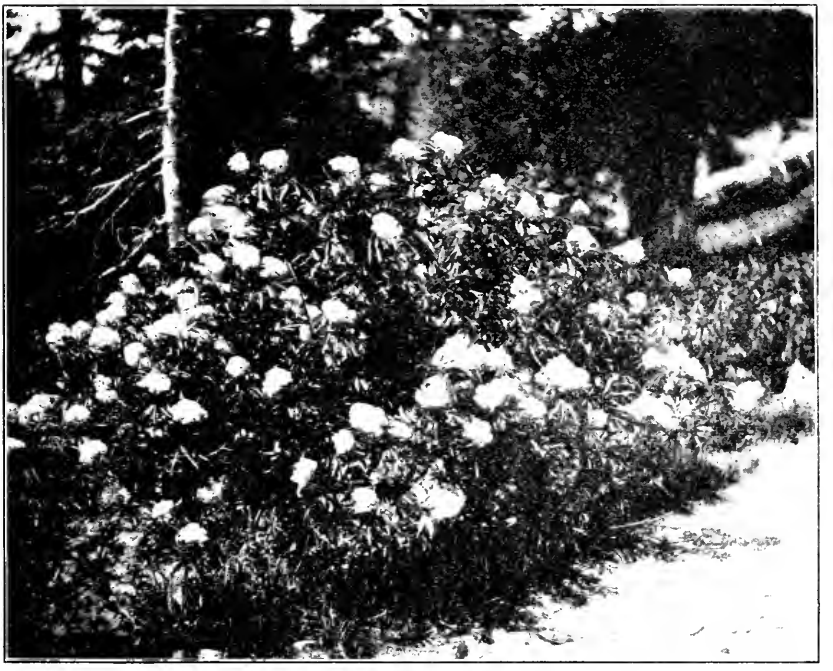

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FIG. 16.—Red elderberry (*Sambucus microbotrys*) in bloom, Sierra Madre, July 7, 1911 (10,000 feet).

Sambucus canadensis Linnæus. Elderberry.

The large elderberry, *Sambucus canadensis*, was detected only at the southern base of the Bear Lodge Mountains near Sundance, in the Transition Zone. Its handsome flat-topped cymes of white flowers were very conspicuous in the canyon along Sundance Creek, at 4,700 feet elevation, on June 20, 1912.

Viburnum lentago Linnæus. Sweet Viburnum.

Vernon Bailey found the sweet viburnum not uncommon in August, 1913, in the shaded canyons and gulches along Sand Creek above Beulah, at the northern base of the Black Hills. He also reports it from the Belle Fourche Valley near Devils Tower, and along Big Goose Creek at the east base of the Bighorn Mountains.

Symphoricarpos occidentalis Hooker. Wolfberry.

The wolfberry occurs over much of the Upper Sonoran Great Plains area, forming dense thickets 2 feet in height in gulches and along streams, and in many localities constituting the principal shrubby growth. The species regularly extends west to the bases of the Laramie and Bighorn Mountains, and was found also in Wind River Basin, and at the eastern base of the Absaroka Range northwest of Cody.

Symphoricarpos pauciflorus (Robbins) Britton. Few-Flowered Snowberry.

The few-flowered snowberry is higher ranging than the wolfberry (*Symphoricarpos occidentalis*) and occurs mainly in the Transition Zone in northern Wyoming. It was recorded at various altitudes from 4,700 feet to 8,500 feet in the Bear Lodge, Bighorn, Absaroka, and Wyoming Ranges.

Symphoricarpos oreophilus Gray. Mountain Snowberry.

The mountain snowberry is the predominating species of its genus in Wyoming, where it is rarely absent from dry, rocky, open, or partly forested slopes and ridges in the Transition Zone. On some of the southern and western ranges it is common on exposed points in dry forest openings up to 9,000 feet elevation. This shrub enters the lower portions of Yellowstone Park at the north and south, and occurs in the open sections of Jackson Hole.

Symphoricarpos rotundifolius Gray. Round-Leaved Snowberry.

The round-leaved snowberry is apparently uncommon. It is represented by a specimen from Rawhide Butte, taken July 23, 1909, where scattering bushes were noted from base to summit in the Transition Zone.

Lonicera glaucescens Rydberg. Douglas Honeysuckle.

The Douglas honeysuckle reaches Wyoming in the extreme northeast, where it is found sparingly along streams and on damp slopes above 4,700 feet elevation near Sundance, in the Bear Lodge Mountains.

Lonicera utahensis Watson. Utah Honeysuckle.

The Utah honeysuckle abounds in the mountain forests of extreme western and northwestern Wyoming. From the forests of Yellowstone Park, where it is especially abundant, it occurs south at least to the Salt River Mountains, reaching its upper limits on the western slope of this range at 9,000 feet elevation, and on the eastern slope of the Teton Range at about 8,000 feet.

Lonicera involucrata Banks. Involucred Fly Honeysuckle.

In Wyoming the involucred fly honeysuckle occurs commonly in all the principal ranges with the possible exception of the Bighorn Mountains. It becomes increasingly abundant westward, and is one of the most characteristic shrubs on the banks of cold streams up to 8,000 or 9,000 feet elevation in the Canadian forest belt, ripening its blackish berries about the first of August.

Chrysothamnus graveolens (Nuttall) Greene. Rabbit Brush.

The plains, deserts, and basal mountain slopes of Wyoming are rich in species of *Chrysothamnus*, some of them among the best characterizing shrubs of the Upper Sonoran or Transition Zones. The meager data secured by Survey parties relates mainly to species which are of importance in determining life zones. *C. graveolens* is a conspicuous shrub, often several feet high, growing in Upper Sonoran gulches, desert arroyos, and on dry slopes, principally in eastern and northern Wyoming. It is especially abundant on flats along Bighorn River in the lower portions of the Bighorn Basin. The species occurs at Cassa; Fort Fetterman; Casper; along the North Platte near Alcova; Hay Creek east of

Aladdin; Wind Creek northeast of Moorcroft; Buffalo; gulches at south base of Owl Creek Mountains; Badwater River north of Shoshoni; Worland; Manderson; Greybull; Frannie to Garland; and east of Cody.

Chrysothamnus linifolius Greene. Rabbit Brush.

Like *Chrysothamnus graveolens*, this species is a fair-sized shrub, inhabiting principally the cut banks of adobe along desert washes and streams in the Upper Sonoran Zone, as along Bear Creek, south of Cassa; Rock Springs; and warm pockets along Green River between Fontenelle and Labarge. Vernon Bailey collected a specimen at Arvada, on Powder River, August 13, 1913. Nelson found the species at Point of Rocks and Granger.[1]

Chrysothamnus plattensis Greene. Rabbit Brush.

Chrysothamnus plattensis is a low, spreading Upper Sonoran species of rabbit brush of the North Platte and tributary valleys at the southeast. It was noted up to 6,200 feet elevation on Horse Creek, near Meadow, and also at Snow's Ranch, on Rawhide Creek below Patrick.

Chrysothamnus stenophyllus Greene. Rabbit Brush.

This is a common species of rabbit brush over most of the sandy plains and ridges of central Wyoming, in the Upper Sonoran Zone, as at Casper, Efell, and in Sweetwater Valley from Independence to Splitrock. Nelson records it from Point of Rocks, on the Red Desert.[1]

Chrysothamnus stenophyllus Greene. Rabbit Brush.

This species was taken in the Upper Sonoran Zone in the Belle Fourche Valley at Moorcroft, August 15, 1913, by Vernon Bailey.

Chrysothamnus howardi (Parry) Greene. Rabbit Brush.

A specimen of *Chrysothamnus howardi* was collected by Vernon Bailey at Arvada, on Powder River, August 13, 1913. It is usually of the higher plains.

Chrysothamnus wyomingensis A. Nelson. Rabbit Brush.

Mainly of the high Transition plains and basal mountain slopes at the north. It is very abundant at the northern base of the Bighorn Mountains at Wolf, where a specimen was collected on June 6, 1912, and is apparently the species so abundant on the basal slopes of the Bear Lodge Mountains. Vernon Bailey collected it at Arvada, on Powder River.

Chrysothamnus pulcherrimus A. Nelson. Rabbit Brush.

This rabbit brush is common in the Transition Zone on the high central plains and in the upper Green River Basin, growing on open slopes with sagebrush regularly to 8,000 feet altitude. It is especially abundant on both slopes of the mountains near Laramie Peak, on the northern Laramie Plains, and in Shirley Basin. It was noted along Little Medicine Bow River west of Marshall at 7,000 feet.

Artemisia tridentata Nuttall. Black Sagebrush. (Fig. 17.)

The most widely distributed shrub in Wyoming is the black sagebrush. It is omnipresent in open country east to the edge of the Great Plains, where its eastern limits are marked by Orin Junction (North Platte Valley), Lost Spring, Indian Creek north of Kirtley at State line, Clifton, Newcastle, Wind Creek northeast of Moorcroft, and Colony. It was not found east of the Laramie Mountains in southeast Wyoming. From 4,000 feet elevation at the east this

[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 66, 1898.

sagebrush extends to timberline on some of the ranges, attaining 9,800 feet on the Bighorns above Hyattville, and 10,000 feet on the Wind Rivers south of Dubois and on the Wyoming Range west of Bigpiney and Merna.

Artemisia cana Pursh. Gray Sagebrush.

The gray sagebrush is generally dispersed and especially common in the mountain valleys and parks, but less abundant than the black species. It extends into the edge of the Great Plains area. In the valleys east of the Laramie Mountains this is usually the only shrubby sage present, and it forms much of the scattering growth on the open stretches between the Black Hills and Bighorn Mountains. Westward it rapidly gives way to the black sagebrush.

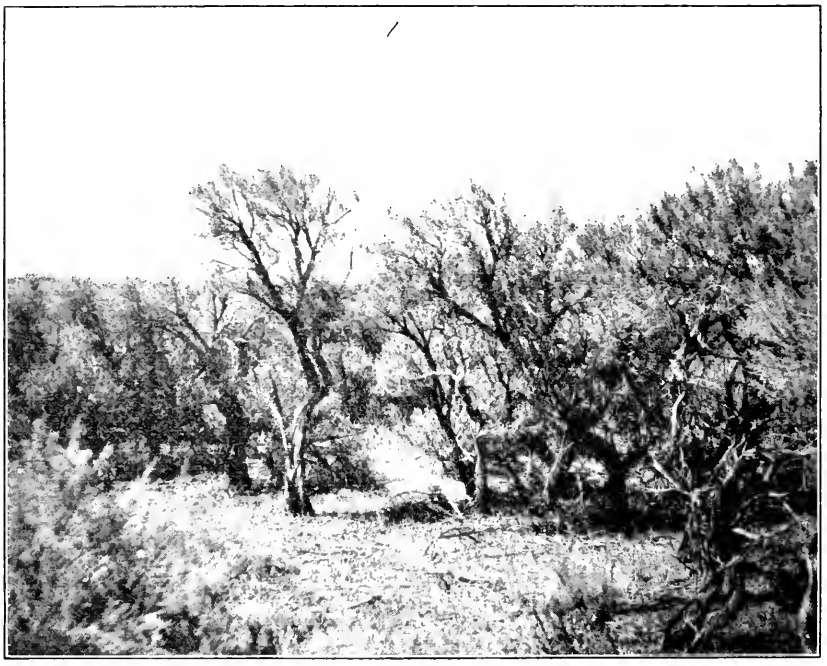

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FIG. 17.—Black sagebrush (*Artemisia tridentata*) 10 feet high, upper Wind River Valley.

Artemisia trifida Nuttall. Sagebrush.

A small shrubby sage, sparingly present in open Transition country chiefly at the west, as on the summit of the Owl Creek Mountains; Bear River Divide north of Evanston, 7,500 feet elevation; benches above Cokeville; and Salt River Valley. Vernon Bailey found the species in open parks in the mountains south of Douglas, near Valley, and in Jackson Hole.

Artemisia filifolia Torrey. Narrow-Leaved Sagebrush.

The narrow-leaved sagebrush is a characteristic shrub of the Great Plains Sonoran area, occurring in the North Platte drainage chiefly in sandy tracts as far west as Guernsey. A very dense growth 2 or 3 feet high covers the Rawhide flats at Snow's Ranch south of Patrick, and it is abundant in the sandy valley of the Chugwater east of Wheatland.

Artemisia arbuscula Nuttall. Brown Sagebrush.

The brown sagebrush is uncommon, according to the author's observations. Vernon Bailey reports it at Hams Fork Station (Moyer Junction) and Valley, and collected specimens on the Owl Creek Mountains in 1893 and in Salt River Valley on August 15, 1911, all Transition Zone localities in western Wyoming.

Artemisia spinescens Eaton. Spiny Sage; Bud Brush.

A low spinescent shrubby sage, abundant at many localities in the Upper Sonoran desert region at the southwest. It is common, also, on sandy benches near Shoshoni and in the lower parts of the Bighorn Valley near Greybull and Manderson. It occurs at many stations with the less shrubby *Artemisia pedatifida*, with which it is sometimes confused.

Artemisia frigida Willdenow. Pasture Sage.

The pasture sage, a low silvery sage, is scarcely a shrub, but is included as a characteristic Transition species of the genus. It has a very wide range over Wyoming on high plains, bare ridges and plateaus, and open mountain slopes generally.

Tetradymia spinosa Hooker and Arnott. Spiny Rabbit Brush.

The members of the genus *Tetradymia* are characteristic shrubs of the Great Basin Division of the Upper Sonoran Zone, and do not enter the Great Plains area. They occur in varying abundance and scattered bunchlike growths over the dry hills and plains of the arid central desert section, from the Green River Valley and Red Desert north to the Bighorn Basin.

Tetradymia spinosa is the more widely distributed species below 6,500 feet altitude. It is common at Green River, Superior, Rock Springs region, warm river flats (Fontenelle to Labarge), sand flats north of Opal, Shoshoni, Worland, Bonanza, Manderson, Greybull to Cody, and Frannie to Garland.

Tetradymia nuttalli Torrey and Gray. Nuttall Rabbit Brush.

The Nuttall rabbit brush is more spiny than the preceding species. It was collected only at Fort Steele, where it was abundant in the warm, lower parts of the North Platte Valley. Nelson mentions specimens from Bitter Creek and Green River.[1]

Tetradymia inermis Nuttall. Rabbit Brush. (Pl. VII, fig. 2.)

This high-ranging rabbit brush grows abundantly on the sandy plains of the upper Green River Basin to an elevation of 7,500 feet. It was not found at the lower levels, but was common on sand flats at Eden and Big Sandy and also on Little Piney Creek. Nelson collected specimens at Bitter Creek on the Red Desert.[1]

[1] Bull. 13, Div. of Agrost., U. S. Dept. Agr., p. 67, 1898.

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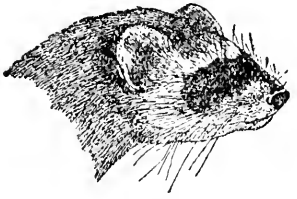
NORTH AMERICAN FAUNA

No. 43

[Actual date of publication, September 23, 1918]



THE RICE RATS OF NORTH AMERICA

(Genus ORYZOMYS)

BY

EDWARD A. GOLDMAN
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., April 26, 1917.

SIR: I have the honor to transmit for publication as North American Fauna No. 43 the results of a study of North American forms of the rice rats (genus *Oryzomys*), by Edward A. Goldman, assistant biologist of this bureau. This constitutes a revision of this group, based chiefly upon material in the collection of the Biological Survey. Rice rats are distributed from the latitude of Maryland and Delaware south through parts of the Southeastern States, Mexico, and Central America to South America, where they reach their highest development. While not so injurious to agriculture as some other rodents, they consume in the aggregate large quantities of forage when, like cottonrats and meadow mice, they increase locally to excessive numbers. A knowledge of their distribution, as presented in this report and its accompanying maps, will aid in studies made to control the depredations of rice rats. Owing to their nocturnal habits the animals are little known, and their economic relations should be better understood.

Respectfully,

E. W. NELSON,
Chief, Biological Survey.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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No. 43. NORTH AMERICAN FAUNA. Sept. 23, 1918.

THE RICE RATS OF NORTH AMERICA.

(Genus Oryzomys.)

By Edward A. Goldman.

INTRODUCTION.

The rice rats of the genus *Oryzomys* belong to the murine subfamily Cricetinæ, which includes also a number of closely allied generic groups of American rodents, as the vesper rats (*Nyctomys*), deer mice (*Peromyscus*), grasshopper mice (*Onychomys*), and others. By reason of their small size and nocturnal habits all these rodents largely escape observation, and the economic importance resulting from their excessive numbers and wide distribution is not generally realized. The vernacular name "rice meadow-mouse," bestowed on *Oryzomys palustris* by Bachman, because originally it was found in the rice fields of South Carolina and Georgia, has led to the appellation "rice rat" commonly applied to all species of the genus, although many inhabit regions where rice is not cultivated.

Owing to similarity in ratlike form and general appearance, most of the genera with which *Oryzomys* is allied, including species with widely differing habits, are scarcely recognizable by external characters alone, and reliance must be placed on distinguishing features exhibited by skulls and teeth. The genus *Oryzomys* comprises a somewhat composite assemblage of species presenting considerable diversity in general characters, but having the essential dental arrangement repeated with remarkable fidelity throughout the series.

The general range of the genus is from New Jersey and the central part of the Mississippi Valley southward, the group being represented in nearly every part of South America and apparently reaching its greatest development there. More than 150 species and subspecies have been described, of which number, however, some have been segregated in the erection of closely allied genera, and others are doubtfully allocated. Many regions remain unexplored and the number of forms assignable to *Oryzomys* as now restricted will probably far outnumber those of any other genus of American rodents. In the present revision are treated the North American continental species

as far as the eastern border of Panama, and those of outlying islands. Fifty-one forms of 21 species are recognized, two of which are characterized for the first time. These are comprised in the three subgenera *Oryzomys*, *Oligoryzomys*, and *Melanomys*.

HABITS AND ECONOMIC RELATIONS.

The habits of all the rice rats are somewhat similar, but differ in details in conformity with varying environmental conditions. In general, a preference is shown for meadows or marshy areas, commonly in the vicinity of water at rather low elevations; but some species have ascended, especially along the courses of streams, to high altitudes; others, departing farther from the semiaquatic environment, have entered the forest and become partially scansorial. They are nocturnal and, like many other small rodents, thus escape ordinary observation, most species coming out and wandering here and there through marsh, meadow, and herbaceous or even shrubby vegetation. Fairly well-worn runways are sometimes made along the edges of water or form general routes through dense vegetation, but these are not so well defined as those of the cotton rats (*Sigmodon*), which often share the same local habitat. The more aquatic species readily enter the water and swim and dive freely.

The nests, made of plant fibers of many kinds, are placed in shallow burrows or sheltered places, commonly under massed vegetation on or near the ground, but the site chosen may be in a tangled clump of flags or marsh grasses standing in the water. From 3 to 7 young are produced at a birth, 4 or 5 being the usual number. In *Oryzomys palustris* many young are brought forth in the months of April and May, but in this and other species their appearance at all seasons is ample evidence that there is no definite breeding season, except possibly near the extreme northern limit of the group.

The rice rats feed extensively on green or succulent plants, food habits shared with the cottonrats (*Sigmodon*) and meadow mice (*Microtus*). In early morning many freshly cut grass stems in the meadows evidence their nocturnal activity in favored places. While green food forms the normal ration of most species, drier foods, as seeds, also are eaten to some extent, and as with some other small rodents meat is relished at times. Specimens may be taken in meat-baited traps, and individuals thus caught are sometimes devoured by their own kind. Bachman,[1] who studied the habits of *Oryzomys palustris*, records that those kept in captivity "fed on grains of various kinds, but always gave the preference to small pieces of meat." In their natural habitat he observed them scratching up the recently

[1] Audubon, J. J., and Bachman, John, Quadr. North Amer., III, p. 215, 1854.

planted rice. He found that they begin feeding on rice when it is in the milky state and continue gathering the scattered grains in the fields during autumn and winter. He also observed them feeding on the large seeds of the gama grass (*Tripsacum dactyloides*), on those of the wild rye (*Elymus virginicus*), and at certain seasons on those of the marsh grass (*Spartina glabra*). Bachman further states that the rice rat "sometimes retires to the shore for food, but has no disrelish to the small crustacea and mollusks that remain on the mud at the subsiding of the tide."

Species inhabiting forested areas usually become very abundant in clearings where a ground cover is allowed to grow. Rice rats apparently are not so injurious to crops as some other rodents, but like the cotton rats and meadow mice increase locally to excessive numbers and then consume, in the aggregate, very large quantities of forage. Methods of poisoning that have proved effective in checking the ravages of meadow mice could probably be utilized with similar success in the control of rice rats. Owing to their nocturnal habits these mice are preyed upon by owls and doubtless by many carnivorous mammals. The rice rats and allied members of the great murine family to which they belong are the most numerous of American mammals, and their economic relations should be better known.

GENERAL CHARACTERS.

The rice rats as a whole present a wide range of variation in external appearance. Some of the larger, more robust species, including *Oryzomys palustris*, have not infrequently been mistaken for Old World rats of the genus *Rattus*, which have followed civilized man in his migrations and now not only universally infest his structures, but in favorable districts invade the fields in close competition with native rodents. Superficial resemblances are often striking, the bodily proportions and color and texture of pelage being very similar. On the other hand, many species are widely different from the Old World rats, in rich tawny coloration or character of pelage, and are more likely to be confused with allied American murine genera. The smallest North American species (subgenus *Oligoryzomys*) simulate in color, delicate structure, and great length of tail some of the harvest mice (*Reithrodontomys*); another group (subgenus *Melanomys*) is more robust, the tail very short, and general proportions *Akodon*-like.

In *Oryzomys* and allied genera superficial resemblances frequently mask the more essential features, and external characters, especially size and color, are less dependable than cranial modifications in tracing relationships of species. The group alignment, however, is often indicated by proportions of body and limbs; color and length of general pelage; length of vibrissæ; hairiness of ears, feet, and tail;

presence or absence of prominent tufts of digital bristles; and form of claws. Aside from the general form and angularity of the skull, the principal characters of taxonomic value are the following: Size and form of incisors and molars; depth and arrangement of reentrant angles, form and position of enamel islands, and development of cusps in molar crowns; length and form of anterior palatine foramina; length of palatal bridge; position of lachrymals; form of maxillæ, premaxillæ, frontals, parietals, and interparietal; and size and form of audital bullæ.

PELAGE.

The pelage is rather harsh in texture throughout the genus, but varies greatly in length in the component groups. The overfur is longer, the vibrissæ shorter, and the underfur denser and more woolly in semiaquatic species. Groups in which the pelage is normally short tend to develop longer fur in the forms which range at high altitudes; but several species, some with pelage much longer than others, may occur together at the same elevations. The ears are rather small and in typical *Oryzomys* and various groups, including the subgenus *Oligoryzomys*, the hairy covering is moderately long, coarse, and not sharply differentiated from the body fur; in the *O. talamancæ* and other groups the ears are minutely pilose, in marked contrast with the general pelage. The claws on the toes of the hind feet in the semiaquatic or more strictly terrestrial species are relatively long and straight, broad, and obtuse, and only partially overlapped by the digital bristles, while in the less aquatic or scansorial species they are short and recurved, compressed and sharp pointed, and prominent digital tufts project beyond the ends. In *O. palustris* the vibrissæ scarcely reach from the muzzle to the ears; in *O. pirrensis* and *O. bombycinus* they extend over the shoulders, while in various species they are intermediate in length.

COLOR.

In coloration of upperparts the range of variation in the rice rats is from pale shades of buff or gray to rich tawny or russet, more or less mixed with black, especially over the median part of the dorsum. The underparts usually are dull white or buff, without a sharp line of demarcation along the sides, the plumbeous basal color showing through (a few species exhibiting basally white areas). The tail is not very sharply bicolor, but usually is brown above and lighter below, at least basally, the epidermis and scanty investing hairs of about the same tone.

MOLT.

As breeding begins during adolescence and is continuous throughout the year, and as individuals arrive at maturity at all seasons, there is no very definite period for molting, although the more

northerly forms tend in winter to acquire a longer pelage, which becomes abraded in summer. As a rule the new coat seems to replace the old almost imperceptibly, but adults in apparently fresh and in obviously worn pelages may often be seen together.

AGE.

The age of individuals is indicated approximately by the degree of wear on the molar crowns. The shearing of the slopes, beginning early in life, becomes distinctly noticeable as full growth is attained, and, progressing rapidly across the summits of the tubercles, in advanced age results in the obliteration of all trace of enamel arrangement.

VARIATION.

Variation in the rice rats is assignable to several categories, of which perhaps the most obvious are individual and geographic.

INDIVIDUAL VARIATION.

By individual variation is meant all the degrees of divergence from a typical mean exhibited by large series of conspecific skins and skulls from any given locality. The range of this variation, especially in general size, is extraordinary; in many species of corresponding age and sex it exceeds 10 per cent both in external and cranial dimensions. The typical mean, therefore, may be difficult to determine when a small series of examples exhibits preponderance toward either of the extremes; and conclusions based on the dimensions of a small number of individuals are likely to be misleading. While males average slightly larger than females, sexual differences in size appear to be negligible. Cranial variations in proportions and in the form of individual bones are noticeable, but usually within rather circumscribed limits. Some skulls are decidedly broader and more massive than others of the same age and sex. Thickness of rostrum is usually, but not always, associated with breadth of frontal region and braincase. General expansion of the braincase commonly results in increased breadth across the posterior part of the frontals. The interparietal is variable in form, as are the parietals in the extent of encroachment of the lateral wings on the squamosals. The size of the molar teeth and of the audital bullæ is fairly constant.

Individual variation in color is much less than in size. Much of the variation in color observable is due to age or condition of pelage. The older adults tend at all seasons to exhibit more rufescent tones than the younger. A rusty reddish appearance is often due to much-worn pelage. There are no distinct color phases.

GEOGRAPHIC VARIATION.

Geographic variation, or the tendency of species to subdivide into regional or more or less localized forms, is very great in the genus *Oryzomys*. Of the numerous forms first described as distinct species a considerable number prove when better known to be geographic representatives of widely ranging specific types, presenting differential characters associated in part with environmental conditions. The intergradation and subspecific position of many such forms can be demonstrated beyond any reasonable doubt in some instances, and in others may be safely assumed, in the light of knowledge of the essential characters of the particular group. Since the distribution of the rice rats is mainly at low elevations, it is not surprising to find that species maintaining the same characters over extensive areas near sea level, where nearly uniform topographic and climatic conditions prevail, become locally modified on ascending to high altitudes. Thus, *O. couesi* and *O. alfaroi* are represented by widely ranging coastal forms and by more localized high-mountain races. That forms inhabiting mainly open, arid regions are paler than those inhabiting humid or heavily forested areas is well illustrated by the distribution of the races of *O. couesi* in Mexico. The dark typical form occupies the relatively humid area near the Gulf of Mexico and the Caribbean Sea, while the pale subspecies, *O. c. mexicanus*, pushes far northward along the arid Pacific coast, the point of divergence being near the Isthmus of Tehuantepec. Species reaching high altitudes tend to develop structural as well as color differences, while varying climatic conditions at low elevations are apt to result mainly in color modifications. Insular species are usually related to those inhabiting the adjacent mainland, but may exhibit very distinctive characters, unless the islands are very near the coast.

HISTORY AND MATERIAL.

A species of *Oryzomys* was first described under the name *Mus palustris* from New Jersey, by Richard Harlan,[1] in 1837. He compared the animal with the Norway rat, and owing to superficial resemblances regarded it as congeneric with the rats of the Old World. It was erroneously referred to the genus *Arvicola* in 1854 by Bachman,[2] who mentions having obtained specimens as early as the winter of 1816. According to Bachman, these specimens were described by him (but the description not published) in May, 1836. One was sent to the Academy of Natural Sciences of Philadelphia for comparison with material there, and on the basis of this and an example in the Academy collection Dr. Harlan felt authorized to publish his *Mus palustris*.

[1] Silliman's Amer. Journ. Sci., XXXI, p. 385, 1837.

[2] Audubon, J. J., and Bachman, John, Quadr. North Amer., III, p. 214, 1854.

In renaming the species *Arvicola oryzivora*, Bachman assumed that *Mus palustris* Harlan was preoccupied by *Arvicola palustris* Harlan,[1] an obvious error, as the two were not congeneric.

In 1857 Baird,[2] recognizing distinctive characters, used *Oryzomys* as a full generic name for the group, with *Mus palustris* Harlan as type, apparently inadvertently, however, as on a later page of his publication[3] he accorded it only subgeneric value under *Hesperomys* of Waterhouse. In this course he was followed by Coues in 1877.[4] Thirteen years later the same author[5] raised the name to generic rank. Meanwhile *Hesperomys fulvescens* Saussure[6] and *Hesperomys couesi* Alston[7] had been described, but their real generic position was not determined until later. New species were added at intervals, but of the relationships of the North American members of the genus little was known until 1901, when, as a result of study mainly of material which had accumulated in the collection of the Biological Survey, Merriam[8] published a synopsis of the forms inhabiting the United States and Mexico. Thirty-five species and subspecies were recognized by him, of which 20 were new. The species were divided into natural groups for the first time, and their salient characters pointed out. Short papers, largely descriptive of new species, by Thomas,[9] Allen,[10] Bangs,[11] Elliott,[12] and Goldman,[13] have since appeared. The larger collections now available render it possible to determine the status of nearly all names, and the relationship, especially of the more austral species, to South American forms.

The present revision is the result of a study of the rice rats in the Biological Survey, the Merriam, and other collections in the United States National Museum, now numbering 1,050 specimens, augmented by 563 from other American museums,[14] the assemblage including the types or topotypes of most of the species. The location

[1] Harlan, Richard, Fauna Americana, p. 136, 1825.

[2] Baird, S. F., Mamm. North Amer., p. 459, 1857.

[3] Op. cit., p. 482.

[4] Coues, Elliott, Monogr. North Amer. Rodentia, p. 113, 1877.

[5] Coues, Elliott, Century Dict., IV, p. 4165, 1890.

[6] Saussure, H. de, Rev. et Mag. de Zool., ser. 2, XII, p. 102, March, 1860.

[7] Alston, E. R., Proc. Zool. Soc., London, p. 756, 1876.

[8] Merriam, C. Hart., Proc. Washington Acad. Sci., III, pp. 273–295, July 26, 1901.

[9] Thomas, O., Ann. Mag. Nat. Hist., ser. 7, VIII, pp. 251–253, Sept., 1901.

[10] Allen, J. A., Bull. Amer. Mus. Nat. Hist., XXIV, pp. 654–657, Oct. 13, 1908 (inciuding *Oryzomys ochraceus* [=*Nectomys alfari*], see Goldman, Proc. Biol. Soc., Washington, XXIX, p. 127, June 6, 1916); ibid., XXXIII, pp. 99–100, Apr. 30, 1910; ibid., XXXII, pp. 533–554, Nov. 17, 1913.

[11] Bangs, O., Bull. Mus. Comp. Zool., XXXIX, pp. 33–36, Apr. 1902.

[12] Elliott, D. G., Field Columb. Mus. publ. 71, Zool. ser. III, p. 145, Feb., 1903; ibid., III, pp. 266–267, Mar. 1904.

[13] Goldman, E. A., Smiths. Misc. Coll., LVI, no. 36, pp. 5–8, Feb. 19, 1912; ibid., LX., no. 22, pp. 5–6, Feb. 28, 1913; Proc. Biol. Soc. Washington, XXVIII, pp. 127–130, June 29, 1915.

[14] For the use of material generously loaned and for other courtesies the author's thanks are due to Dr. J. A. Allen, American Museum of Natural History; to Mr. Samuel Henshaw and Mr. Outram Bangs, Museum of Comparative Zoology; to Mr. W. H. Osgood, Field Museum of Natural History; to Mr. Witmer Stone, Academy of Natural Sciences of Philadelphia; to Mr. W. E. Clyde Todd and Mr. O. P. Murie, Carnegie Museum; and to Mr. C. D. Bunker, Kansas University Museum. In addition he is indebted to Mr. Oldfield Thomas for critical notes and comparisons of specimens with types in the British Museum.

of specimens examined in collections other than those in the United States National Museum is indicated by footnotes.

EXPLANATIONS.

MEASUREMENTS.

All measurements of specimens are in millimeters. With a few exceptions, usually stated, the external measurements were taken in the flesh by the collector, as follows: *Total length*, nose to end of terminal tail vertebra; *tail vertebræ*, upper base of tail to end of terminal tail vertebra; *hind foot*, heel to end of longest claw. While adult males average slightly larger than females, the difference is scarcely appreciable and in the small series usually available may be ignored. The external and cranial measurements given, therefore, are of series which may include specimens of both sexes. Of many species and subspecies so few nearly typical examples are available that the measurements given may not represent the normal range of individual variation, and too broad generalizations, therefore, should not be based upon them. The following cranial measurements were taken with a vernier caliper by the author:

Greatest length.—Length from tip of nasals to supraoccipital in median line over foramen magnum.

Zygomatic breadth.—Greatest distance across zygomata.

Interorbital breadth.—Least distance between orbits.

Width of braincase.—Distance between outer sides of squamosals at the slight constriction over auditory meatus and immediately in front of lateral occipital crests.

Nasals.—Greatest length of nasals.

Anterior palatine foramina.—Greatest length of large palatal foramina.

Palatal bridge.—Distance from excavated posterior border of palate to posterior end of either large palatal foramen.

Upper molar series.—Greatest length of maxillary toothrow at alveolar border.

COLORS.

The names of colors used in descriptions are mainly those of Ridgway.[1] A few other modifying or comparative terms, however, have been employed, usually when some special difficulty was encountered in naming an indefinite hue or tone.

TEETH.

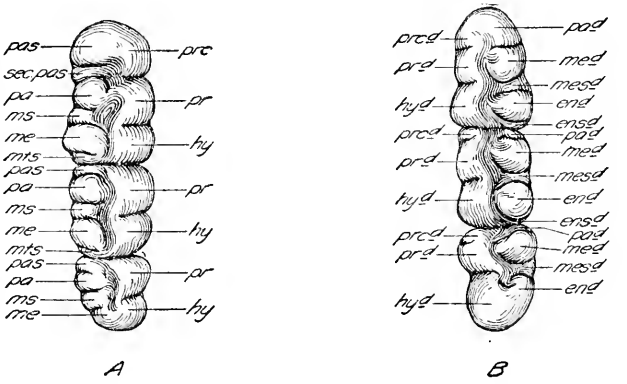
The nomenclature of the principal tooth elements used in the text is given in figure 1.[2]

[1] Ridgway, Robert, Color Standards and Color Nomenclature, 1912.

[2] For the homology and nomenclature of the molar crown divisions the writer is indebted to Messrs. Gerrit S. Miller, jr., and James W. Gidley, whose extensive researches, still in progress, in the phylogeny of the rodents, enable them to render an authoritative opinion.

ZONAL DIVISIONS.

Aside from the well-known extratropical North American zonal divisions, all references in the text under "Geographic distribution" are to less well-known tropical divisions, the Lower and Upper Tropical Zones, which may be roughly defined as follows: The Lower Tropical Zone, extending in tropical Middle America from sea level to elevations varying mainly in accordance with latitude and local topographic conditions. South of the twentieth parallel this zone reaches to about 3,000 or 3,500 feet altitude. Above these limits it is replaced by the Upper Tropical Zone, which extends to about 7,000



pas.....Parastyle.	*prc*.....Protoconule.	*prcd*.....Protoconulid.	*pad*.....Paraconid.
sec. pas....Secondary parastyle.	*pr*.....Protocone.	*prd*.....Protoconid.	*med*.....Metaconid.
pa.....Paracone.	*hy*.....Hypocone.	*hyd*.....Hypoconid.	*mesd*.....Mesostylid.
ms.....Mesostyle.			*end*.....Entoconid.
me.....Metacone.			*ensd*.....Entostylid.
mts.....Metastyle.			

FIG. 1.—Molar teeth of typical *Oryzomys* with outlines accentuated to show principal crown elements. A, Right upper molars; B, left lower molars.

or 8,000 feet. Each of these zones is readily separable into subdivisions on the basis of moisture, and are denominated, respectively, the Humid and Arid Lower Tropical and the Humid and Arid Upper Tropical Zones.

GENUS ORYZOMYS Baird.

Oryzomys Baird, Mamm. North Amer., pp. xlii, 458, 482, 1857 (subgenus of *Hesperomys* Waterhouse). Type *Mus palustris* Harlan.

Oryzomys Coues, Century Dict., IV, p. 4164, 1890.

Oligoryzomys Bangs, Proc. New England Zool. Club, I, p. 94, Feb. 23, 1900 (subgenus). Type *Oryzomys navus* Bangs.

Melanomys Thomas, Ann. Mag. Nat. Hist., ser. 7, X, p. 248, Sept. 1902 (subgenus). Type *Oryzomys phæopus* Thomas.

Melanomys Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 533, Nov. 17, 1913 (genus).

Geographic distribution.—Eastern and central United States from New Jersey, Kentucky, Illinois, Kansas, and Texas across Mexico to Lower California and south through South America to Cape Horn.

Generic characters.—Form murine; pelage slightly hispid, but not bristly or spiny; tail usually long, but varying from about three-fourths length of head and body to one-fourth longer, the annulated scales distinctly visible through short, sparse investing hairs; ears varying from small to rather large, and finely to coarsely haired; soles of hind feet naked to heels, normally 6-tuberculate; mammæ 8: pectoral, 2–2; inguinal, 2–2.

Skull relatively thin and smoothly rounded; supraorbital and temporal ridges prominent or obsolescent; interparietal variable in size and contour; zygomata slender, depressed to near level of molars; antorbital foramen subcylindrical above, more or less abruptly constricted to a narrow slitlike opening below; outer wall of antorbital foramen rather broad, but varying in extent of anterior projection, the upper border rounded or slightly angular; palate reaching posteriorly beyond plane of last molars, the interpterygoid border concave or presenting a slight median projection; palatal pits present; audital bullæ rather slightly inflated, tapering anteriorly and oblique in position.

Molar crowns low (slightly higher in *Melanomys* than in the other subgenera) with prominent cusps, cones, or tubercles, and well-developed styles, the principal cusps arranged nearly opposite in two longitudinal series; upper molars 3-rooted; lower molars 2-rooted. First upper molar with parastyle and paraconule strongly developed, partially divided near middle, and extended across internally for a distance equal to three-fourths or more of the greatest transverse diameter of tooth; secondary parastyle usually prominent; mesostyles and metastyles in all the upper molars present as small cusps or represented by enamel ridges connecting with principal inner cusps; inner cusps of first and second upper molars with oblique commissures; third upper molar with posterior portions more or less obsolete, the hypocone varying in development and the metacone usually indicated only by a low abbreviated enamel fold. Lower molar cusp-arrangement similar to upper, but paraconid and paraconulid in anterior tooth faintly or not at all notched longitudinally; protoconids and hypoconids in first and second molars with oblique commissures as in the homologous elements in upper teeth; mesostylids and entostylids joined by transverse enamel ridges with outer principal cusps; second lower molar with a moderately developed protoconulid; third lower molar with entoconid and entostylid completely fused or obsolescent. Front of upper incisors without grooves.

Remarks.—When the molars of *Oryzomys* are opposed the cusps in the upper jaw enter behind the corresponding cusps in the lower jaw. The parastyle is overlapped by the paraconid, the trenchant

anterior border of which shears on its anterior surface. The paraconule of the anterior molar and the protocones and hypocones of the other molars are broadly beveled or sheared internally, as are the protoconids and hypoconids. The paracones and metacones, on the other hand, are at first sheared posteriorly, while the metaconids and entoconids are sheared anteriorly, but progressive wear extending across the summits tends to level the entire series uniformly.

The genus presents complex relationships to various murine genera. Among its nearer relatives is *Nectomys*, which the more typical forms much resemble in external appearance as well as in the general form of the cranium. In dentition the two genera are also similar, but in typical *Oryzomys*, while the molar crowns as a whole are decidedly lower, the cusps or cones are higher, more conical, with summits more fully covered with enamel. In *Nectomys*, on the other hand, the low cusps tend to fuse with the styles and dentine is exposed at an earlier age. *Oryzomys* differs from *Nectomys* in other dental details, especially the development of the paraconulid of the second lower molar. The subgenus *Melanomys*, however, exhibits a somewhat intermediate condition; the molar crowns as a whole are somewhat higher than in typical *Oryzomys*, and lower than in *Nectomys;* the cones are high as in *Oryzomys*, but in sculpture, especially the early exposure of dentine, approach those of *Nectomys*. Another character suggesting gradation of *Melanomys* toward *Nectomys* is the position of the lachrymal, its attachment being mainly with the maxilla as in that genus, instead of about equally with maxilla and frontal as in typical *Oryzomys*. Agreement with *Oryzomys* is shown in the more essential dental details, including the marked development of the paraconulid in the second lower molar, an element absent in *Nectomys*.

Comparison with various other genera reveals obvious resemblances and points of difference in varying combination. *Oryzomys* agrees closely with *Neacomys* in cranial and dental characters, but the latter genus exhibits a departure in its grooved and bristly or spiny pelage. The generic name *Nesoryzomys* based on rice rats inhabiting the Galapagos Islands does not seem well founded, as the palate and dentition are *Oryzomys*-like and in the short tail and reduced interorbital space, alleged generic characters, it is not widely different from some of the continental species of *Oryzomys*.

In dentition *Oryzomys* is similar to *Rhipidomys*, but the molar cusps are more crowded and the parastyle and protoconule are less distinctly separated by a median notch. The posterior part of the palate, however, presents features at variance in the two genera. Unlike that of *Oryzomys* the palate in *Rhipidomys* is excavated between the posterior molars, and the palatal pits are separated by the

interpterygoid fossa. The genus *Nyctomys* is allied to *Rhipidomys*, but exhibits a wider departure from *Oryzomys*. The molar crown arrangement is similar in all three genera, but in *Nyctomys* the cusps are more angular, the styles and commissures less developed, and the enamel covering maintained until later in life than in the others. In the posterior excavation of the palate *Nyctomys* more nearly resembles *Rhipidomys;* but, in the remarkable lateral development of the interparietal to a broad line of contact with the squamosals and consequent isolation of supraoccipital and parietals, *Nyctomys* differs notably from both *Rhipidomys* and *Oryzomys*.

Some sections of the large genus *Peromyscus* are not very widely different from *Oryzomys* in dentition, but the principal cusps are obliquely placed, the protoconule much more developed, and the paracone and metacone shear mainly internally instead of posteriorly as in *Oryzomys*. The general form of the skull in *Peromyscus* is distinctive; the palate ends near the posterior plane of the molars and the palatal pits present in *Oryzomys* are absent.

In external appearance the genus *Reithrodontomys* bears a remarkable resemblance to the oryzomine subgenus *Oligoryzomys;* and in the *Aporodon* section of *Reithrodontomys*, in which the styles are present, an approach in molar pattern is manifested; but in *Reithrodontomys* generic distinction is lodged in the grooved upper incisors. The genus *Zygodontomys*, until recently associated with *Oryzomys*, is similar in outward appearance and in general form of skull, but in height of molar crowns, absence of style ridges, and longitudinal instead of oblique commissures of cusps it departs widely from *Oryzomys* and more nearly approaches *Akodon*.

SUBGENERA AND MINOR GROUPS.

Of the three subgenera into which the North American species of the genus *Oryzomys* are here divided, *Oligoryzomys* and *Melanomys* each contain a single group of closely related forms, while the subgenus *Oryzomys* is divisible into seven rather well-defined minor groups, or assemblages, of species or subspecies (excluding *O. victus*, whose exact relationships are unknown). These assemblages are usually distinguishable by external characters, but recourse to cranial structure is sometimes necessary in order to make accurate determinations.

(1) The *O. palustris* group is characterized by large, robust form, small, coarsely haired ears, short vibrissæ, and the absence of conspicuous tufts of silvery bristles, which in all the other groups project beyond the ends of the longer claws on the hind feet. The skull is broad with short rostrum, very long anterior palatine foramina (normally reaching anterior plane of first molars), and large audital

bullæ. The principal reentrant angles normally reach less than halfway across the molar crowns. In the moderately worn crown of the second upper molar a crescentic central enamel island extends along the postero-internal base of the paracone.

(2) The *O. melanotis* group comprises slender, medium-sized, rich ochraceous-buffy or ochraceous-tawny species with large ears clothed externally with short, fine dusky hairs and internally with similarly short, fine rufescent hairs. The skull is narrow with elongated rostrum, short anterior palatine foramina, and small audital bullæ. The dentition departs slightly from the *O. palustris* type; the enamel arrangement is very similar but the reëntrant angles extend farther across the molar crowns.

(3) The *O. alfaroi* group includes small, dark-colored forms with short pelage, comparatively large, conspicuous ears clothed externally and internally with short, fine blackish hairs. The skull is small and delicate in structure. The dentition is similar to that of the *O. melanotis* group.

(4) The *O. talamancæ* group bears much superficial resemblance to the *O. alfaroi* group, but the members are usually brighter, more tawny in color. More distinctive characters are exhibited by the skull and teeth, especially the molar crown arrangement. In the grinding surface of the second upper molar the dentine ridge connecting paracone and protocone, owing to more posterior position, eliminates the large central enamel island present in the *O. alfaroi* group, and the crown of the third lower molar is much more than half cleft by the outer reentrant angle (about half cleft in the *O. alfaroi* group).

(5) The *O. bombycinus* group is easily recognized by very long pelage, that of the back measuring about 12 millimeters. The supraorbital vibrissæ reach the remarkable length of 50 to 70 millimeters. The dentition is about as in the *O. talamancæ* group.

(6) The *O. devius* group is distinguished by very large but rather slender form, relatively long tail (much longer than head and body), and dark general coloration. The dentition is similar to that of the *O. talamancæ* and *O. bombycinus* groups.

(7) The *O. tectus* group may be known by large size, rich tawny coloration, small ears clothed with rather coarse hairs of general body color, and short, stout hind feet. The skull is broad, with short rostrum and prominently projecting supraorbital ridges. The dentition is much as in the *O. talamancæ* group.

In the present revision 44 species and subspecies are assigned to the typical subgenus *Oryzomys*, 5 forms are placed in the subgenus *Oligoryzomys*, and 2 in the subgenus *Melanomys*.

List of North American Species and Subspecies, with Type Localities.

Subgenus ORYZOMYS.

Oryzomys palustris group:

Oryzomys palustris palustris (Harlan)	"Fastland," near Salem, New Jersey.
palustris natator Chapman	Gainesville, Florida.
palustris coloratus Bangs	Cape Sable, Florida.
palustris texensis Allen	Rockport, Texas.
couesi couesi (Alston)	Coban, Guatemala.
couesi richmondi Merriam	Escondido River, Nicaragua.
couesi zygomaticus Merriam	Nenton, Guatemala.
couesi mexicanus Allen	Hacienda San Marcos, Jalisco, Mexico.
couesi aztecus Merriam	Yautepec, Morelos, Mexico.
couesi crinitus Merriam	Tlalpam, Federal District, Mexico.
couesi regillus Goldman	Los Reyes, Michoacan, Mexico.
couesi albiventer Merriam	Ameca, Jalisco, Mexico.
couesi peragrus Merriam	Rio Verde, San Luis Potosi, Mexico.
couesi aquaticus Allen	Brownsville, Texas.
fulgens Thomas	"Mexico."
gatunensis Goldman	Gatun, Canal Zone, Panama.
cozumelæ Merriam	Cozumel Island, Mexico.
antillarum Thomas	Jamaica.
peninsulæ Thomas	Santa Anita, Lower California, Mexico.
nelsoni Merriam	Maria Madre Island, Mexico.

Oryzomys melanotis group:

Oryzomys melanotis melanotis Thomas	Mineral San Sebastian, Jalisco, Mexico.
melanotis colimensis, nobis	Armeria, Colima, Mexico.
rostratus rostratus Merriam	Metlaltoyuca, Puebla, Mexico.
rostratus megadon Merriam	Teapa, Tabasco, Mexico.
rostratus yucatanensis Merriam	Chichen Itza, Yucatan, Mexico.

Oryzomys alfaroi group:

Oryzomys alfaroi alfaroi (Allen)	San Carlos, Costa Rica.
alfaroi daricnsis Goldman	Cana, Panama.
alfaroi angusticeps Merriam	Volcan Santa Maria, Guatemala.
alfaroi rhabdops Merriam	Calel, Guatemala.
alfaroi caudatus Merriam	Comaltepec, Oaxaca, Mexico.
alfaroi palatinus Merriam	Teapa, Tabasco, Mexico.
alfaroi saturatior Merriam	Tumbala, Chiapas, Mexico.
alfaroi chapmani Thomas	Jalapa, Vera Cruz, Mexico.
alfaroi dilutior Merriam	Huauchinango, Puebla, Mexico.
guerrerensis Goldman	Omilteme, Guerrero, Mexico.
hylocetes Merriam	Chicharras, Chiapas, Mexico.

Oryzomys talamancæ group:

Oryzomys talamancæ Allen	Talamanca, Costa Rica.

Oryzomys bombycinus group:

Oryzomys bombycinus bombycinus Goldman	Cerro Azul, Panama.
bombycinus alleni Goldman	Tuis, Costa Rica.

Oryzomys devius group:

Oryzomys devius Bangs	Boquete, Panama.
pirrensis Goldman	Mount Pirre, Panama.

Oryzomys tectus group:

Oryzomys tectus tectus Thomas	Bugaba, Panama.
tectus frontalis Goldman	Corozal, Canal Zone, Panama.
Oryzomys victus [1] Thomas	St. Vincent, Lesser Antilles.

[1] Not examined and group association not determined.

Subgenus OLIGORYZOMYS.

Oryzomys fulvescens fulvescens (Saussure)..	Orizaba, Vera Cruz. Mexico.
fulvescens lenis Goldman.....	Los Reyes, Michoacan, Mexico.
fulvescens mayensis, nobis.....	Apazote, Campeche, Mexico.
fulvescens costaricensis Allen.....	El General, Costa Rica.
fulvescens vegetus Bangs.....	Boquete, Panama.

Subgenus MELANOMYS.

Oryzomys caliginosus idoneus Goldman....	Cerro Azul. Panama.
caliginosus chrysomelas Allen.....	Suerre, Costa Rica.

Key to Subgenera.

a^1. Lachrymal articulating about equally with frontal and maxilla anteriorly; tail about equal to or longer than head and body.

b^1. Second upper molar with central enamel island normally elongated or absent; supraorbital and temporal ridges present; hind foot usually more than 25..... **Oryzomys** (p. 17).

b^2. Second upper molar with central enamel island normally circular; supraorbital and temporal ridges absent; hind foot usually less than 25. **Oligoryzomys** (p. 87).

a^2. Lachrymal articulating almost entirely with maxilla anteriorly; tail about three-fourths length of head and body..... **Melanomys** (p. 94).

Subgenus ORYZOMYS Baird.

Subgeneric characters.—Color of upperparts usually contrasting strongly with that of underparts;[1] feet (epidermis and hairs), including toes, whitish, yellowish, or brownish;[1] tail about equal to or longer than head and body;[1] anterior border of lachrymal articulating about equally with maxilla and frontal;[1] supraorbital and temporal ridges usually prominent;[2] secondary parastyle well developed;[1] slightly worn crown of second upper molar with central enamel island elongated or absent;[2] upper incisors decidedly curved backward near points.[1]

Key to Species of the Subgenus Oryzomys.

[Typical adults.]

a^1. Habitat North America and Greater Antilles.

b^1. Hind foot without prominent tufts of digital bristles projecting beyond ends of three median claws.

c^1. Habitat Rio Grande Valley south to Panama, and including islands near coasts of Mexico and West Indies.

d^1. Habitat continental.

e^1. Supraorbital ridges not projecting prominently over orbits.

f^1. Head and shoulders not distinctly grayish.

g^1. Upperparts richer ochraceous-tawny. ("Mexico."). **O. fulgens** (p. 41).

g^2. Upperparts duller ochraceous-tawny or ochraceous-buffy. (Southern Texas to Costa Rica.)..... **O. couesi** (p. 28).

f^2. Head and shoulders distinctly grayish. (Lower California.) **O. peninsulæ** (p. 45).

[1] Contrasting with *Melanomys*.

[2] Contrasting with *Oligoryzomys*.

e^2. Supraorbital ridges projecting prominently over orbits. (Panama.) **O. gatunensis** (p. 42).

d^2. Habitat insular.

e^1. Habitat islands off coasts of Mexico.

f^1. Upperparts ochraceous-buffy. (Maria Madre Island.). **O. nelsoni** (p. 46).

f^2. Upperparts ochraceous-tawny. (Cozumel Island.). **O. cozumelæ** (p. 43).

e^2. Habitat Greater Antilles. (Jamaica.)..... **O. antillarum** (p. 44).

c^2. Habitat United States north of Rio Grande Valley.... **O. palustris** (p. 21).

b^2. Hind foot with prominent tufts of digital bristles projecting beyond ends of three median claws.

c^1. Ears clothed externally with fine blackish hairs contrasting with color of head; hind foot long and narrow.

d^1. Hind foot less than 33.

e^1. Supraorbital vibrissæ less than 40.

[1]. Ears clothed internally with fine blackish hairs.

g^1. Second upper molar with central enamel island present; third lower molar with outer reentrant angle extending about half way across crown.

h^1. Upperparts darker ochraceous-buff or ochraceous-tawny.

i^1. Zygomata not wider anteriorly than posteriorly, or if wider zygomatic breadth more than 14. (Atlantic slope in eastern and southern Mexico and south to Panama.) **O. alfaroi** (p. 58).

i^2. Zygomata wider anteriorly than posteriorly; zygomatic breadth 14 or less. (Pacific slope of mountains of southern Chiapas.) **O. hylocetes** (p. 70).

h^2. Upperparts paler ochraceous-buff or ochraceous-tawny. (Pacific slope of Sierra Madre in Guerrero and Oaxaca.) **O. guerrerensis** (p. 69).

g^2. Second upper molar with central enamel island absent; third lower molar with outer reentrant angle extending more than half way across crown. (Costa Rica and Panama.). **O. talamancæ** (p. 73).

f^2. Ears clothed internally with buffy or rusty reddish hairs.

g^1. Size larger; hind foot 30 or more. (Atlantic coast of Mexico.) **O. rostratus** (p. 52).

g^2. Size smaller; hind foot less than 30. (Pacific coast of Mexico.) **O. melanotis** (p. 49).

e^2. Supraorbital vibrissæ more than 50..... **O. bombycinus** (p. 76).

d^2. Hind foot 33 or more.

e^1. Color paler; supraorbital ridges absent. (Costa Rica and western Panama.) **O. devius** (p. 80).

e^2. Color darker; supraorbital ridges present. (Eastern Panama.) **O. pirrensis** (p. 81).

c^2. Ears clothed externally with coarse tawny hairs not contrasting with color of head; hind foot short and broad. (Costa Rica and Panama.) **O. tectus** (p. 84).

a^2. Habitat Lesser Antilles. (St. Vincent.)..... **O. victus** (p. 86).

Oryzomys palustris Group.

Geographic distribution.—Coastal areas from southern New Jersey to southern Texas; north in the Mississippi Valley to southern Illinois, and southward from the Rio Grande Valley on the east, and southern

Sinaloa on the west, through Middle America to Panama, with outlying forms inhabiting southern Lower California, the Tres Marias Islands, and Cozumel Island. Confined mainly to the vicinity of water at low elevations, but ranging up to over 7,000 feet altitude in the marshy bottom of the Valley of Mexico (see maps, figs. 2 and 3).

General characters.—Size large; form robust; tail usually equal to or longer than head and body (shorter in some examples), thinly but rather distinctly haired; ears small and inconspicuous, well haired internally as well as externally; general pelage long, rather coarse and rigid; the underfur somewhat woolly; vibrissæ short, the longest arising from muzzle scarcely as long as head; hind feet broad, the upper surface rather well haired and under surface naked and coarsely granular anteriorly, becoming smooth along outer side of large posterior tubercle; inner edge of plantar surface overlapped by fringing bristles; toes of hind feet webbed near base; the claws long, relatively straight, and projecting well beyond overlapping bristles. Color of upperparts presenting a wide range of variation from grizzled grayish brown, or pale buff, to rich ochraceous-buff or ochraceous-tawny, more or less heavily overlaid with black; underparts ranging from white to light ochraceous-buff.

Skull.—Size large, with rostrum short and braincase high and well arched; outer wall of antorbital foramen with superior border extending well forward, the foramen appearing as a deep circular notch as viewed from above; frontal region rather broad, the lateral margins trenchant, somewhat upturned, and projecting as supraorbital ridges, frontals usually encroaching in a narrow point posteriorly along the median line between the parietals; temporal ridges well developed anteriorly along parieto-squamosal borders, usually becoming indistinct posteriorly in crossing lateral wings of parietals to low lambdoid crest; interparietal small, subtriangular, the anterior border a nearly straight line and the posterior with an ill-defined median angle; anterior palatine foramina narrow and much elongated, about equal in length to palatal bridge, normally reaching posteriorly to anterior plane of first molars, the median septum with posterior or maxillary portion contracted and anterior or premaxillary section expanded above; palatal pits large and normally oval in outline; interpterygoid fossa moderately broad; sphenopalatine vacuities large in *O. palustris*, absent, or present as very narrow slits, in *O. couesi* and related forms; audital bullæ large, the swollen portion projecting anteriorly beyond anterior plane of basioccipital; basioccipital narrow; angle of mandible rather broad and projecting posteriorly; coronoid process large, rising high above condyle; dentition moderately heavy; third lower molar rather short and broad; mandibular toothrow only slightly narrower posteriorly than anteriorly; inner reëntrant angles in upper molars and outer reentrant angles in lower molars reaching

less than half way across moderately worn crowns; second upper molar with a somewhat crescentic enamel island, or furrow, along postero-internal base of paracone, becoming restricted and finally obliterated through extended wear; tubercle over root of lower incisor prominent.

Remarks.—The *O. palustris* group includes *O. palustris* of the United States, and *O. couesi* and nearly related Middle American forms. Aside from the darker, more brownish colors which usually characterize *O. palustris*, in contrast with the brighter, more ochraceous buffy or rufescent tones of *O. couesi* and its relatives, these sections of the group also differ notably in quality of pelage, the overfur being longer and projecting farther beyond the underfur in the former than in the latter. The forms of the two sections of the group agree closely in essential cranial details, but skulls of subspecies of *O. palustris* are usually recognizable by the large size of the sphenopalatine vacuities. Members of the group as a whole are distinguished externally from those of other Middle American groups of the same subgenus by the small size and internal as well as external hairiness of the ears.

Key to Species and Subspecies of the O. palustris Group.

[Typical adults.]

a^1. Upperparts mainly grayish or brownish, or if ochraceous-buffy or ochraceous-tawny underparts not distinctly buffy. (United States north of Rio Grande Valley [*O. palustris*].)

b^1. Upperparts mainly grayish or brownish.

c^1. Color darker. (Atlantic coast region from southern New Jersey to northern Florida; Alabama; southeastern Mississippi; central Tennessee; southern Kentucky; southern Illinois, and parts of southeastern Missouri.) **O. p. palustris** (p. 22).

c^2. Color paler. (Coast region of Texas from Nueces Bay northward; Louisiana; western Mississippi; southern and eastern Arkansas; extreme southeastern Missouri; southeastern Kansas.) ..... **O. p. texensis** (p. 27).

b^2. Upperparts mainly clay color or ochraceous-tawny.

c^1. Color duller, less distinctly ochraceous-tawny. (North-central Florida.) **O. p. natator** (p. 24).

c^2. Color brighter, more distinctly ochraceous-tawny. (Southern Florida.) **O. p. coloratus** (p. 26).

a^2. Upperparts mainly ochraceous-buffy or ochraceous-tawny. (Rio Grande Valley to Panama and islands near coasts of Mexico and West Indies [*O. couesi* and related forms].)

b^1. Habitat continental.

c^1. Supraorbital ridges not projecting prominently over orbits.

d^1. Head and shoulders not distinctly grayish.

e^1. Upperparts duller ochraceous-tawny or ochraceous-buffy. [*O. couesi* and subspecies.]

f^1. Underparts normally white.

g^1. Size larger; hind foot usually 35 or more; upper molar series usually more than 5.

h^1. Upperparts more intense ochraceous-buff. (Northwestern Michoacan)..... **O. c. regillus** (p. 37).
h^2. Upperparts less intense ochraceous-buff. (Central Jalisco.) **O. c. albiventer** (p. 38).
g^2. Size smaller; hind foot usually less than 35; upper molar series usually less than 5.
h^1. Upperparts darker ochraceous-buff. (Pacific coastal region from southern Sinaloa to southeastern Oaxaca.) **O. c. mexicanus** (p. 33).
h^2. Upperparts paler ochraceous-buff. (Morelos; southern Puebla; northern Oaxaca; northeastern Guerrero.). **O. c. aztecus** (p. 35).
f^2. Underparts normally buffy.
g^1. Size larger; hind foot usually more than 33; upper molar series usually more than 4.8.
h^1. Size smaller; hind foot averaging less than 35.
i^1. Color darker. (San Luis Potosi.)..... **O. c. peragrus** (p. 39).
i^2. Color paler. (Rio Grande Valley.).. **O. c. aquaticus** (p. 39).
h^2. Size larger; hind foot averaging about 36. (Valley of Mexico.) **O. c. crinitus** (p. 36).
g^2. Size smaller; hind foot usually less than 33; upper molar series usually more than 4.8.
h^1. Upperparts normally ochraceous-buffy.
i^1. Color darker. (Northern Vera Cruz to northwestern Costa Rica.)..... **O. c. couesi** (p. 29).
i^2. Color paler. (Southwestern Gautemala and south-central Chiapas.)..... **O. c. zygomaticus** (p. 32).
h^2. Upperparts normally ochraceous-tawny. (Lowlands of eastern Nicaragua.)..... **O. c. richmondi** (p. 32).
e^2. Upperparts richer ochraceous-tawny. (Mexico.)..... **O. fulgens** (p. 41).
d^2. Head and shoulders distinctly grayish. (Lower California.) **O. peninsulæ** (p. 45).
c^2. Supraorbital ridges projecting prominently over orbits. (Panama.) **O. gatunensis** (p. 42).
b^2. Habitat insular.
c^1. Habitat off east coast of Mexico. (Cozumel Island.).. **O. cozumelæ** (p. 43).
c^2. Habitat off west coast of Mexico. (Maria Madre Island.). **O. nelsoni** (p. 46).
c^3. Habitat West Indies. (Jamaica.)..... **O. antillarum** (p. 44).

ORYZOMYS PALUSTRIS (HARLAN).

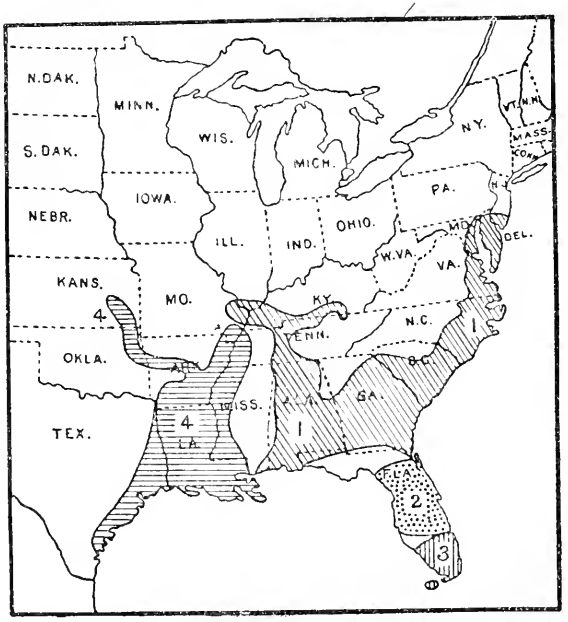
[Synonymy under subspecies.]

Geographic distribution.—Atlantic and Gulf coastal areas from southern New Jersey (not yet recorded from Delaware and Maryland, but doubtless occurs there), to southern Texas, and north through the Mississippi Valley to southern Kentucky, southern Illinois, and eastern Kansas (fig. 2). Altitudinal range from sea level up along streams to about 500 feet altitude (rarely to 1,000 feet), mainly in the Lower Austral Zone, but reaching into the Upper Austral Zone in the more northerly localities, and into the Tropical Zone in southern Florida.

General characters.—Similar in general to *O. couesi*, but pelage longer; colors usually darker and duller grayish brown instead of

ochraceous-buffy or ochraceous-tawny: skull differing in various details, but dentition about the same.

Color.—Upperparts in general varying from grizzled grayish brown or pale buff, to tawny-olive, clay color, and ochraceous-tawny; the face, top of head, and back heavily lined or overlaid with black; sides paler, owing to a thinner admixture of blackish hairs; underparts white, varying to buffy white and rarely to pale buff; outer sides of ears dusky, the inner sides clothed with grayish or rusty hairs; feet whitish; tail varying from brownish above and whitish below to dusky all round. *Young* (in first pelage): Varying from grayish brown to dull tawny-olive above, whitish below.



1. *O. p. palustris.* 2. *O. p. natator.* 3. *O. p. coloratus.* 4. *O. p. texensis.*

FIG. 2.—Geographic distribution of subspecies of *Oryzomys palustris.*

Skull.—(For general outlines see under *O. palustris* group.) In general form closely resembling that of *O. couesi*, but sphenopalatine vacuities, absent or much reduced in size in that species, large and widely open; antorbital foramen with anterior border less rounded above, less inclined or produced forward at the base, in many examples somewhat excised or tending to develop a point as in *Sigmodon.*

Remarks.—*O. palustris* is divisible into four geographic races which form a closely intergrading series. The species apparently attains its largest size in Florida and along the coast of the Gulf of Mexico east of the Mississippi delta.

ORYZOMYS PALUSTRIS PALUSTRIS (HARLAN).

SWAMP RICE RAT.

[Pl. I, figs. 1, 1a; Pl. V, figs, 1, 4; Pl. VI, figs. 1, 1a.]

Mus palustris Harlan, Silliman's Amer. Journ. Sci., XXXI, p. 385, 1837.

Arvicola oryzivora, Bachman, in Audubon and Bachman, Quadr. North Amer., III, p. 214, 1854. Type from St. Johns Parish, South Carolina.

H[esperomys] palustris Wagner, in Suppl. Schreber's Saügthiere, III, p. 543, 1843.

Oryzomys palustris Baird, Mamm. North Amer., p. 459, 1857.

Type locality.—"Fastland," near Salem, Salem County, New Jersey.

Type.—Not known to exist.

Geographic distribution.—Atlantic coastal areas from southern New Jersey (not yet known from Delaware or Maryland, but doubtless occurs there) south to northeastern Florida, thence westward through southern Georgia to the Gulf coast of Alabama and Mississippi, and north through Alabama and western Tennessee to southwestern Kentucky, southern Illinois, and parts of southeastern Missouri. Altitudinal range from sea level up along streams to about 500 feet (rarely to 1,000 feet), mainly in Lower Austral Zone, but reaching into Upper Austral Zone in southern New Jersey, southeastern Kentucky, and southeastern Missouri (Marble Hill).

General characters.—Size usually smaller and color more brownish, less tawny, than in *O. p. natator* and *O. p. coloratus;* skull less massive. Closely resembling *O. p. texensis*, but darker, more brownish than topotypes of the latter form; skull broader.

Color.—*Fresh pelage* (December): Upperparts grizzled grayish brown or pale buff, the brownish or buffy tone most intense on rump, darkened on face, top of head, and back by overlying blackish hairs; feet whitish; tail brownish above, whitish below, becoming in some specimens dark all round near tip. *Young* (in first pelage): Grayish brown above, dull whitish below.

Skull.—(For general outlines see under *O. palustris* group.) Very similar to those of *O. p. natator* and *O. p. coloratus*, but narrower; braincase decidedly narrower; zygomata less widely spreading; frontal region narrower, the supraorbital borders less projecting. Compared with that of *O. p. texensis* the skull differs mainly in somewhat larger average size; zygomata usually more widely spreading.

Measurements.—Average of four adults from Greenwich, N. J. (near type locality): Total length, 242 (237–245); tail vertebræ, 112 (109–116); hind foot, 31 (30–31.5). An adult from Pope Creek, Va.: 260; 130; 33. Average of four adults from Georgetown, S. C.: 257 (233–273); 125 (113–132); 32.5 (31–33). Average of three adults from Bon Secour, Ala.: 265 (250–280); 131 (125–138); 30.5 (30–31.5). Adult from Bayou La Batre, La.: 233; 116; 30. Adult from Marble Hill, Mo.: 252; 115; 29. Adult from Olive Branch, Ill.: 255; 113 29. Adult from Barbourville, Ky.: 270; 133; 30.5. *Skull* (two adults from Greenwich, N. J.: Greatest length, 32.4, 31; zygomatic breadth, 17.2, 16.6; interorbital breadth, 5.2, 5.1; width of braincase, 11.9, 12; nasals, 12.7, 12; anterior palatine foramina, 6.7, 6.7; palatal bridge, 6.2, 6.2; upper molar series, 4.5, 4.6.

Remarks.—*O. p. palustris* passes into *O. p. texensis* in the Mississippi Valley. Specimens from Marble Hill, Mo., and Olive Branch, Ill., however, seem referable to the typical form. A tendency to develop

the ruddy color and more massive skull of *O. p. natator* is exhibited by specimens from New Berlin and Burnside Beach, northern Florida, and intergradation of the two forms seems evident in that part of the State. No rice rats have been recorded from Delaware or Maryland, but the favorable character of the country and the narrowness of the gap between collecting stations to the north and south point to probable continuity of range. Specimens from South Carolina apparently representing *Arvicola oryzivora* of Audubon and Bachman are inseparable from typical *palustris*.

Specimens examined.—Total number, 233, as follows:

Alabama: Autaugaville, 1; Bayou La Batre, 2; Bon Secour, 3; Elmore, 1; Florence, 1; Gallion, 1; Hayneville, 2; Huntsville, 4; Jackson, 2; Mobile, 1; Montgomery, 1; Mount Weogufka, 1; Reform, 1; Sand Mountain (near Carpenter), 1; Seale, 1.

Florida: Burnside Beach, 9;[1] New Berlin, 8.[2]

Georgia: Cumberland Island, 14;[3, 4] Hursman Lake, 1;[1] McIntosh County, 1; Okefinokee Swamp, 1;[2] Ossabaw Island, 12;[1] Riceboro, 7;[5] Saint Marys, 20;[3, 6] Savannah, 10; Toccoa, 2.

Illinois: Olive Branch, 3.

Kentucky: Barbourville, 3.

Missouri: Marble Hill, 1.

Mississippi: Biloxi, 1.

New Jersey: Cedar Creek, 1;[7] Greenwich, 13.[8]

North Carolina: Coinjock, 1; Pea Island, 2;[1] Raleigh, 31.[9, 10]

South Carolina: Beaufort County, 2; Calhoun Falls, 2;[2] Easley, 1; Frogmore, 1;[3] Georgetown, 11; Plantersville, 7; Saint Helena Island, 1; Society Hill, 3.

Tennessee: High Cliff, 1; Lawrenceburg, 2.

Virginia: Dismal Swamp, 20; Pope Creek (5 miles southeast of Colonial Beach), 2; Smith Island, 6; Suffolk, 1; Wallops Island, 3; Warsaw (4 miles southwest), 5; Wreck Island, 1.

ORYZOMYS PALUSTRIS NATATOR Chapman.

Central Florida Rice Rat.

Oryzomys palustris natator Chapman, Bull. Amer. Mus. Nat. Hist., V., p. 44, March 17, 1893.

Type locality.—Gainesville, Alachua County, Florida.

Type.—No. $\frac{18\,13}{10\,8\,9}$, ♂ adult, American Museum of Natural History; collected by F. M. Chapman, January 31, 1889.

Geographic distribution.—Central Florida, north of Everglades; Austroriparian division of Lower Austral Zone.

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[1] Collection Mus. Comp. Zool.
[2] Collection Field Mus. Nat. Hist.
[3] Collection Amer. Mus. Nat. Hist.
[4] Eleven in collection Mus. Comp. Zool.
[5] Five in collection Field Mus. Nat. Hist.
[6] Three in collection Field Mus. Nat. Hist.; 15 in Mus. Comp. Zool.
[7] Collection Acad. Nat. Sci. Philadelphia.
[8] Five in collection Acad. Nat. Sci. Philadelphia.
[9] Five in collection Amer. Mus. Nat. Hist.
[10] Two in collection Field Mus. Nat. Hist.; 6 in Mus. Comp. Zool.

General characters.—Most like *O. p. coloratus;* differing usually in less intense tawny suffusion of upperparts, especially cheeks and sides of body. Size larger, color more tawny, and skull more massive than usual in *O. p. palustris* or *O. p. texensis.*

Color.—Fresh pelage (December): Upperparts varying from grizzled grayish brown or pale buff to tawny-olive, clay color, or ochraceous-tawny, deepest and richest on lower part of back and rump, becoming paler and more buffy on sides, and darkened dorsally by admixture of blackish hairs; face grayish or pale buffy beneath overlying dusky hairs; underparts usually white, but in some specimens more or less suffused with pale buff; feet white; tail brownish above, whitish below, becoming in some specimens dark all round toward tip. *Young* (in first pelage): Brownish or dull tawny-olive mixed with black above, whitish below.

Skull.—Similar to those of *O. p. palustris* and *O. p. texensis,* but broader; braincase decidedly broader; zygomata more widely spreading; frontal region broader, the supraorbital borders more projecting. Comparison with the skull of *O. p. coloratus* reveals no appreciable difference.

Measurements.—Type: Total length, 295; tail vertebræ, 143; hind foot (dry skin), 33. Average of 10 adults (type and 9 topotypes): 276.7 (271–300); 142.9 (132–156); 34.3 (32.5–37). *Skull* (average of 6 adults, type and 5 topotypes): Greatest length, 32.4 (31.4–33.7); zygomatic breadth, 17.2 (16.4–17.7); interorbital breadth, 5.4 (5.1–6.1); width of braincase, 12.4 (12–12.8); nasals, 12.7 (12–13.5); anterior palatine foramina, 6.9 (6.4–7.2); palatal bridge, 6.1 (5.7–6.5); upper molar series, 4.7 (4.5–4.9).

Remarks.—In northern Florida, not far to the northward of the type locality, *O. p. natator* passes into *O. p. palustris,* as shown by specimens from New Berlin and Burnside, which, however, seem more properly placed with the latter form. In the vicinity of Lake Okechobee *natator* merges with *O. p. coloratus,* a richer colored form inhabiting the southern part of the State.

Specimens examined.—Total number, 121, as follows:

Florida: Anastasia Island, 2;[1] Canaveral, 4; Cape Canaveral, 3; Cartersville, 1; Crystal River, 1;[1] Enterprise, 26;[2] Espanita, 3;[3] Fort Kissimmee, 1; Gainesville, 19 (type and topotypes);[4] Geneva, 1; Kissimmee, 2; Kissimmee River, 2; Lake Harney, 11; Lake Kissimmee, 19; Micco, 9;[5] Mullet Lake, 1; Oak Lodge, 9;[1] Ocala, 2; Tarpon Springs, 1;[6] Titusville, 4.

[1] Collection Mus. Comp. Zool.
[2] Fourteen in collection Amer. Mus. Nat. Hist.; 10 in Field Mus. Nat. Hist.; 2 in Mus. Comp. Zool.
[3] Collection Field Mus. Nat. Hist.
[4] Nine in collection Amer. Mus. Nat. Hist.; 5 in Field Mus. Nat. Hist.; 5 in Mus. Comp. Zool.
[5] Three in collection Amer. Mus. Nat. Hist.; 3 in Field Mus. Nat. Hist.
[6] Collection Acad. Nat. Sci. Philadelphia.

ORYZOMYS PALUSTRIS COLORATUS Bangs.

Everglades Rice Rat.

(Pl. I, figs. 2, 2a.)

Oryzomys palustris coloratus Bangs, Proc. Boston Soc. Nat. Hist., XXVIII, p. 189, March, 1898.

Oryzomys natator floridanus Merriam, Proc. Washington Acad. Sci., III, p. 277, July 26, 1901. Type from Everglade, Florida, No. 71349, ♂ ad., U. S. Nat. Mus. (Biological Survey collection); collected by J. Alden Loring, March 29, 1895.

Type locality.—Cape Sable, Monroe County, Florida.

Type.—No. 4470, ♂ adult, Museum of Comparative Zoology (collection of E. A. and O. Bangs); collected by C. L. Brownell, April 17, 1895.

Geographic distribution.—Tropical southern Florida, north to Lake Okechobee.

General characters.—Closely resembling *O. p. natator;* differing in more intense tawny suffusion of upperparts; size about the same. Size larger than usual in *O. p. palustris* and *O. p. texensis,* and color much more tawny than either.

Color.—About as in *O. p. natator,* but general tone of upperparts slightly richer, more tawny or rufescent.

Skull.—Like that of *O. p. natator.*

Measurements.—Type: Total length, 301; tail vertebræ, 150; hind foot, 35. Average of three adult topotypes: 296 (278–305); 144 (133–152); 33.4 (33.4–33.4). *Skull* (average of four adults, type and three topotypes): Greatest length, 32.2 (31.8–32.7); zygomatic breadth, 17.1 (16.8–17.5); interorbital breadth, 5.8 (5.8–5.9); width of braincase, 12.4 (12.2–12.5); nasals, 12.4 (12.1–12.6); anterior palatine foramina, 6.6 (6.3–7); palatal bridge, 6.1 (5.7–6.6); upper molar series, 4.8 (4.7–4.9).

Remarks.—*O. p. coloratus* requires close comparison with *O. p. natator,* from which it apparently differs only in color. The richer tone in *coloratus* is most noticeable when specimens are turned on their sides, and the cheeks and flanks contrasted with those of examples of *natator.* As Bangs rightly states, *coloratus* "occupies only the southern, tropical part of the Florida peninsula."

In describing "*Oryzomys natator floridanus,*" Merriam overlooked the name *coloratus,* which had already been applied to the animal of the region; the two are clearly synonymous.

Specimens examined.—Total number, 50, as follows:

Florida: Cape Sable, 11 (type and topotypes);[1] Eden, 1; Everglade, 16 (including type of "*floridanus*"); Flamingo, 13;[2] Juno (Lake Worth), 5; Jupiter, 2;[1] Miami, 1; Miami River, 1.

[1] Collection Mus. Comp. Zool. [2] Twelve in collection Mus. Comp. Zool.; 1 in Amer. Mus. Nat. Hist.

ORYZOMYS PALUSTRIS TEXENSIS Allen.

Texas Rice Rat.

Oryzomys palustris texensis Allen, Bull. Amer. Mus. Nat. Hist., VI, p. 177, May 31, 1894.

Type locality.—Rockport, Aransas County, Texas.

Type.—No. $\frac{71666}{57764}$, ♂ ad., American Museum of Natural History; collected by H. P. Attwater, November 15, 1893.

Geographic distribution.—From Corpus Christi Bay north and east along the Gulf coast of Texas and Louisiana to the delta of the Mississippi, thence north in the Mississippi Valley to southeastern Missouri; general range reaching southeastern Kansas, probably by way of the Arkansas River valley through Oklahoma (not yet known from Oklahoma); altitudinal range in Austroriparian Zone, mainly below 500 feet, but extending up to about 1,000 feet in Kansas.

General characters.—Closely resembling *O. p. palustris*, but typical examples paler; skull usually narrower. Color paler, less rufescent, and skull decidedly narrower, less massive, than in *O. p. natator* and *O. p. coloratus*.

Color.—About as in *O. p. palustris*, but averaging slightly paler. An ochraceous-tawny suffusion of upperparts and underparts is shown in rare examples.

Skull.—About like that of *O. p. palustris*, but averaging somewhat smaller, with less widely spreading zygomata. Similar to that of *O. p. natator*, but narrower; braincase decidedly narrower; zygomata less widely spreading; frontal region narrower, the supraorbital borders less projecting.

Measurements.—Type: Total length, 256; tail vertebræ, 139; hind foot, 30.5. Average of eight adult topotypes: 242 (226–279); 120 (108–133); 29 (28.5–30.5). *Skull* (average of 5 adults—type and 4 topotypes): Greatest length, 31 (30–32.1); zygomatic breadth, 16 (15.2–16.8); interorbital breadth, 5.3 (5.2–5.4); width of braincase, 11.8 (11.1–12.3); nasals, 12.5 (12–12.9); anterior palatine foramina, 6.1 (5.7–6.5); palatal bridge, 5.8 (5.5–6.1); upper molar series, 4.4 (4.3–4.7).

Remarks.—Specimens from the type locality are paler than those from other localities in the immediate vicinity, some of which are practically indistinguishable from many typical examples of *O. p. palustris*. Moreover, in cranial characters, especially in width of braincase and outward spread of zygomata (characters which distinguish *O. p. texensis* from *O. p. natator* and *O. p. coloratus*), *texensis* very closely approaches *palustris*. The skull of the type and larger topotypes of *texensis* seem inseparable from some of the smaller skulls of comparable age from the region of the type locality of *palustris*. The cranial difference noted, however, affects the majority of indi-

viduals, and together with a tendency toward pallid coloration exhibited by animals inhabiting a wide area, seems to entitle *texensis* to recognition as a separate form. The few specimens available from Arkansas, western Tennessee, and extreme southeastern Missouri seem referable to *texensis*, but approach *palustris* so closely that they might with nearly equal propriety be assigned to that subspecies.

Specimens examined.—Total number, 110, as follows:

Arkansas: Camden, 2; Delight, 1; Lake City, 1; Wilmot, 1.

Kansas: Neosho Falls, 2.[1]

Louisiana: Burbridge, 18;[2] Gibson, 4;[2] Houma, 1; Iowa, 3; Lake Catherine, 6;[3] Main Pass, 2; Mermenton, 4;[4] New Orleans, 2.

Mississippi: Fayette, 1.

Missouri: Kennett, 2; Portageville, 1.

Tennessee: Arlington, 1.

Texas: Corpus Christi, 7;[5] Matagorda, 7; Matagorda Island, 2; Matagorda Peninsula, 1; Nueces Bay, 5; Padre Island, 4; Port Lavaca, 4; Rockport, 24 (type and topotypes);[6] Sabine, 1; Victoria, 1; Virginia Point, 1; Wharton County, 1.[3]

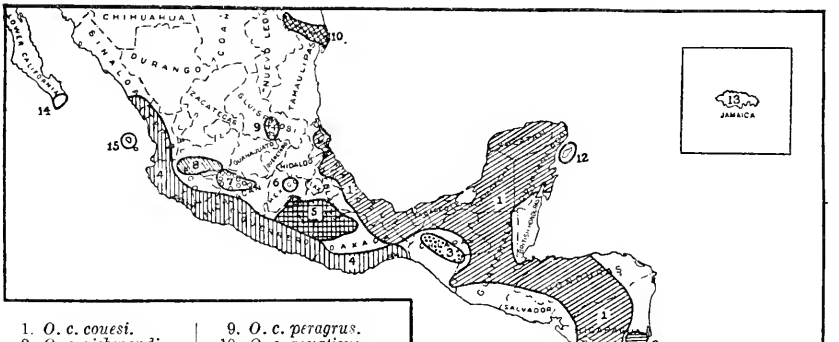


FIG. 3.—Geographic distribution of *Oryzomys couesi* and related species.

ORYZOMYS COUESI (ALSTON).

[Synonymy under subspecies.]

Geographic distribution.—River valleys and marshy areas from southern Texas on the east and southern Sinaloa on the west, south through central and southern Mexico, Guatemala, Honduras, and Nicaragua to northern Costa Rica. Altitudinal range from sea level, regardless of latitude, to over 7,000 feet in the Valley of Mexico; zonal range mainly Tropical but reaching into Sonoran Zone on the tableland of Mexico (fig. 3).

[1] One in Mus. Comp. Zool.
[2] Collection Mus. Comp. Zool.
[3] Collection Amer. Mus. Nat. Hist.
[4] Collection Field Mus. Nat. Hist.
[5] One in collection Amer. Mus. Nat. Hist.
[6] Nineteen in collection Amer. Mus. Nat. Hist.; 2 in Field Mus. Nat. Hist.; 1 in Mus. Comp. Zool.

General characters.—Similar in general to *O. palustris*, but pelage shorter; colors usually brighter and richer, ochraceous-buffy or ochraceous-tawny instead of grayish brown; skull differing in various details, but dentition about the same.

Color.—Upperparts varying from light buff or pinkish buff through ochraceous-buff to ochraceous-tawny, more or less suffused with tawny or russet, the general shade paler on cheeks, shoulders, and along sides, becoming deeper, more intense, and darkened on face, top of head, and back by admixture of black hairs; underparts varying from nearly pure white through light buff to light ochraceous-buff, more or less suffused with pale salmon color; outer sides of ears blackish, inner sides moderately clothed with short hairs varying from grayish to ochraceous-buff or rusty reddish; feet white; tail dark brownish above, whitish or light brownish below.

Skull.—(For general outlines see under *O. palustris* group.) In general form closely resembling that of *O. palustris*, but sphenopalatine vacuities, large in that species, absent or much reduced in size; antorbital foramen with anterior border more rounded above, more inclined or produced forward at the base, not excised or tending to develop the somewhat *Sigmodon*-like point often present in *palustris;* interparietal with a more evident posterior angle.

Remarks.—Ten geographic races of *O. couesi* appear to be recognizable in the area between the valley of the Rio Grande, Texas, and northern Costa Rica. While all the more minute steps of intergradation are not always shown by the material now available, mainland forms throughout this wide interval agree so closely in all essential details that they seem safely assignable to a single species. Several outlying insular forms (and *O. peninsulæ* of Lower California) exhibit more distinctive characters and are accorded specific rank, but they are clearly related to the widely ranging *O. couesi* section of the *O. palustris* group.

ORYZOMYS COUESI COUESI (Alston).

Coues Rice Rat.

(Pl. I, figs. 3, 3a.)

Hesperomys couesi Alston, Proc. Zool. Soc. London, 1876, p. 756.

Oryzomys couesi Thomas, Ann. Mag. Nat. Hist., ser. 6, XI, p. 403, May 1893 (type and locality fixed).

Oryzomys jalapæ Allen and Chapman, Bull. Amer. Mus. Nat. Hist., IX, p. 206, June 16, 1897. Type from Jalapa, Vera Cruz, Mexico (altitude 4,400 ft.). No. $\frac{12551}{10361}$, ♂ ad., Amer. Mus. Nat. Hist.; collected by F. M. Chapman, April 16, 1897.

Oryzomys jalapæ rufinus Merriam, Proc. Washington Acad. Sci., III, p 285, July 26, 1901. Type from Catemaco, Vera Cruz, Mexico (altitude 1,000 feet). No. 65499, ♀ ad., U. S. Nat. Mus. (Biological Survey collection); collected by Nelson and Goldman, April 27, 1894.

Oryzomys teapensis Merriam, Proc. Washington Acad. Sci., III, p. 286, July 26, 1901. Type from Teapa, Tabasco, Mexico. No. 99973, ♂ subad., U. S. Nat. Mus. (Biological Survey collection); collected by Nelson and Goldman, April 4, 1900.

Oryzomys goldmani Merriam, Proc. Washington Acad. Sci., III, p. 288, July 26, 1901. Type from Coatzacoalcos, Vera Cruz, Mexico (near sea level). No. 78110, ♀ ad., U. S. Nat. Mus. (Biological Survey collection); collected by Nelson and Goldman, April 11, 1896.

Oryzomys jalapæ apatelius Elliot, Field Columb. Mus., publ. 90, zool. ser., III, p. 266, March 8, 1904. Type from San Carlos, Vera Cruz, Mexico. No. 13107, ♀ ad., Field Mus. Nat. Hist.; collected by N. G. Buxton, March 1, 1903.

Oryzomys richardsoni Allen, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 99, April 30, 1910. Type from Pena Blanca, Nicaragua. No. 29800, ♂ ad., Amer. Mus. Nat. Hist.; collected by Wm. B. Richardson, May 25, 1909.

Type locality.—Coban, Guatemala.

Type.—In British Museum: collected by Osbert Salvin.

Geographic distribution.—From northern Vera Cruz southeastward through eastern Puebla, eastern Oaxaca, northern and extreme southern Chiapas, Tabasco, Campeche, Yucatan, Quintana Roo, Guatemala, Honduras, and Nicaragua, to northwestern Costa Rica; altitudinal range from sea level to about 5,000 feet mainly in Humid Lower Tropical Zone.

General characters.—Size about as in *O. c. zygomaticus, O. c. mexicanus* and *O. c. richmondi;* color slightly darker than in *zygomaticus,* decidedly darker than in *mexicanus,* and decidedly paler than in *richmondi;* skull about like those of *mexicanus* and *richmondi;* sphenopalatine vacuities absent or represented by very narrow slits as usual in the *O. couesi* section of the *O. palustris* group. Similar in general to *O. c. peragrus,* but somewhat smaller, with upperparts, especially cheeks, shoulders, and sides, more ochraceous-buffy; skull less massive.

Color.—Fresh pelage: Upperparts varying from ochraceous-buffy to ochraceous-tawny, deepened in rare examples to light cinnamon-brown, lightest on cheeks, shoulders, and along sides, the face, top of head, and back much darkened by black hairs; underparts varying from light buff to light ochraceous buff (rarely dull white); outer sides of ears blackish, the inner sides clothed with short ochraceous-buffy hairs; feet white; tail brownish above, dull yellowish below proximally, becoming light brownish toward tip.

Skull.—About as in *O. c. zygomaticus, O. c. mexicanus,* and *O. c. richmondi;* differing mainly in smaller general size, decidedly narrower braincase, and smaller molars than those of *O. c. crinitus, O. c. albiventer,* and other Mexican tableland forms. Similar to that of *O. c. peragrus,* but braincase narrower.

Measurements.—Average of 4 adults from Tumbala, Chiapas: Total length, 252 (242–265); tail vertebræ, 130 (127–135); hind foot, 30.7 (30–31). Average of 10 adults from Yaruca, Honduras: 267.5 (255–280); 138 (130–145); 29.1 (28–32). Average of seven adults from Orizaba, Vera Cruz: 263 (248–294); 148 (139–174); 33.1

(32–34.5). *Skull* (average of 5 adults from Yaruca, Honduras): Greatest length, 30.5 (29.9–31.3); zygomatic breadth, 16 (15.5–17.2); interorbital breadth, 4.8 (4.5–5.1); width of braincase, 11.4 (11.2–11.6); nasals, 11.9 (11.4–12.4); anterior palatine foramina, 6 (5.5–6.2); palatal bridge, 5.5 (5.3–6.1); upper molar series, 4.7 (4.5–4.8).

Remarks.—In the absence of material from the type locality as fixed by Thomas, specimens from Tumbala, Chiapas; and Yaruca, Honduras, which agree closely with his description, are assumed to represent typical *couesi* and have been used as a basis for comparison. Individual variation in size, color, and cranial details exhibited by every large series of *O. c. couesi* is very striking, but the form maintains with remarkable constancy its essential characters throughout its wide range. Examples from northern Vera Cruz and eastern Puebla present the same general variations and are not satisfactorily separable from those from Honduras and Nicaragua. This variation has resulted in the publication of several names based on characters which prove to be inconstant in the large number of specimens passed in review. Specimens from various localities indicate direct intergradation with *O. c. zygomaticus, O. c. mexicanus*, and *O. c. peragrus*.

Specimens examined.—Total number, 199, as follows:

Campeche: La Tuxpeña, 1.
Chiapas: Chicharras, 4; Tumbala, 6.
Costa Rica: Bahia de Salinas, 1.[1]
Guatemala: Jacaltenango, 3.
Honduras: Yaruca, 35.[2]
Nicaragua: Chontales, 22;[1] Matagalpa, 4;[1] Ocotal, 2;[1] Peña Blanca, 8 (including type of "*richardsoni*");[1] Quilali, 1;[1] Rio Coco, 14;[1] Rio Grande, 1;[1] Rio San Juan del Norte, 1;[1] Rio Tuma, 2;[1] San Juan, 1;[1] Tuma, 5;[1] Uluce, 1;[1] Vijagua, 2.[1]
Oaxaca: Comaltepec, 1; Guichicovi, 3; Reforma, 1[3]; Santo Domingo (mountain near), 8; Tuxtepec, 2.
Puebla: Huauchinango, 1; Metlaltoyuca, 11.
Quintana Roo: Santa Lucia, 3.[4]
Tabasco: Teapa, 3 (including type of "*teapensis*").
Vera Cruz: Achotal, 4;[3] Buena Vista, 2; Catemaco, 2 (including type of "*rufinus*"); Jalapa, 4 (including type of "*jalapæ*");[1] Pasa Nueva, 1;[1] Coatzacoalcos, 3 (including type of "*goldmani*"); Jico, 2;[3] Mirador, 1; Motzorongo, 1; San Carlos, 3 (including type of "*apatelius*");[3] Orizaba, 16;[5] Rivera (75 miles south), 1; Papantla, 1; Teocelo, 1;[4] Tlacotalpam, 7; Ubero, 1.
Yucatan: Rio Lagartos, 2.[3]

[1] Collection Amer. Mus. Nat. Hist.
[2] Twenty-six specimens in Mus. Comp. Zool.; 6 in Field Mus. Nat. Hist.
[3] Collection Field Mus. Nat. Hist.
[4] Collection Mus. Comp. Zool.
[5] Two in Field Mus. Nat. Hist.

ORYZOMYS COUESI RICHMONDI Merriam.

Richmond Rice Rat.

Oryzomys richmondi Merriam, Proc. Washington Acad. Sci., III, p. 284, July 26, 1901.

Type locality.—Escondido River (50 miles above Bluefields), Nicaragua.

Type.—No. $\frac{36340}{48705}$, ♂ adult, United States National Museum (Biological Survey collection); collected by Charles W. Richmond, June 21, 1892.

Geographic distribution.—Low river valleys of eastern Nicaragua; Humid Lower Tropical Zone.

General characters.—Size and proportions about as in *O. c. couesi;* color decidedly darker.

Color.—Similar to that of *O. c. couesi,* but decidedly darker, more regularly ochraceous-tawny, the back and upper part of sides more heavily darkened by admixture of black hairs; underparts light ochraceous-buff.

Skull.—As in *O. c. couesi.*

Measurements.—Type: Total length, 295; tail vertebræ, 150; hind foot, 33.5. Average of 10 adults (type and nine topotypes): 275.8 (255–295); 137 (124–151); 30.9 (29–33.5). *Skull* (average of 5 adults—type and 4 topotypes): Greatest length, 31.8 (31.2–33.3); zygomatic breadth, 16.9 (16.4–17.9); interorbital breadth, 5.1 (5–5.3); width of braincase, 11.7 (11–11.9); nasals, 12.3 (11.6–13); anterior palatine foramina, 6 (5.8–6.2); palatal bridge, 5.8 (5.7–5.9); upper molar series, 4.5 (4.3–4.6).

Remarks.—This form, the darkest of the *O. couesi* series, is known only from low elevations in eastern Nicaragua, where Richmond found it inhabiting banana plantations. Although much darker in general tone of upperparts than most examples of *O. c. couesi* from adjacent territory, close agreement in all other important respects points to complete intergradation with the latter.

Specimens examined.—Total number, 35, as follows:

Nicaragua: Escondido River (50 miles above Bluefields, 12[2] [type and topotypes]; 45 miles above Bluefields, 18; 40 miles above Bluefields, 3; 25 miles above Bluefields, 1; 16 miles above Bluefields, 1).

ORYZOMYS COUESI ZYGOMATICUS Merriam.

Guatemalan Rice Rat.

Oryzomys zygomaticus Merriam, Proc. Washington Acad. Sci., III, p. 285, July 26, 1901.

Type locality.—Nenton, Guatemala (altitude 3,000 feet).

Type.—No. 76794, ♂ adult United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, December 15, 1895.

Geographic distribution.—Known only from the Chiapas River valley in southwestern Guatemala and south-central Chiapas; Arid Lower Tropical Zone.

General characters.—Closely resembling *O. c. couesi* and *O. c. mexicanus,* but upperparts slightly paler than in the former and slightly darker than in the latter.

Color.—About as in *O. c. couesi* but averaging slightly paler, the general tone ochraceous-buff as in the palest examples of *O. c. couesi;* underparts nearly pure white in the type, varying to light buff in other examples.

Skull.—As in *O. c. couesi.*

Measurements.—Type: Total length, 290; tail vertebræ, 152; hind foot, 33. *Skull* (type): Greatest length, 30.9; zygomatic breadth, 26.9; interorbital breadth, 4.8; width of braincase, 11.6; nasals, 11.6; anterior palatine foramina, 6; palatal bridge, 5.9; upper molar series, 4.6.

Remarks.—*O. c. zygomaticus* seems to be a slightly differentiated and rather localized form intermediate in color and geographic position between *O. c. couesi* and *O. c. mexicanus.* It doubtless intergrades directly with *couesi,* the type of which came from a higher elevation about 100 miles to the eastward in central Guatemala. Three specimens from Jacaltenango, at about 5,500 feet altitude, only a few miles to the southeast, are appreciably darker in color and seem to represent typical *couesi.* Near the Pacific Coast in southwestern Chiapas, *zygomaticus* doubtless passes into *mexicanus,* which differs mainly in having slightly paler color.

Specimens examined.—Total number, 5, as follows:

Chiapas: Ocuilapa, 1.
Guatemala: Nenton, 4 (type and topotypes).

ORYZOMYS COUESI MEXICANUS Allen.

Mexican Rice Rat.

Oryzomys mexicanus Allen, Bull. Amer. Mus. Nat. Hist., IX, p. 52, March 15, 1897.

Oryzomys bulleri Allen, Bull. Amer. Mus. Nat. Hist., IX, p. 53, March 15, 1897. Type from Valle de Banderas, Tepic, Mexico, No. $\frac{83299}{66633}$, ♂ subad., Amer. Mus. Nat. Hist.; collected by Audley C. Buller, February 2, 1893.

Oryzomys rufus Merriam, Proc. Washington Acad. Sci., III, p. 287, July 26, 1901. Type from Santiago, Tepic, Mexico (altitude 200 feet). No. 91404, ♀ old, U. S. Nat. Mus. (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, June 20, 1897.

Type locality.—Hacienda San Marcos, Tonila, Jalisco, Mexico (altitude 3,500 feet).

Type.—No. $\frac{26550}{21288}$, ♂ adult, American Museum of Natural History; collected by Audley C. Buller, December 30, 1889.

Geographic distribution.—Pacific coastal plains and basal mountain slopes from southern Sinaloa to southeastern Oaxaca, Mexico; altitudinal range from sea level to about 1,000 feet (rarely to 3,500 feet), mainly in Arid Lower Tropical Zone.

General characters.—Size and proportions about as in *O. c. couesi;* color of upperparts rather decidedly paler, more ochraceous-buffy; underparts usually white, but varying to light buff, or light ochraceous-buff, the normal shades in *couesi.* Slightly paler than *O. c. zygomaticus;* slightly darker than *O. c. aztecus,* with smaller molar teeth. Similar in color to *O. c. albiventer,* but size smaller, and skull differing in detail.

Color.—Fresh pelage: Upperparts in general varying shades of ochraceous-buff, more or less suffused with tawny in old adults, becoming warm buff on cheeks, shoulders, and along lower parts of sides; the face, top of head, and back moderately darkened by blackish hairs; underparts usually nearly pure white, but varying to light buff; outer sides of ears dusky, the inner sides clothed with grayish or rusty reddish hairs; feet white; tail brownish above, dull yellowish below on proximal portion, becoming light brownish toward tip. *Young* (in first pelage): Upperparts near tawny-olive, the general tone darker and duller than in adults.

Skull.—About as in *O. c. couesi.* Differing from those of *O. c. aztecus, O. c. regillus,* and *O. c. albiventer* most noticeably in smaller size of molar teeth, the toothrows being correspondingly shortened.

Measurements.—Average of 10 adults from Escuinapa, Sinaloa: Total length, 251.4 (239–273); tail vertebræ, 137.4 (127–165); hind foot, 28.9 (27–35). *Skull* (average of same): Greatest length, 31.2 (29.8–33); zygomatic breadth, 17 (16.1–17.8); interorbital breadth, 4.8 (4.5–5.3); width of braincase, 11.6 (11.3–12.2); nasals, 12.2 (11.1–13.4); anterior palatine foramina, 6.1 (5.8–6.7); palatal bridge, 5.5 (4.8–6); upper molar series, 4.4 (4.2–4.8).

Remarks.—The narrow distribution area of *O. c. mexicanus* along the west coast of Mexico somewhat parallels that of *O. c. couesi* along the east coast; and as in that form, wide range of individual variation in size and color has resulted in the publication of names which appear to be based on unstable characters. While individuals vary notably in size and contour, as shown by every large series, skulls of *mexicanus* and *couesi* seem indistinguishable, their general characters being maintained with remarkable uniformity throughout the combined ranges of the two forms. Intergradation of *mexicanus* with *couesi* seems to be indicated by specimens from the Isthmus of Tehuantepec, and with *O. c. aztecus* by examples from the valley of the Balsas River in Guerrero.

Specimens examined.—Total number, 106, as follows:

Colima: Armeria, 11; Hacienda Magdalena, 2.
Guerrero: Ometepec, 7.
Jalisco: Hacienda San Marcos, 1 (type).[1]
Michoacan: La Huacana, 5.
Oaxaca: Huilotepec, 2; Juchitan, 1; Llano Grande, 5; Pluma, 3; Puerto Angel, 8; Reforma, 1;[2] Santa Efigenia, 1; Tehuantepec, 1.
Sinaloa: Escuinapa, 47;[1] Mazatlan, 1;[3] Rosario, 2.[4]
Tepic: San Blas, 4; Santiago, 2 (including type of "*rufus*"); Valle de Banderas, 2 (including type of "*bulleri*").

ORYZOMYS COUESI AZTECUS Merriam.

Aztec Rice Rat.

Oryzomys crinitus aztecus Merriam, Proc. Washington Acad. Sci., III, p. 282, July 26, 1901.

Type locality.—Yautepec, Morelos, Mexico (altitude 4,000 feet).

Type.—No. 51173, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 16, 1893.

Geographic distribution.—Interior river valleys of Morelos, southern Puebla, northern Oaxaca, and northeastern Guerrero, Mexico; altitudinal range from about 3,000 to at least 4,000 feet in Arid Lower Tropical Zone.

General characters.—A pale form with white underparts and rather heavy dentition. Closely resembling *O. c. mexicanus*, but paler in color and with heavier dentition than usual in that subspecies. Differing from *O. c. crinitus* in paler upperparts, white instead of buffy underparts, and in cranial details.

Color.—As in the paler examples of *O. c. mexicanus*, the prevailing tone beneath the dark hairs on the back pale ochraceous-buff; underparts nearly pure white.

Skull.—About like that of *O. c. mexicanus*, but molar teeth larger. Similar to that of *O. c. crinitus*, but braincase narrower and molars slightly smaller.

Measurements.—Type: Total length, 290; tail vertebræ, 154; hind foot, 35. Two adults from Puente de Ixtle, Morelos: 318, 313; 160, 170; 34, 33. *Skull* (type): Greatest length, 32.4; zygomatic breadth, 17; interorbital breadth, 5.2; width of braincase, 12.2; nasals, 12.9; anterior palatine foramina, 6.4; palatal bridge, 6.2; upper molar series, 5.

Remarks.—*O. c. aztecus* is the palest form of the *O. couesi* series, but the light ochraceous tone of the upperparts is very closely approached by the paler examples of *O. c. mexicanus*, *O. c. albiventer*,

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Field Mus. Nat. Hist.
[3] Collection Mus. Comp. Zool.
[4] One in collection Mus. Comp. Zool.

and *O. c. aquaticus*. Specimens from the valley of the Balsas River in Guerrero and from northern Puebla approach *mexicanus* in dentition, as well as color, and might with nearly equal propriety be referred to that subspecies. The characters separating *aztecus* and *O. c. crinitus* are rather slight, as indicated in the original descriptions, and it seems best to regard both as forms of *O. couesi*.

Specimens examined.—Total number, 20, as follows:

Guerrero: Balsas, 1;[1] Tlalixtaquilla, 1.
Morelos: Cuernavaca, 1; Puente de Ixtle, 6;[2] Yautepec, 5 (type and topotypes).
Oaxaca: Cuicatlan, 2.
Puebla: Piaxtla, 4.

ORYZOMYS COUESI CRINITUS Merriam.

Valley of Mexico Rice Rat.

Oryzomys crinitus Merriam, Proc. Washington Acad. Sci., III, p. 281, July 26, 1901.

Type locality.—Tlalpam, Federal District, Mexico (altitude 7,500 feet).

Type.—No. 50182, ♂ subadult (molars unworn), United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, November 30, 1892.

Geographic distribution.—Known only from type locality, at about 7,500 feet altitude in the Valley of Mexico; Upper Sonoran Zone.

General characters.—A large, moderately dark form with light buffy underparts and heavy dentition. Similar to *O. c. aztecus* and *O. c. albiventer*, but upperparts darker than either and underparts buffy instead of white; differing also in cranial details.

Color.—Very similar to that of *O. c. mexicanus*, but general tone of upperparts slightly darker; underparts light buffy as in some examples of *mexicanus*.

Skull.—Rather large with broad braincase and heavy dentition. Very similar to those of *O. c. aztecus*, *O. c. albiventer*, and *O. c. regillus*, but frontal region usually broader posteriorly; dentition about the same; interparietal rather large.

Measurements.—Type: Total length, 307; tail vertebræ, 161; hind foot, 37. Adult topotype: 280; 148; 35. *Skull* (type): Greatest length, 32.4; zygomatic breadth, 17; interorbital breadth, 5; width of braincase, 12.3; nasals, 12.4; anterior palatine foramina, 6.7; palatal bridge, 5.7; upper molar series, 4.9.

Remarks.—In the vicinity of marshes along the southern border of the Valley of Mexico, *O. c. crinitus* occurs at about 7,500 feet, the highest altitude attained by any known member of the *O. couesi* section of the genus. The exact relationship of this form to *O. fulgens* remains to be determined, since it possesses some of the characters

[1] Collection Field Mus. Nat. Hist. [2] Three in collection Field Mus. Nat. Hist.

ascribed to the latter species, the exact habitat of which is unknown. It is closely allied to the other forms inhabiting river valleys of the plateau region of Mexico—*O. c. aztecus, O. c. albiventer,* and *O. c. regillus.*

Specimens examined.—Three, from type locality.

ORYZOMYS COUESI REGILLUS Goldman.

Michoacan Rice Rat.

(Pl. I, figs. 4, 4a.)

Oryzomys couesi regillus Goldman, Proc. Biol. Soc. Washington, XXVIII, p. 129, June 29, 1915.

Type locality.—Los Reyes, Michoacan, Mexico.

Type.—No. 125945, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 17, 1903.

Geographic distribution.—Plateau region of northwestern Michoacan, Mexico; altitudinal range from about 3,000 to 4,000 feet, mainly in Arid Lower Tropical Zone.

General characters.—A large form closely allied to *O. c. albiventer;* upperparts darker, more rufescent in color. Similar in general to *O. c. mexicanus,* but larger and richer colored; cranial details also distinctive.

Color.—Much as in *O. c. mexicanus* and *O. c. albiventer* but upperparts darker and more rufescent, the general tone rich ochraceous-buff, the back and rump strongly suffused with tawny and lined with black hairs as usual in the group; underparts varying from nearly pure white to light buff.

Skull.—Like that of *O. c. albiventer;* similar to those of *O. c. mexicanus* and *O. c. couesi,* but larger, with broader braincase and heavier dentition.

Measurements.—Type: Total length, 305; tail vertebræ, 169; hind foot, 36. Average of three adult topotypes: 308 (285–320); 168 (155–180); 35 (34–36). *Skull* (average of 4 adults—type and 3 topotypes): Greatest length, 33.1 (32.5–33.5); zygomatic breadth, 18.1 (17.5–18.5); interorbital breadth, 4.9 (4.6–5.3); width of braincase, 12.5 (12.4–12.5); nasals, 12.9 (12.5–13.3); anterior palatine foramina, 6.2 (6–6.5); palatal bridge, 6.5 (6.4–6.6); upper molar series, 5.1 (4.9–5.3).

Remarks.—This handsome rice rat differs only in color from its near geographic neighbor, *O. c. albiventer,* and the two doubtless intergrade in northern Michoacan.

Specimens examined.—Total number, 13, as follows:

Michoacan: Los Reyes, 11 (type and topotypes); Querendaro, 1; Zamora, 1.

ORYZOMYS COUESI ALBIVENTER Merriam.

White-Bellied Rice Rat.

Oryzomys albiventer Merriam, Proc. Washington Acad. Sci., III, p. 279, July 26, 1901.
Oryzomys molestus Elliot, Field Columb. Mus., publ. 71, zool. ser., III, p. 145, February, 1903. Type from Ocotlan, Jalisco, Mexico (altitude 5,000 feet). No. 8667, ♂ old, Field Mus. Nat. Hist.; collected by F. E. Lutz, June, 1901.

Type locality.—Ameca, Jalisco, Mexico (altitude 4,000 feet).

Type.—No. 82236, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 6, 1897.

Geographic distribution.—River valleys of the plateau region in central Jalisco, Mexico; altitudinal range from about 4,000 to 5,000 feet mainly in Lower Sonoran Zone.

General characters.—Color about as in *O. c. mexicanus*, but size usually larger and cranial details distinctive. Similar in size and proportions to *O. c. regillus* and *O. c. crinitus*, but paler than either, the upperparts lacking the rich rufescent tone of the former, and the underparts normally white instead of buffy as in the latter.

Color.—About as in *O. c. mexicanus*, underparts normally white, but varying to pale, creamy buff.

Skull.—About like that of *O. c. regillus;* similar to that of *O. c. crinitus*, but frontal region usually narrower posteriorly. Compared with those of *O. c. couesi* and *O. c. mexicanus* the skull is decidedly broader, with heavier dentition.

Measurements.—Type: Total length, 288; tail vertebræ, 153; hind foot, 37.5. Average of 10 adults (type and 9 topotypes): 294 (276–314); 161 (151–173); 36.6 (34–40). *Skull* (average of 10 adults—type and 9 topotypes): Greatest length, 33.1 (31.5–34.4); zygomatic breadth, 17.9 (17.3–18); interorbital breadth, 4.8 (4.1–5.2); width of braincase, 12.3 (11.5–12.8); nasals, 13 (12.3–14.2); anterior palatine foramina, 6.3 (5.9–6.6); palatal bridge, 6.3 (5.8–6.7); upper molar series, 5.3 (5–5.5).

Remarks.—While *O. c. albiventer* is usually larger in general size, with broader skull and decidedly larger molar teeth than *O. c. mexicanus*, occasional examples of the two forms are difficult to distinguish and point to probable intergradation in western Jalisco. "*Oryzomys molestus*" of Elliot is based on an unusually large old adult which is clearly referable to *albiventer*, as are four examples in the Biological Survey collection from the same locality.

Specimens examined.—Total number, 18, as follows:

Jalisco: Ameca, 12 (type and topotypes); La Barca, 1; Ocotlan, 5 (including type of "*molestus.*")[1]

[1] Collection Field Mus. Nat. Hist.

ORYZOMYS COUESI PERAGRUS Merriam.

Rio Verde Rice Rat.

Oryzomys mexicanus peragrus Merriam, Proc. Washington Acad. Sci., III, p. 283, July 26, 1901.

Type locality.—Rio Verde, San Luis Potosi, Mexico.

Type.—No. 82119, ♂ subadult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 8, 1897.

Geographic distribution.—Known only from type locality, at about 3,000 feet altitude on the Rio Verde River, in southern San Luis Potosi; Lower Sonoran Zone.

General characters.—Closely allied to *O. c. couesi* but slightly larger, with upperparts more pinkish instead of ochraceous-buffy in general tone; skull more massive. Similar to *O. c. aquaticus* but upperparts usually darker, the ground color less ochraceous-buffy and the dorsal area more heavily lined with black.

Color.—Similar to that of *O. c. couesi* but upperparts paler, less ochraceous-buffy, the cheeks, shoulders, and sides near pinkish buff; lips and chin whitish.

Skull.—About like that of *O. c. aquaticus;* larger and more massive than that of *O. c. couesi,* with broader braincase and broader interorbital space.

Measurements.—Type: Total length, 294; tail vertebræ, 167; hind foot, 35. Average of 2 adult topotypes: 274 (265–283); 151 (143–160); 33.5 (33–34). *Skull* (average of 3 adults—type and 2 topotypes): Greatest length, 31.5 (31–32.2); zygomatic breadth, 16.6 (16.1–17.1); interorbital breadth, 5.5 (5.4–6.2); width of braincase, 12.1 (12–12.3); nasals, 12.1 (11.8–12.5); anterior palatine foramina, 5.8 (5.7–5.8); palatal bridge, 5.9 (5.7–6.2); upper molar series, 4.9 (4.7–5).

Remarks.—As nearly as can be determined by the three known specimens, all young adults, *O. c. peragrus* is somewhat intermediate in characters, as well as geographic position, between *O. c. couesi* and *O. c. aquaticus.* It differs in color from both, but in cranial details approaches the latter form.

Specimens examined.—Three, from type locality.

ORYZOMYS COUESI AQUATICUS Allen.

Rio Grande Rice Rat.

(Pl. I, figs. 5, 5a.)

Oryzomys aquaticus Allen, Bull. Amer. Mus. Nat. Hist., III, p. 289, June 30, 1891.

Type locality.—Brownsville, Cameron County, Texas.

Type.—No. $\frac{3\,4\,1\,1}{2\,6\,8\,4}$, ♂ adult, American Museum of Natural History; collected by F. B. Armstrong, March 6, 1891.

Geographic distribution.—Rio Grande Valley, from Camargo, Tamaulipas, to Gulf coast near Brownsville, Texas; altitudinal range from sea level to about 300 feet in lower Sonoran Zone.

General characters.—Size large; closely resembling *O. c. peragrus* but upperparts usually paler, less pinkish, more ochraceous-buffy; underparts buffy, as in *peragrus*. Similar in general to *O. c. couesi* but larger; general color above paler ochraceous-buff; skull relatively broader and more massive.

Color.—Fresh pelage: Upperparts near ochraceous-buff, palest on cheeks, shoulders, and along sides; the face, top of head, and back obscured by dusky hairs; underparts varying from light buff to warm buff, becoming in some specimens more or less distinctly whitish on lips, chin, and throat; feet whitish; tail brownish above, pale yellowish below, becoming pale brownish toward tip. *Young* (in first pelage): Upperparts near tawny-olive; underparts with a pale buffy wash, the plumbeous basal color of the fur showing through.

Skull.—About like that of *O. c. peragrus;* decidedly larger and heavier throughout than that of *O. c. couesi*, with broader braincase and more widely spreading zygomata; ascending branches of premaxillæ exhibiting a tendency to exceed nasals in posterior extent (nasals usually exceeding premaxillæ in forms of *O. couesi*).

Measurements.—Type: Total length, 286; tail vertebræ, 140; hind foot, 31.2 (dry skin). Average of 5 adult topotypes: 297 (283–310); 161 (138–180); 34.5 (32–38). *Skull* (average of same): Greatest length, 33 (32–35.4); zygomatic breadth, 18 (16.7–18.8); interorbital breadth, 5 (4.7–5.2); width of braincase, 12 (11.6–12.7); nasals, 12.7 (11.6–13.8); anterior palatine foramina, 6.3 (6.1–6.6); palatal bridge, 6 (5.4–6.6); upper molar series, 5.1 (4.8–5.3).

Remarks.—The Rio Grande Valley, inhabited by *O. c. aquaticus*, marks the extreme northern limit of the general range of the *O. couesi* series. No rice rats are yet known from the interval of coastal plain in Tamaulipas, but close resemblance in all essential respects points to intergradation through *O. c. peragrus* with typical *couesi*. In general size and contour the skull of aquaticus is not widely different from those of *O. c. albiventer*, *O. c. regillus*, and *O. c. crinitus* of the Mexican plateau region, but it maintains the lighter dentition of typical *couesi*.

Specimens examined.—Total number, 41, as follows:

Texas: Brownsville, 37 (type and topotypes);[1] Lomita Ranch (Hidalgo County), 1.

Tamaulipas: Camargo, 1; Matâmoros, 2.

[1] Fourteen in Amer. Mus. Nat. Hist.; 3 in Kansas Univ. Mus.; 2 in Field Mus. Nat. Hist.; 2 in Mus. Comp. Zool.; 2 in Acad. Nat. Sci. Philadelphia.

ORYZOMYS FULGENS Thomas.

Thomas Rice Rat.

Oryzomys fulgens Thomas, Ann. Mag. Nat. Hist., ser. 6, XI, p. 403, May, 1893.

Type locality.—"Mexico." Southern Mexico, exact locality unknown (probably in or near Valley of Mexico).

Type.—70.6.20.3, ♂ adult, British Museum; purchased of Geale, collected by A. Boucard.

Geographic distribution.—Range unknown.

General characters.—From original description: "Size large. Fur very thick, coarse and woolly. General colour above bright fulvous, brighter than in any other Central-American species; anterior half of the body, including the head, rather paler and duller than the posterior half. Ears decidedly small, broadly rounded, thinly haired, their hairs practically the same colour as those of the head in general, so that they are not distinguishable by colour at a distance. Lips, chin, throat, and inguinal region whitish, belly with a strong suffusion of fawn, which reaches a maximum on the breast between the fore legs; passage of upper colour into lower quite gradual. Outer sides of limbs like back, inner sides whitish; upper surfaces of hands and feet thinly clothed with pale silvery-fawn hairs. Tail long, thinly haired, the scales not hidden by the hairs; above blackish, below yellowish, darkening towards the tip."

Skull.—From original description: "Skull readily distinguishable from all allied species by its great breadth, the bold expansion of the zygomata, and especially by the evenly incurved outline of the supraorbital edges; in all other species these edges form two approximately straight lines diverging from the narrowest interorbital point, but in *O. fulgens* the whole inner wall of the orbit forms one even curve, the breadth at the posterior end of the olfactory chamber being scarcely greater than at the anterior end. Nasals broad and flattened. Frontal premaxillary processes very narrow and barely attaining to the same level as the back of the nasals. Anterior palatine foramina large, widely open, their posterior margin just level with the front of *m1*."

Measurements.—Dry skin of type (from original description): Head and body, 160; tail, 151; hind foot, 37.5 (c. u.). *Skull* (type): Upper length,[1] 31.8; zygomatic breadth, 17.8 (c.); nasals, 13.2; interorbital breadth, 4.8; diastema, 9.1; anterior palatine foramina, 7.2; upper molar series, 5.2.

Remarks.—The type of *O. fulgens* I have been unable to examine, and none of the more recently accumulated material from Mexico can at present be assigned with certainty to that species. Thomas's full description, above quoted, and comparisons kindly made for me

[1] To back of parietal suture only.

by W. H. Osgood, however, seem to indicate that this is a member of the widely dispersed *O. couesi* section of the genus. Some of the characters given are shared in common by various forms now recognized. In size and color arrangement it closely approaches *O. c. crinitus*, of the Valley of Mexico, and may be identical with that form, but the intensity of color and details presented by the incomplete skull, especially the form of the interorbital region, appear to be distinctive and the exact position of *fulgens* remains to be determined.

ORYZOMYS GATUNENSIS Goldman.

GATUN RICE RAT.

(Pl. I, figs. 6, 6a.)

Oryzomys gatunensis Goldman, Smiths. Misc. Coll., LVI, no. 36, p. 7, February 19, 1912.

Type locality.—Gatun, Canal Zone, Panama.

Type.—No. 171034, ♂ young (about two-thirds grown), United States National Museum (Biological Survey collection); collected by E. A. Goldman March 7, 1911.

Geographic distribution.—Known only from type locality, near sea level; Humid Lower Tropical Zone.

General characters.—A dark-colored form externally similar to *O. c. richmondi*, but with distinctive cranial characters.

Color.—Fresh pelage: Upperparts near ochraceous-tawny, palest on cheeks, shoulders, and along sides; the face, top of head, and back much darker by admixture of black hairs; underparts light ochraceous-buffy; outer sides of ears blackish, the inner sides clothed with ochraceous-buffy hairs; feet thinly covered with very short whitish or grayish hairs; tail light brownish above, somewhat paler below.

Skull.—Similar in general to that of *O. c. richmondi*, but frontal region broader, the lateral margins more developed as supraorbital shelves; interparietal much less extended antero-posteriorly; nasals more prolonged posteriorly beyond premaxillæ; dentition about as in *richmondi*.

Measurements.—Type: Total length, 224; tail vertebræ, 115; hind foot, 31.5. *Skull* (type): Greatest length, 27.7; zygomatic breadth, 14.5; interorbital breadth, 5.3; width of braincase, 11.4; nasals, 10.2; anterior palatine foramina, 5.6; palatal bridge, 5.2; upper molar series, 5.

Remarks.—This species requires comparison with only *O. c. richmondi*, with which it is nearly identical in color and general external appearance. The skull, however, differs in apparently important respects from those of all the forms of *O. couesi*. Especially noticeable is the lateral development of the supraorbital ridges, a character

which in fully adult examples would doubtless be more pronounced; the reduced antero-posterior extent of the interparietal seems to be another distinguishing feature. On the other hand the material representing *O. gatunensis* is scanty and the range of individual variation being undetermined, intergradation with *couesi* and *richmondi* in Costa Rica or western Panama seems not improbable.

Specimens examined.—Two, from type locality.

ORYZOMYS COZUMELÆ Merriam.

Cozumel Rice Rat.

(Pl. I, figs. 7, 7a.)

Oryzomys cozumelæ Merriam, Proc. Washington Acad. Sci., III, p. 280, July 26, 1901.

Type locality.—Cozumel Island, off east coast of Quintana Roo, Mexico.

Type.—No. 108462, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, April 8, 1901.

Geographic distribution.—Known only from type locality.

General characters.—Size large; tail much longer than head and body; color dark. A large species allied to *O. c. couesi* of the neighboring mainland, differing in larger size, darker color, and proportionately longer tail.

Color.—*Worn pelage:* Upperparts between ochraceous-tawny and cinnamon-brownish, palest on cheeks, shoulders, and sides, darkened on face, top of head, and back by a brownish admixture; underparts between light buff and light ochraceous-buff; feet whitish; tail dark brownish above, dull yellowish below basally, becoming dusky all around toward tip.

Skull.—In general outline closely resembling that of *O. c. couesi* but larger and more massive; rostrum and anterior roots of zygomata relatively slightly heavier; dentition about as in *couesi*.

Measurements.—Type: Total length, 332; tail vertebræ, 182; hind foot, 35. Average of 6 adult topotypes: 306 (285–327); 172 (163–177); 34.3 (33–35.5). *Skull* (average of 6 adults—type and 5 topotypes): Greatest length, 32 (30.5–34.4); zygomatic breadth, 16.9 (15.9–17.9); interorbital breadth, 5 (4.7–5.6); width of braincase, 12.1 (11.5–12.6); nasals, 12.5 (11.7–13.6); anterior palatine foramina, 6.3 (6.2–6.7); palatal bridge, 5.8 (5.7–6.1); upper molar series, 5 (4.8–5.3).

Remarks.—This insular species is clearly an offshoot of *O. couesi*, the widely ranging mainland form. Its divergence from typical *couesi* is mainly in the direction of larger general size and the development of a relatively longer tail.

Specimens examined.—Nine, from type locality.

ORYZOMYS ANTILLARUM Thomas.

Jamaican Rice Rat.

Oryzomys antillarum Thomas, Ann. Mag. Nat. Hist., ser. 7, I, p. 177, February, 1898.

Type locality.—Jamaica.

Type.—No. 45.10.25.48, British Museum; collected by P. H. Gosse.

Geographic distribution.—Known only from Jamaica.

General characters.—Allied to *O. couesi;* size and proportions about as in the typical subspecies; color apparently similar; skull differing in rather slight details.

Color.—From original description of type: "General colour dull rufous, rather (though not prominently) richer on the rump and greyer on the head; black lining of back not prominently marked. Belly dull yellowish, not sharply defined, the hairs slaty grey basally. No blackish ring round eyes. Ears small, their visible external surface blackish and internal yellowish, but in neither case very strongly contrasting with the general colour. Hands and feet dull whitish above. Tail apparently about as long as head and body, very thinly haired, almost naked, pale brownish above, rather lighter below." Two specimens in the United States National Museum, collected many years ago, are very tawny above, but appear to have been immersed in alcohol, and the naturally ruddy tone thereby intensified.

Skull.—Closely resembling that of *O. c. couesi*, but nasals reaching farther posteriorly beyond premaxillæ (nasals and premaxillæ more nearly conterminous in *couesi*); maxillary arm of zygoma heavier; anterior palatine foramina shorter than usual in *couesi;* dentition about the same.

Measurements.—From original description of type (measured in skin): "Head and body (apparently stretched) 130 millim.; tail (imperfect at tip) 130; hind foot without claws (moistened), 28." * * * Skull (type): "Basal length (c.) 26, basilar length (c.) 24; greatest breadth 17; nasals 12.6 x 4.1; interorbital breadth 5.2; breadth of braincase on squamosals 12.9; interparietal 2.8 x 8.5; palate length from henselion 14; diastema 8.3; palatal foramina 5.7 x 2.1; length of upper molar series 4.6". An adult from Metcalfe Parish (dry skin): Total length, 252; tail vertebræ, 122; hind foot (c. u.), 29.2. *Skull* (of same): Greatest length, 30.5; zygomatic breadth, 16.6; interorbital breadth, 5.1; width of braincase, 12.2; nasals, 12.6; anterior palatine foramina, 5.7; upper molar series, 4.5.

Remarks.—The relationship of the Jamaican rice rat to *O. couesi* was pointed out by Thomas in his original account of the species. In view of its isolation, the general agreement in all the more important respects, even to size, a character usually subject to modification in insular forms, is remarkable, and suggests the possibility that *O. antil-*

larum may have been transported from some point on the coast of the North American mainland within a comparatively recent period. As suggested by Thomas, however, the fact that no specimens appear to have been taken since 1877, while rats of the Old World have devastated the island, to be persecuted in their turn by the mongoose, introduced in 1872, renders it probable that the rice rat has been exterminated there.

Specimens examined.—Total number, 2, as follows:

Jamaica: Metcalfe Parish, 1; Spanishtown, 1.

ORYZOMYS PENINSULÆ Thomas.

Lower California Rice Rat.

(Pl. I, figs. 8, 8a.)

Oryzomys peninsulæ Thomas, Ann. Mag. Nat. Hist., ser. 6, XX, p. 548, December, 1897.

Type locality.—Santa Anita, Lower California, Mexico.

Type.—Male adult, British Museum.

Geographic distribution.—Known only from very limited marshy areas near sea level in extreme southern Lower California; Arid Lower Tropical Zone.

General characters.—General size and proportions about as in *O. c. mexicanus;* color similar, but anterior part of body, especially head and shoulders, strongly suffused with gray; skull rather broad, with squarely spreading zygomata and large interparietal.

Color.—Fresh pelage: Upperparts between warm buff and pale ochraceous-buff (more or less distinctly tawny in worn pelage of old adults) most intense on rump, becoming light buffy grayish on head, fore limbs, shoulders, and sides; underparts overlaid with white, the basal color of the fur usually plumbeous, except on chin and throat, where it is pure white to roots; outer sides of ears brownish, inner sides clothed with grayish or ochraceous-buffy hairs; feet white; tail light brownish above, yellowish below, becoming more or less distinctly brownish toward tip. *Young* (in first pelage): Upperparts more fuscous, the head and shoulders lacking the grayish suffusion so noticeable in adults; underparts dull buffy or soiled white, becoming pure white on chin and throat.

Skull.—Similar to that of *O. c. mexicanus*, but broader; zygomata more widely and squarely spreading; braincase less flattened, higher, more rounded or inflated; interparietal larger; anterior palatine foramina much broader, more widely open; lateral wings of parietals extending farther below temporal ridges at expense of squamosals; ascending branches of premaxillæ usually reaching posteriorly beyond nasals (nasals usually exceeding premaxillæ in posterior extent in *mexicanus*).

Measurements.—Average of nine adults from San Jose del Cabo, Lower California (near type locality): Total length, 283 (270–305); tail vertebræ, 143 (138–156); hind foot, 32.2 (31.5–34). *Skull* (average of eight adults from San Jose del Cabo, Lower California): Greatest length, 32.5 (31.5–33.9); zygomatic breadth, 17.9 (17.1–19); interorbital breadth, 5.1 (4.9–5.3); width of braincase, 12 (11.4–12.2); nasals, 13 (12.6–13.4); anterior palatine foramina, 6.6 (6.2–7.4); palatal bridge, 6.2 (6–6.4); upper molar series, 4.8 (4.7–5.1).

Remarks.—*O. peninsulæ* is allied to *O. c. mexicanus* of the adjacent mainland coast of Mexico, but important differential cranial characters are numerous. The range of the species seems to be centered in the marshes near the mouth of the San Jose River at San Jose del Cabo, extending a few miles inland along the course of the stream. The neighboring coast is extremely arid and unsuitable for habitation by an *Oryzomys*.

Specimens examined.—Total number, 16, as follows:

Lower California: San Jose del Cabo, 15; Santa Anita, 1 (topotype).

ORYZOMYS NELSONI Merriam.

Nelson Rice Rat.

(Pl. II, figs. 1, 1a.)

Oryzomys nelsoni Merriam, Proc. Biol. Soc. Washington, XII, p. 15, January 27, 1898.

Type locality.—Maria Madre Island, Tres Marias Islands, off coast of Tepic, western Mexico (altitude 800 feet).

Type.—No. 89200, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, May 13, 1897.

Geographic distribution.—Known only from type locality, Maria Madre Island, where it inhabits moist places on the upper slopes at about 800 feet altitude; Arid Lower Tropical Zone.

General characters.—Size very large; tail much longer than head and body; color of upper parts rich ochraceous-buff; skull rather long and narrow, but massive. Allied to *O. c. mexicanus*, but differing widely in details of structure.

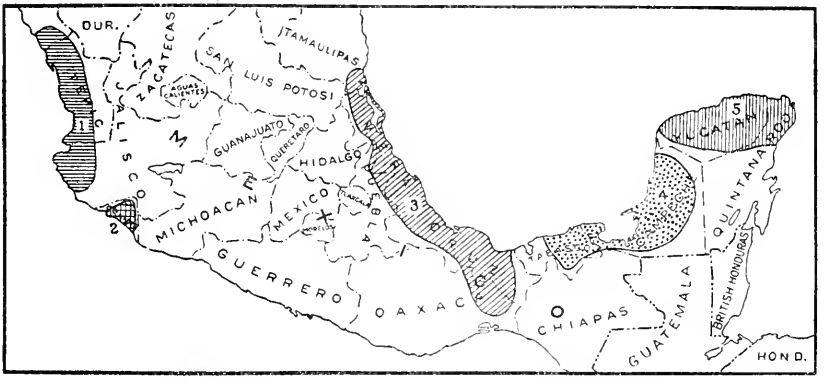
Color.—*Fresh pelage:* Upperparts rich ochraceous-buff, most intense on rump, paling to warm buff on head, shoulders, and lower parts of sides; somewhat darkened on face, top of head, and back by dusky hairs; underparts white; outer and inner sides of ears thinly clothed with grayish hairs; tail light brownish above and all round near tip, becoming yellowish below on basal portion.

Skull.—Massive, upper outline rising high over anterior roots of zygomata, the rostrum very heavy and strongly decurved. Somewhat similar in general to that of *O. c. mexicanus*, but much larger and heavier; rostrum much more swollen and decurved; zygomata

heavier, but relatively less widely spreading, the sides more nearly parallel; supraorbital ridges less divergent posteriorly; interparietal larger; anterior palatine foramina relatively shorter; dentition about as in *mexicanus*.

Measurements.—Type: Total length, 324; tail vertebræ, 190; hind foot, 38. Two adult topotypes: 344, 320; 191, 185; 39, 37. *Skull* (average of 3 adults—type and 2 topotypes): Greatest length, 35.8 (34.5–37.8); zygomatic breadth, 18.7 (18.2–19); interorbital breadth, 5.4 (5.2–5.6); width of braincase, 12.9 (12.8–13. 1); nasals, 14.5 (14.2–14.8); anterior palatine foramina, 6.3 (6.1–6.7); palatal bridge, 6.9 (6.6–7.3); upper molar series, 5.3 (5.1–5.4).

Remarks.—The isolation of *O. nelsoni* on an island 70 miles off the mainland coast has resulted in the evolution of a well-marked species,



1. *O. m. melanotis.*
2. *O. m. colimensis.*
3. *O. r. rostratus.*
4. *O. r. megadon.*
5. *O. r. yucatanensis.*

FIG. 4.—Geographic distribution of the *Oryzomys melanotis* group.

but agreement in essential characters with forms of *O. couesi* places it in that widely distributed section of the genus. It differs strikingly from all the mainland forms in the remarkable development of the rostrum.

Specimens examined.—Four, from type locality.

Oryzomys melanotis Group.

Geographic distribution—Mainly lower elevations near the Pacific coast of Mexico from southern Sinaloa to Colima, and along the gulf coast from southern Tamaulipas to the Yucatan peninsula; altitudinal range from sea level to about 3,000 feet; Arid and Humid Lower Tropical Zones (fig. 4).

General characters.—Size small, medium, or large; form rather slender; tail about same length as head and body or somewhat longer,

scantily and indistinctly haired; ears large and conspicuous, thinly clothed externally with short, fine dusky hairs and internally with similarly short, rufescent hairs; general pelage short, rather harsh, and lacking the woolly quality of *O. palustris;* vibrissæ about as long as head; toes of hind feet more or less distinctly webbed at base, the three longest bearing tufts of silvery bristles which project beyond ends of claws; claws short, recurved, compressed, and sharp pointed. Color of upperparts varying from ochraceous-buff to rich ochraceous-tawny, lined with black; underparts white or buffy whitish.

Skull.—Size small, medium, or large, with rostrum long and brain-case rather narrow; maxillary arm of zygoma heavy; outer wall of antorbital foramen with projecting border rounded or sloping forward, the antorbital fossa deep and conspicuous, but less evenly circular than in *O. palustris* as viewed from above; nasals and premaxillæ about conterminous posteriorly; frontal region wide or narrow, constricted near middle, the lateral margins ridged or smooth; temporal ridges moderately developed anteriorly along parieto-squamosal sutures, becoming indistinct posteriorly in crossing lateral wings of parietals; interparietal large; anterior palatine foramina short and broad, much shorter than palatal bridge, not normally reaching anterior plane of first molars; palatal pits and spheno-palatine vacuities large; interpterygoid fossa broad; audital bullæ small, the inner sides extensively overlapped by mastoids; basi-occipital broad; angle of mandible broad, the inferior border strongly turned inward; coronoid process short and low, owing largely to high, thin commissural border extending to condyle; molars small, approaching the *O. palustris* type but smaller, second upper molar more evenly cleft by inner reentrant angle, and third lower molar more deeply incised by outer reentrant angle. The skulls of *O. melanotis* and its allies differ from those of the *O. palustris* group most noticeably in the elongation of the rostrum, shortness of anterior palatine foramina in relation to palatal bridge, small size of audital bullæ, and the dental details noted.

Remarks.—Unlike *O. palustris* and its allies, which live on the ground mainly in open marshy places or resort to the vicinity of water, members of this group favor more forested areas, where they are partially scansorial in habits, and occur on well-drained but moist mountain slopes sometimes at points distant from water.

In external appearance, forms of the *O. melanotis* group superficially resemble those of *O. couesi,* and the two often occur together at the same localities. In contrast with *O. couesi,* however, the upperparts are usually more rufescent, the ears are much larger, less conspicuously hairy, and tufts of silvery bristles project beyond the points of the three longer claws on the hind foot (claws reaching beyond bristles in *couesi*).

Key to Species and Subspecies of the O. melanotis Group.

a^1. Size larger; hind foot 30 or more. (Atlantic coast of Mexico [*O. rostratus*].)
  b^1. Upper molar series 4 or more.
    c^1. Color darker. (Tabasco; Campeche.)..... **O. r. megadon** (p. 54).
    c^2. Color paler. (Southern Tamaulipas; Vera Cruz; northern Puebla; northeastern Oaxaca.)..... **O. r. rostratus** (p. 53).
  b^2. Upper molar series less than 4. (Yucatan.).....**O. r. yucatanensis** (p. 55).
a^2. Size smaller; hind foot less than 30. (Pacific coast of Mexico [*O. melanotis*].)
  b^1. Color darker. (Sinaloa; Tepic; Jalisco.)..... **O. m. melanotis** (p. 50).
  b^2. Color paler. (Colima.)..... **O. m. colimensis** (p 51).

ORYZOMYS MELANOTIS THOMAS.

[Synonymy under subspecies.]

Geographic distribution.—Pacific coastal plains and basal mountain slopes from southern Sinaloa south through western Tepic and Jalisco to Colima; altitudinal range from sea level to 3,000 feet; Arid Lower Tropical Zone.

General characters.—Size small or medium; general color above varying from rich ochraceous-buffy to pale ochraceous-tawny; similar to small forms of *O. rostratus* in general external appearance but skull differing in important details.

Color.—Fresh pelage: Upperparts varying from ochraceous-buff to pale ochraceous-tawny (sometimes becoming intense tawny or rusty reddish in the worn pelage of old adults), rather sparingly lined with black hairs, which becoming less numerous along cheeks and sides, leave them a purer, brighter color than the back; underparts pale buffy white, the dark basal color of the fur showing through; outer sides of ears blackish, the inner sides thinly clothed with rusty reddish hairs; a more or less conspicuous patch of light-colored fur under base of ear; feet (epidermis) dull yellowish, thinly covered above with short white hairs; tail (epidermis) brownish above, becoming light brownish or dull yellowish below except near lip, which is usually dark all around. *Young* (in first pelage): Upperparts duller and darker, the general tone browner than in adults.

Skull.—Similar in general to that of *O. rostratus*, but upper outline less elevated over anterior part of frontals; braincase relatively higher, the parietal region more expanded; rostrum more slender, less decurved; frontals broader, with narrow and delicate but rather well-developed supraorbital borders; parietals more squarely truncate anteriorly, the fronto-parietal sutures more widely divergent; temporal ridges tending to spread more widely posteriorly, rejoining squamosals after crossing slightly developed lateral wings of parietals; interparietal larger, with a less evident posterior angle; outer wall of antorbital foramen narrower, less extended anteriorly; anterior palatine foramina short and wide as in *rostratus;* dentition about the same.

Remarks.—Two closely allied geographic races of *O. melanotis* occupy a part of the arid coast region of western Mexico, where they appear to be completely isolated from their relatives (subspecies of *O. rostratus*) along the Gulf coast of eastern Mexico. The not very distant relationship of *O. melanotis* to *O. rostratus* is evidenced in numerous characters, but the two species appear to be distinct. In general external appearance, including color, they are much alike; in fresh pelage *O. melanotis* may usually be distinguished by the whitish subauricular spots; the skulls are easily separable by the characters pointed out.

ORYZOMYS MELANØTIS MELANOTIS Thomas.

Jalisco Rice Rat.

(Pl. II, figs. 2, 2a; Pl. V, fig. 5; Pl. VI, figs. 2, 2a.)

Oryzomys melanotis Thomas, Ann. Mag. Nat. Hist., ser. 6, XI, p. 404, May, 1893.

Type locality.—Mineral San Sebastian, Jalisco, Mexico.

Type.—93.3.6.25, ♂ old, British Museum; collected by Dr. Audley C. Buller, January 25, 1893.

Geographic distribution.—Coastal plains and basal mountain slopes in southern Sinaloa, Tepic, and Jalisco; altitudinal range from sea level to about 3,000 feet; Arid Lower Tropical Zone.

General characters.—Size medium; color of upperparts near pale ochraceous-tawny; closely allied to *O. m. colimensis* but larger and darker colored; externally similar to pale examples of *O. rostratus;* skull with long, slender rostrum and high-arched braincase.

Color.—Fresh pelage: Upperparts pale ochraceous-tawny (becoming intense tawny or rusty reddish in the worn pelage of old adults), rather sparingly lined with black hairs, which becoming less numerous along cheeks and sides leave them a purer, brighter color than on the back; underparts white or pale buffy white, the dark basal color of the fur showing through; outer sides of ears blackish, inner sides thinly clothed with rusty reddish hairs; a more or less conspicuous patch of whitish fur under base of ear; feet whitish; tail brownish above, becoming light brownish or yellowish below except near tip, which is usually dark all around. *Young* (in first pelage): Upperparts duller and darker, the general tone browner than in adults.

Skull.—Similar to that of *O. m. colimensis*, but larger, with comparatively smaller molar teeth.

Measurements.—Average of five adult topotypes: Total length, 235 (228–244); tail vertebræ, 128 (124–134); hind foot, 28.2 (27.5–29). *Skull* (two adult topotypes): Greatest length, 28.5, 27.9; zygomatic breadth, 14.4, 14.5; interorbital breadth, 4.8, 5.2; width of braincase, 10.8, 10.7; nasals, 11.5, 10.3; anterior palatine foramina, 4.3, 5.2; palatal bridge, 5.4, 5.4; upper molar series, 4, 4.3.

Remarks.—Specimens from localities near sea level in Jalisco and Tepic are larger than those from the type locality at 3,000 feet altitude on the slope of the mountains, and may represent a slightly different form. In size they contrast strongly with the small form *O. m. colimensis* inhabiting the coast of Colima.

Specimens examined.—Total number, 13, as follows:

Jalisco: Ixtapa, 2; San Sebastian, 6 (type and topotypes).
Sinaloa: Los Limones, 1.[1]
Tepic: San Blas, 2; Santiago, 2.

ORYZOMYS MELANOTIS COLIMENSIS, SUBSP. NOV.

COLIMA RICE RAT.

(Pl. II, figs. 3, 3a.)

Type locality.—Armeria, Colima, Mexico (altitude about 100 feet).

Type.—No. $\frac{33289}{45317}$, ♀ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson, March 2, 1892. Original number 1987.

Geographic distribution.—Forested coastal plains and basal mountain slopes in the State of Colima, Mexico; altitudinal range from sea level to 1,500 feet; Arid Lower Tropical Zone.

General characters.—A small form closely allied to *O. m. melanotis;* differing mainly in smaller size and paler color; general tone of upperparts ochraceous-buff instead of ochraceous-tawny as in *melanotis.*

Color.—Upperparts in general near ochraceous-buff, the top of head and back sparingly mixed with black, giving a lined effect; cheeks, shoulders, and sides paler than back, the general tone light ochraceous-buff; underparts whitish or pale buffy whitish; ears blackish or brownish, thinly clothed on outer sides with short dusky hairs, and on inner sides with buffy or rusty reddish hairs; a patch of whitish fur under base of ear as in *O. m. melanotis;* feet yellowish, thinly covered above with short white hairs; tail brownish above, yellowish below to near tip, which is dusky all around.

Skull.—About like that of *O. m. melanotis,* but smaller; molar teeth actually about the same size as those of *melanotis,* and therefore relatively larger.

Measurements.—Type: Total length, 216; tail vertebræ, 116; hind foot, 26. Adult topotype: 220; 118; 28. *Skull* (average of two adults, type and topotype): Greatest length, 27 (26.3–27.7); zygomatic breadth, 14 (13.9–14.2); interorbital breadth, 4.7 (4.5–4.9); width of braincase, 10.2 (9.9–10.6); nasals, 10.7 (10.3–11.1); anterior palatine foramina, 4.4 (4.3–4.5); palatal bridge, 5.4 (5.4–5.5); upper molar series, 4 (3.9–4.1).

[1] Collection Amer. Mus. Nat. Hist.

Remarks.—This small form is known only from the State of Colima, but probably ranges to the southward along the coast of Michoacan. An adult example from Hacienda Magdalena is dark in color and in this respect approaches *O. m. melanotis*, but agrees otherwise with the small series of topotypes from near the Pacific coast.

Specimens examined.—Total number, 4, as follows:

Colima: Armeria, 3 (type and topotypes); Hacienda Magdalena, 1.

ORYZOMYS ROSTRATUS MERRIAM.

[Synonymy under subspecies.]

Geographic distribution.—Coastal plains and basal mountain slopes from extreme southeastern Tamaulipas through northern Puebla, Vera Cruz, northeastern Oaxaca, Tabasco, Campeche, and Yucatan to northern Quintana Roo; altitudinal range from sea level to about 1,500 feet; Arid and Humid Lower Tropical Zones.

General characters.—A rather large, rufescent species, not very unlike *O. melanotis* in external appearance, but cranial characters distinctive. (For additional characters, excepting specific color, see under *O. melanotis* group.)

Color.—Upperparts varying from ochraceous-buff to rich intense ochraceous-tawny, purest and brightest along cheeks and sides; the face, top of head, and back moderately lined with black hairs, which alter the general tone; underparts white or pale buffy white, the plumbeous basal color usually showing through; outer sides of ears blackish, the inner sides thinly and inconspicuously clothed with pale buffy or rusty reddish hairs; feet (epidermis) dull yellowish, thinly covered with short white hairs; tail (epidermis) varying from nearly uniform brownish throughout to irregularly yellowish on under side. *Young* (in first pelage): Upperparts darker and less rufescent than in adults.

Skull.—Similar in general to that of *O. melanotis*, but upper outline more elevated over anterior part of frontals; braincase relatively lower, the parietal region less expanded; rostrum heavier, more decurved; frontals narrower posteriorly; parietals less squarely truncate anteriorly, the fronto-parietal sutures less widely divergent; temporal ridges tending to spread less widely posteriorly; interparietal smaller, with a more evident posterior angle; outer wall of antorbital foramen broader, more extended anteriorly; anterior palatine foramina short and wide as in *melanotis;* dentition about the same.

Remarks.—Three geographic races of *O. rostratus* are recognizable, all of which closely intergrade and differ rather slightly in average size, color, or cranial details. Viewed as a whole, the forms exhibit a progressive decrease in size from west to east, typical *rostratus* being the largest and *O. r. yucatanensis* the smallest of the series.

ORYZOMYS ROSTRATUS ROSTRATUS Merriam.

Metlaltoyuca Rice Rat.

(Pl. II, figs. 4, 4a.)

Oryzomys rostratus Merriam, Proc. Washington Acad. Sci., III, p. 293, July 26, 1901.

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

Type.—No. 93112, ♂ old, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 5, 1898.

Geographic distribution.—Forested coastal plains and basal mountain slopes in southeastern Tamaulipas, northern Puebla, Vera Cruz, and northeastern Oaxaca; altitudinal range from sea level to about 1,500 feet; Arid and Humid Lower Tropical Zones.

General characters.—Similar to *O. r. megadon* and *O. r. yucatanensis*, but averaging larger than either; color rather pale, much as in *yucatanensis*, slightly paler, less rufescent than usual in *megadon;* skull broad.

Color.—Fresh pelage: Upperparts rich ochraceous-tawny, purest and brightest along cheeks and sides; the face, top of head, and back moderately lined with black hairs which darken the general tone; underparts nearly pure white in some specimens, pale buffy white in others, the dark basal color, however, usually showing through; outer sides of ears blackish, the inner sides thinly clothed with pale buffy or rusty reddish hairs; feet (epidermis) dull yellowish, thinly covered with short white hairs; tail varying from nearly uniform brownish throughout to irregularly yellowish on under side.

Skull.—Closely resembling those of *O. r. megadon* and *O. r. yucatanensis* in general form, but larger and relatively broader than either, the greater breadth most conspicuous in the braincase; dentition about as in *megadon*, decidedly heavier than in *yucatanensis*. Similar to that of *O. talamancæ*, but narrower; zygomata less squarely spreading, the sides more divergent anteriorly; frontal region narrower, the supraorbital ridges weakly developed; parietals with lateral wings less developed below temporal ridges; interparietal smaller. Contrasted with that of *O. melanotis*, the skull is larger, the upper outline more arched over anterior part of frontals; braincase relatively lower and flatter; frontals relatively narrower posteriorly; interparietal smaller.

Measurements.—Type: Total length, 277; tail vertebræ, 141; hind foot, 32.5. Average of seven adult topotypes: 255 (240–270); 136 (125–145); 31.9 (30–33). *Skull* (average of 7 adults—type and 6 topotypes): Greatest length, 31.4 (30.8–33.3); zygomatic breadth, 16.1 (15.4–17.4); interorbital breadth, 5 (4.6–5.2); width of braincase, 11.5 (11.4–11.7); nasals, 12.8 (11.5–13.8); anterior palatine foramina, 5.2 (4.4–6); palatal bridge, 6.6 (6.3–7.3); upper molar series, 4.3 (4.1–4.4).

Remarks.—While *O. r. rostratus* is distinguished by somewhat larger general size, and the greater breadth of the braincase is an especially noticeable cranial feature, the wide range of individual variation shown in large series of specimens renders the smaller examples difficult to separate from some of those of *O. r. megadon.* Specimens from Pasa Nueva and Achotal, Vera Cruz, are rather small and grade toward *megadon.* Those from Alta Mira, Tamaulipas, marking the extreme northern limit of the known range of *rostratus*, average slightly paler than typical examples.

Specimens examined.—Total number, 48, as follows:

Oaxaca: Santo Domingo (mountains near), 5.
Puebla: Metlaltoyuca 14 (type and topotypes).
Tamaulipas: Alta Mira, 5.
Vera Cruz: Achotal, 8;[1] Motzorongo, 1; Pasa Nueva, 6;[2] San Carlos, 9.[1]

ORYZOMYS ROSTRATUS MEGADON Merriam.

Tabasco Rice Rat.

(Pl. II, figs. 5, 5a.)

Oryzomys rostratus megadon Merriam, Proc. Washington Acad. Sci., III, p. 294, July 26, 1901.

Type locality.—Teapa, Tabasco, Mexico.

Type.—No. 99978, ♂ old, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, March 24, 1900.

Geographic distribution.—Heavily forested coastal plains and lower mountain slopes in Tabasco and Campeche; altitudinal range from sea level to at least 500 feet; Humid Lower Tropical Zone.

General characters.—Closely resembling *O. r. rostratus* and *O. r. yucatanensis*, but color slightly richer, more tawny than either; skull smaller than that of *rostratus* and larger than that of *yucatanensis.*

Color.—About like that of *O. r. rostratus*, but slightly darker and richer, more intense ochraceous-tawny.

Skull.—Similar to that of *O. r. rostratus*, but smaller and narrower; differing from that of *O. r. yucatanensis* mainly in larger size and heavier dentition.

Measurements.—Type: Total length, 272; tail vertebræ, 140; hind foot 32.5. Average of 2 adult topotypes: 236.5 (236–237); 121 (120–122); 30 (29–31). *Skull* (average of 3 adults—type and 2 topotypes): Greatest length, 30.5 (29.1–32.3); zygomatic breadth, 15.6 (15–16.5); interorbital breadth, 4.6 (4.4–4.9); width of braincase, 10.6 (10.5–10.7); nasals, 11.5 (11.3–12); anterior palatine foramina, 4.9 (4.6–5.1); palatal bridge, 6.3 (6–6.8); upper molar series, 4.3 (4.1–4.6).

[1] Collection Field Mus. Nat. Hist. [2] Collection Amer. Mus. Nat. Hist.

Remarks.—*O. r. megadon* appears to be a rather localized form. A series of specimens from Apazote, Campeche, agree most closely, as a whole, with typical *megadon*, but some are rather pale in color, and in the reduced size of molar teeth also approach *O. r. yucatanensis*.

Specimens examined.—Total number, 18, as follows:

Campeche: Apazote, 11; Champoton, 1.
Tabasco: Teapa 6 (type and topotypes).

ORYZOMYS ROSTRATUS YUCATANENSIS Merriam.

Yucatan Rice Rat.

(Pl. II, figs. 6, 6a.)

Oryzomys yucatanensis Merriam, Proc. Washington Acad. Sci., III, p. 294, July 26, 1901.

Type locality.—Chichen Itza, Yucatan, Mexico.

Type.—No. 108139, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 9, 1901.

Geographic distribution.—Forested lowlands of Yucatan and northern Quintana Roo; mainly Arid Lower Tropical Zone.

General characters.—Similar to *O. r. rostratus* and *O. r. megadon* but somewhat smaller than either; skull small, with very small molar teeth.

Color.—Much as in *O. r. rostratus* but decidedly paler, the general tone ochraceous-buff instead of rich ochraceous-tawny.

Skull.—Most closely resembling that of *O. r. megadon*, but smaller, with short anterior palatine foramina and decidedly smaller molar teeth.

Measurements.—Type: Total length, 235; tail vertebræ, 119; hind foot, 32. Adult from Puerto Morelos, Quintana Roo, 255; 136; 31. *Skull* (type): Greatest length, 28.7; zygomatic breadth, 15; interorbital breadth, 4.6; width of braincase, 10.8; nasals, 11.8; anterior palatine foramina, 4.2; palatal bridge, 5.9; upper molar series, 3.7.

Remarks.—This rather small pale form of *O. rostratus* apparently passes into *O. r. megadon* in southern Campeche. The specimens from Apazote are referred to *megadon*, with which the majority agree most closely, but several are indistinguishable in color from *O. r. yucatanensis*, and, as they present no wide departure in cranial details, might be assigned to that form but for the presence of the larger or darker examples in the same series.

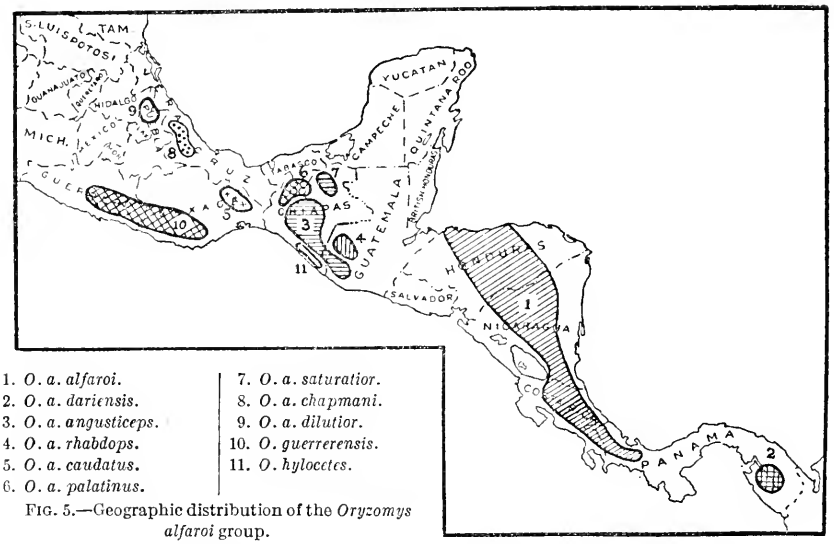
Specimens examined.—Total number, 5, as follows:

Quintana Roo: Puerto Morelos, 1.
Yucatan: Chichen Itza, 4 (type and topotypes).

Oryzomys alfaroi Group.

Geographic distribution.—Mountainous districts from northern Puebla, Mexico, south through Central America and northwestern South America to Ecuador; altitudinal range, from about 1,000 to 10,000 feet, mainly in Humid Upper and Lower Tropical Zones (fig. 5).

General characters.—Size small; form slender; tail usually longer than head and body, thinly and rather indistinctly haired; ears large and conspicuous, thinly clothed externally and internally with short, fine, blackish hairs; general pelage usually rather short and harsh, becoming longest in forms ranging at high elevations; vibrissæ



1. *O. a. alfaroi.*
2. *O. a. dariensis.*
3. *O. a. angusticeps.*
4. *O. a. rhabdops.*
5. *O. a. caudatus.*
6. *O. a. palatinus.*
7. *O. a. saturatior.*
8. *O. a. chapmani.*
9. *O. a. dilutior.*
10. *O. guerrerensis.*
11. *O. hylocetes.*

FIG. 5.—Geographic distribution of the *Oryzomys alfaroi* group.

about as long as head; toes of hind feet inconspicuously webbed at base, the longest three bearing tufts of silvery whitish bristles which project beyond the ends of the claws as in the *O. talamancæ* group; claws short and recurved, compressed and sharp pointed. General color dark, the upperparts usually near ochraceous-tawny, heavily mixed with black; underparts dull whitish or pale buffy.

Skull.—Small and delicate in structure, with rostrum elongated, the braincase moderately broad and rather low; maxillary arm of zygoma weakly developed; outer wall of antorbital foramen with anterior border rounded, the antorbital notch only moderately deep as viewed from above; nasals and premaxillæ ending posteriorly in about the same plane; frontal region broad, the lateral margins very slightly elevated to form delicate supraorbital ridges; temporal ridges slightly developed anteriorly along parieto-squamosal sutures,

usually becoming obsolescent posteriorly in crossing lateral wings of parietals; interparietal large, somewhat irregularly pointed-elliptical in form; anterior palatine foramina short and broad, shorter than palatal bridge and not usually reaching anterior plane of first molars; palatal pits rather large and rounded; sphenopalatine vacuities present but small; interpterygoid fossa broad; audital bullæ small; angle of mandible short and broad, the inferior border even more strongly turned inward than in the *O. talamancæ* group; coronoid process with free portion short owing to high connecting ridge reaching nearly to summit of condyle; molars small, the reentrant angles shallow and the crown arrangement, especially the enamel islands in the second upper molars, much as in the *O. palustris* group, but inner reentrant angles in first upper molars broader. More reliable distinguishing characters are presented by the skull and teeth; the molars are less deeply cleft by reentrant angles in the *O. alfaroi* group, and the enamel island present at the postero-internal base of the paracone of the second upper molar (moderately worn) is absent in the *talamancæ* group.

Remarks.—This group, comprised of a series of small, dark-colored, closely allied, and somewhat localized forms typified by *O. alfaroi*, extends in an irregular chain along the backbone of the continent from southern Mexico to northwestern South America, one form at least ranging as far south as Ecuador. While the *O. palustris* and *O. talamancæ* groups range mainly at low elevations, or are restricted to the vicinity of water at the higher levels, *alfaroi* and its allies often inhabit well-drained but moist mountain slopes, where they commonly ascend to high elevations.

O. alfaroi and its relatives approach the members of the *O. talamancæ* group in general external characters, and the two partially overlap in geographic range. In appearance individuals may be much alike, both groups having large ears, appearing nearly naked, and slender limbs; forms of the *alfaroi* group are, however, usually smaller and decidedly darker in general color; the ears are smaller, but not markedly different in color.

Key to Species and Subspecies of the O. alfaroi Group.

a^1. Zygomata broader posteriorly than anteriorly.
  b^1. Upperparts darker ochraceous-buff or ochraceous-tawny.
    c^1. Upperparts less intense ochraceous-buff or ochraceous-tawny.
      d^1. Median dorsal area not distinctly blackish.
        e^1. Size smaller; total length less than 240.
          f^1. Skull broader; zygomatic breadth 13 or more.
            g^1. Anterior palatine foramina usually 4 or more.
              h^1. Rostrum more massive. (Northern Puebla.) **O. a. dilutior** (p. 68).
              h^2. Rostrum less massive. (Central Vera Cruz.)
                O. a. chapmani (p. 67).

g^2. Anterior palatine foramina usually less than 4. (Mountains of Honduras; Nicaragua; Costa Rica; western Panama.)
O. a. alfaroi (p. 59).

f^2. Skull narrower; zygomatic breadth less than 13. (Mountains of southern Tabasco and northwestern Chiapas.)... **O. a. palatinus** (p. 65).

e^2. Size larger; total length 240 or more.

f^1. Pelage short; tail about 140. (Mountains of northeastern Oaxaca.)
O. a. caudatus (p. 64).

f^2. Pelage long; tail less than 135. (High mountains of southwestern Guatemala and of central and southern Chiapas.)
O. a. angusticeps (p. 62).

d^2. Median dorsal area distiuctly blackish. (Mountains of northern Chiapas.)
O. a. saturatior (p. 66).

c^2. Upperparts more intense ochraceous-tawny. (Eastern Panama.)
O. a. dariensis (p. 61).

b^2. Upperparts paler ochraceous-buff or ochraceous-tawny. (Pacific slope of Sierra Madre in Guerrero and Oaxaca.)..... **O. guerrerensis** (p. 69).

a^2. Zygomata broader anteriorly than posteriorly.

b^1. Size larger; total length 225 or more. (Southeastern Guatemala.)
O. a. rhabdops (p. 63).

b^2. Size smaller; total length less than 225. (Southern Chiapas.)
O. hylocetes (p. 70).

ORYZOMYS ALFAROI ALLEN.

[Synonymy under subspecies.]

Geographic distribution.—Heavily forested mountain slopes from northern Puebla south through southern Mexico and Central America, at least to Colombia and Ecuador; altitudinal range from about 1,000 to 10,000 feet, mainly in Humid Upper and Lower Tropical Zones.

General characters.—Size small; color dark; skull light and rather delicate in structure. Similar in general to *O. guerrerensis*, but color much darker, and skull differing in detail. (For additional general characters see under *O. alfaroi* group.)

Color.—Fresh pelage: Upperparts varying from dark ochraceous-buff to ochraceous-tawny, tawny, russet, or cinnamon-brown, usually heavily mixed with black, this color often predominant over dorsum, the lighter element purest and becoming more or less ochraceous-buffy on cheeks, shoulders, and sides; underparts dull white or buffy, thinly overlying the dark plumbeous basal color; nose blackish; inner and outer sides of ears thinly clothed with very short black hairs, light ochraceous-buffy subauricular spots present in some forms, absent in others; feet dull whitish, the elongated silvery tufts on toes of hind feet projecting beyond points of longer claws; feet (epidermis) yellowish, thinly clothed above with very short glossy white hairs; tail nearly naked, brownish or blackish above, yellowish below basally, becoming dark all around toward tip. *Young* (in first pelage): Upperparts blackish, finely and inconspicuously mixed with ochraceous-tawny; underparts darker than in adults, the dark basal color thinly

overlaid with white; feet varying from dull whitish to brownish; tail blackish.

Skull.—Similar in general to that of *O. guerrerensis*, but more elongated; braincase higher, less flattened. In the anteriorly spreading zygomata, one form of *O. alfaroi* (*O. a. rhabdops*) approaches *O. hylocetes*, but the latter is much smaller, with very small teeth, and present material seems to indicate specific distinctness. (For additional characters see under *O. alfaroi* group.)

Remarks.—All the North American members of the *O. alfaroi* group, excepting *O. hylocetes* and *O. guerrerensis*, and the South American forms *O. palmiræ* and *O. gracilis*, appear to be assignable subspecifically to *O. alfaroi*.[1] While complete intergradation may not be shown by the material examined, the more essential characters prevail with such uniformity throughout the series as to leave little room for doubt of its existence. The accession of new material may not improbably show that *hylocetes* and *guerrerensis* are also geographic races of *alfaroi*. Typical *alfaroi* presents closer resemblance to the geographically distant race *O. a. chapmani*, of Vera Cruz, than to the annectent forms inhabiting the high mountains of Chiapas and Guatemala. This resemblance between the more widely removed subspecies may be due to the fact that the intermediate races occupy more diversified areas, most of them having ascended to high elevations where peculiar environmental conditions would conduce to differentiation.

ORYZOMYS ALFAROI ALFAROI (Allen).

Alfaro Rice Rat.

(Pl. III, figs. 1, 1a.)

Hesperomys (*Oryzomys*) *alfaroi* Allen, Bull. Amer. Mus. Nat. Hist., III, p. 214, April 17, 1891.

Oryzomys alfaroi Allen, Abstr. Proc. Linn. Soc. New York, 1893–94, p. 36, July 20, 1894.

Oryzomys alfaroi incertus Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 655, October 13, 1908. Type from Rio Grande, Nicaragua, No. 28584, ♂ ad., Amer. Mus. Nat. Hist.; collected by W. B. Richardson, March 28, 1908.

Type locality.—San Carlos, Costa Rica.

Type.—No. $\frac{36599}{28008}$, ♀ subadult, American Museum of Natural History; collected by Anastasio Alfaro, December, 1888.

Geographic distribution.—Heavily forested mountainous portions of Honduras, Nicaragua, Costa Rica, and western Panama; altitudinal range from about 1,000 to 4,000 feet; mainly in Humid Lower Tropical Zone.

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[1] The South American forms will therefore stand as follows:
Oryzomys alfaroi palmiræ Allen.....Miraflores, Colombia.
Oryzomys alfaroi gracilis Thomas.....Concordia, Medellin, Colombia.

General characters.—A rather small form with short pelage, resembling *O. a. dariensis*, but coloration duller, less rufescent; skull differing in slight details. Very similar in general to *O. c. chapmani*, but color usually duller; skull with shorter anterior palatine foramina. Smaller than *O. a. angusticeps* and *O. a. rhabdops*, with shorter pelage than either.

Color.—Upperparts varying from ochraceous-buff to dull ochraceous-tawny, heavily mixed with black. (Other colors as given under *O. alfaroi*.)

Skull.—Size medium for the group, rather narrow and elongated with narrowly spreading zygomata and short, wide anterior palatine foramina. In general form very similar to that of *O. a. dariensis*, but braincase and frontal region usually broader; apparently differing from those of *O. a. angusticeps* and *O. a. chapmani* most noticeably in shorter anterior palatine foramina. Compared with that of *O. a. rhabdops* the skull is decidedly narrower, with smaller, less inflated braincase, and zygomata much less divergent anteriorly.

Measurements.—Average of 6 adults from Tuis, Costa Rica: Total length, 210 (188–221); tail vertebræ, 109 (102–114); hind foot, 26.3 (26–27). *Skull* (average of same): Greatest length, 26.7 (25.6–28.3); zygomatic breadth, 13.5 (13.2–14.1); interorbital breadth, 5.2 (5.1–5.5); width of braincase, 10.5 (10.1–10.8); nasals, 10.9 (10.3–11.5); anterior palatine foramina, 3.9 (3.5–4.9); palatal bridge, 5.4 (5.3–5.7); upper molar series, 3.7 (3.6–3.8).

Remarks.—While a considerable gap separates the known geographic ranges of *O. a. alfaroi* and *O. a. dariensis*, these forms exhibit such close approach in size, color, and cranial details that intergradation may be safely assumed. Specimens from Yaruca, Honduras, are referable to *alfaroi*, but in the larger size shown by some examples are not very unlike *O. a. angusticeps* and *O. a. rhabdops*. Three specimens from Managua, Nicaragua, recorded by Thomas [1] as *O. gracilis*, were probably assignable to *alfaroi*.

Allen's "*O. a. incertus*" was based on rather richly colored specimens which are well within the range of individual variation exhibited by typical *alfaroi*, as the accession of additional material indicated to him.[2]

The general range of *alfaroi* overlaps that of *O. talamancæ*, and as it may closely resemble that species in general appearance some confusion of the two has resulted. While many examples may be inseparable in color, *alfaroi* is a smaller animal than *talamancæ*. The skull of *alfaroi* is distinguished by its smaller size and more delicate structure, the maxillary arm of the zygoma is more slender and the teeth are decidedly smaller; the second upper molar has a large,

[1] Thomas, Oldfield, Ann. Mag. Nat. Hist., ser. 6, XVI, p. 57, July, 1895.
[2] Allen, J. A., Bull. Amer. Mus. Nat. Hist., XXVIII, p. 99, Apr. 30, 1910.

elongated enamel island at the postero-internal base of the paracone, and the internal reentrant angle extends less than halfway across the crown of the moderately worn tooth, while in *talamancæ* the enamel island mentioned is absent or represented only by a small island near the apex of the reentrant angle, which in this species reaches halfway across the molar crown.

Specimens examined.—Total number, 86, as follows:

Costa Rica: San Carlos, 3 (type and topotypes);[1] Tuis, 15;[1] exact locality unknown, 7.[1]

Honduras: Yaruca, 19.[2]

Nicaragua: Chontales, 6;[1] Jalapa, 2;[1] Jicaro, 1;[1] Jinotega, 1;[3] Rio Coco, 5;[1] Rio Grande, 3 (including type of "*incertus*");[1] San Juan, 5;[1] Tuma, 2;[1] Uluce, 2;[1] exact locality unknown, 1.[1]

Panama: Boquete, 14.[4]

ORYZOMYS ALFAROI DARIENSIS Goldman.

Darien Rice Rat.

(Pl. III, figs. 2, 2a; Pl. V, figs. 6; Pl. VI, figs. 3, 3a.)

Oryzomys alfaroi dariensis Goldman, Proc. Biol. Soc. Washington, XXVIII, p. 128, June 29, 1915.

Type locality.—Cana, eastern Panama (altitude 2,000 feet).

Type.—No. 178660, ♀ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, March 4, 1912.

Geographic distribution.—Heavily forested mountain slopes in eastern Panama at 2,000 feet altitude, and probably adjacent portions of Colombia; Humid Lower Tropical Zone.

General characters.—A small form closely allied to *O. a. alfaroi;* color of upperparts richer, more rufescent; skull usually narrower. Similar to the South American forms *O. a. gracilis* and to *O. a. palmiræ*, but color more rufescent and skull differing in detail.

Color.—Fresh pelage: Upperparts between ochraceous-tawny and tawny, finely mixed with black; becoming paler and ochraceous-buffy on cheeks, shoulders, and lower part of sides; underparts, feet, and tail as given under *O. alfaroi.*

Skull.—About like that of *O. a. alfaroi,* but braincase and frontal region usually narrower. Closely resembling that of *O. a. palmiræ,* of South America, but shorter, with more widely spreading zygomata and smaller teeth. Compared with Ecuadorean specimens assumed to represent *O. a. gracilis,* the skull is more massive, with more widely spreading zygomata.

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[1] Collection Amer. Mus. Nat. Hist.

[2] Fourteen specimens in Mus. Comp. Zool.; 2 in Field Mus. Nat. Hist.

[3] Collection Field Mus. Nat. Hist.

[4] Eleven specimens in Mus. Comp. Zool.; 2 in Field Mus. Nat. Hist.; 1 in Amer. Mus. Nat. Hist.

Measurements.—Type: Total length, 203; tail vertebræ, 107; hind foot, 25.5. Average of 5 adult topotypes: 220 (212–226); 113 (107–117); 24.6 (23–26). *Skull* (average of 6 adults, type and 5 topotypes): Greatest length, 27.3 (26.5–27.8); zygomatic breadth, 14.3 (14–14.7); interorbital breadth, 4.8 (4.6–5); width of braincase, 10.3 (10–10.5); nasals, 11.1 (10.6–11.4); anterior palatine foramina, 4.3 (4–4.8); palatal bridge, 5.6 (5–5.9); upper molar series, 3.7 (3.6–3.9).

Remarks.—This small, slender rice rat differs from typical *O. a. alfaroi*, of Costa Rica, mainly in richer, more tawny coloration. It is closely allied to the Colombian form described as *O. palmiræ* and the latter is clearly assignable to subspecific rank, if it does not prove to be identical with *O. a. gracilis*, the type of which came from farther north in the Cauca Valley. Comparison with specimens from northern Ecuador, assigned to *gracilis* by Mr. Oldfield Thomas, and reference to the original description of that species indicate that the two are very nearly related. The description of the color of *gracilis*, however, seems to apply to the Ecuadorean specimens, or to *palmiræ*, rather than to the Darien animal. Moreover, the skull *O. a. dariensis* is distinguished from that of *gracilis*, as here understood, by the greater lateral expansion of the zygomata.

O. talamancæ also occurs at the type locality of *dariensis* and the two are superficially much alike. The smaller size, especially the smaller hind foot, usually distinguishes *dariensis* externally, while the skull is smaller, more delicate in structure, the maxillary arm of the zygoma more slender and the molar teeth much smaller; the second upper molar has a large elongated enamel island at the postero-internal base of the paracone, and the internal reentrant angle extends less than half way across the crown of the moderately worn tooth, much as in *O. palustris*. In *talamancæ* the enamel island is absent and the reentrant angle reaches halfway across the molar crown.

Specimens examined.—Eleven, from type locality.

ORYZOMYS ALFAROI ANGUSTICEPS Merriam.

Volcan Santa Maria Rice Rat.

Oryzomys angusticeps Merriam, Proc. Washington Acad. Sci., III, p. 292, July 26, 1901.

Type locality.—Volcan Santa Maria, Guatemala (altitude, 9,000 feet).

Type.—No. 76816, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 22, 1896.

Geographic distribution.—Heavily forested slopes of high mountains in southwestern Guatemala and central and southern Chiapas; altitudinal range from about 8,000 to 9,500 feet.

General characters.—Similar to *O. a. alfaroi* but larger, with longer pelage; anterior palatine foramina longer. Closely approaching *O. a. rhabdops* in size, but color darker and skull differing in detail.

Color.—Lighter element in upperparts pale cinnamon brownish, heavily mixed with black, the general tone appreciably darkened by the dark plumbeous basal color of the long pelage; underparts and sides of muzzle light ochraceous-buffy; ears, feet, and tail as given under *O. alfaroi.*

Skull.—Similar to that of *O. a. alfaroi,* but larger, zygomata more squarely spreading anteriorly, the sides more nearly parallel; frontal region usually narrower; anterior palatine foramina longer. Approaching that of *O. a. rhabdops* in size, but zygomata less divergent anteriorly.

Measurements.—Type: Total length, 245; tail vertebræ, 134; hind foot, 29. *Skull* (type): Greatest length, 28.6; zygomatic breadth, 14; interorbital breadth, 4.6; width of braincase, 10.3; nasals, 10.6; anterior palatine foramina, 5; palatal bridge, 5.4; upper molar series, 3.6.

Remarks.—Aside from its geographic neighbor, *O. a. rhabdops,* no other North American form of the *O. alfaroi* group attains so high an altitude; like *rhabdops* it has developed a longer pelage than forms ranging at lower elevations. The skull of the type of *O. a. angusticeps* seems to be abnormally narrow; the topotypes are all young and their skulls of little value for comparative purposes. An apparent tendency toward greater breadth shown in the skulls of specimens from San Cristobal and Pinabete, Chiapas, is believed to be within the probable range of individual variation; on the other hand, they do not differ appreciably from some skulls of *rhabdops,* and suggest intergradation. In size and color the Chiapas examples are very similar to the topotypes.

Specimens examined.—Total number, 16, as follows:

Chiapas: Pinabete, 2; San Cristobal, 10.
Guatemala: Volcan Santa Maria 4 (type and topotypes).

ORYZOMYS ALFAROI RHABDOPS Merriam.

Calel Rice Rat.

(Pl. III, figs. 3, 3a.)

Oryzomys rhabdops Merriam, Proc. Washington Acad. Sci., III, p. 291, July 26, 1901.

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

Type.—No. 76813, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 15, 1896.

Geographic distribution.—Known only from type locality, at about 10,000 feet altitude on the upper slope of the high mountains in southwestern Guatemala.

General characters.—Size large; pelage very long for a member of the *O. alfaroi* group, the longer hairs on dorsum reaching about 11 mm.;

color rather pale, upperparts near ochraceous-tawny; skull broad with anteriorly divergent zygomata. Similar in general to *O. a. angusticeps,* but color paler, and skull differing in detail.

Color.—Fresh pelage: Upperparts near ochraceous-tawny, richest and purest on cheeks, shoulders, and sides, the back darkened by black hairs, but less copiously than in most forms of *O. alfaroi;* sides of muzzle and underparts in general light ochraceous-buffy; nose deep black, except extreme tip which, like lips, is whitish; ears black, with more or less distinct light ochraceous-buffy subauricular spots; feet and tail as given under *O. alfaroi. Young* (in first pelage): Upperparts blackish, inconspicuously tinged with ochraceous-tawny; underparts plumbeous, lightly overlaid with light ochraceous-buff.

Skull.—Skull broad, with large inflated braincase and anteriorly diverging zygomata. Similar to that of *O. a. angusticeps,* but zygomata wider anteriorly than posteriorly (sides more nearly parallel in *angusticeps*). In general form, especially the anteriorly spreading zygomata, similar to that of *O. hylocetes,* but much larger, with shorter anterior palatine foramina.

Measurements.—Type: Total length, 255; tail vertebræ, 141; hind foot, 29.5. Adult topotype: 255; 138; 28.5. *Skull* (average of two adults—type and topotype): Greatest length, 28.6 (28.4–28.8); zygomatic breadth, 14.8 (14.6–15.1); interorbital breadth, 4.8 (4.8–4.9); width of braincase, 10.9 (10.8–11.1); nasals, 11 (10.5–11.5); anterior palatine foramina, 4.3 (4.2–4.5); palatal bridge, 5.7 (5.5–5.9); upper molar series, 3.8 (3.7–3.9).

Remarks.—No other North American form of the genus is known to range 10,000 feet above sea level, but a near geographic neighbor, *O. a. angusticeps,* which has also pushed up above the Tropical Zones on mountains of similar elevation, approaches and may equal this altitude. The two forms are evidently closely allied. Distinguishing cranial characters are developed mainly in adults, the skulls of most of the younger examples being apparently inseparable. In the remarkable anterior expansion of the zygomata the skull of *O. a. rhabdops* resembles that of *O. hylocetes,* but the latter appears to be a very distinct form.

Specimens examined.—Fourteen, from type locality.

ORYZOMYS ALFAROI CAUDATUS Merriam.

Comaltepec Rice Rat.

(Pl. III, figs. 4, 4a.)

Oryzomys chapmani caudatus Merriam, Proc. Washington Acad. Sci , III, p. 289, July 26, 1901.

Type locality.—Comaltepec, Oaxaca, Mexico (altitude 3,500 feet).

Type.—No. 68641, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, July 31, 1894.

Geographic distribution.—Mountains of northeastern Oaxaca; altitudinal range from 3,500 to 6,500 feet; Humid Upper Tropical Zone.

General characters.—Size largest of the *O. alfaroi* group; color dark; pelage short. Similar in general to *O. a. chapmani*, but decidedly larger, with the lighter colored admixture in upperparts of ochraceous-buffy instead of ochraceous-tawny; skull larger and more massive than usual in the *alfaroi* group.

Color.—Fresh pelage: Upperparts ochraceous-buffy, heavily mixed with black, the latter color predominating, especially along lower part of back; underparts and sides of muzzle light ochraceous-buffy; lips and chin whitish; nose black; ears, feet, and tail as given under *O. alfaroi.*

Skull.—Size very large and structure heavy for *O. alfaroi.* Very similar in general form to that of *O. a. chapmani*, but much larger with more swollen rostrum.

Measurements.—Type: Total length, 257; tail vertebræ, 141; hind foot, 30. *Skull* (type): Greatest length, 29; zygomatic breadth, 15; interorbital breadth, 5; width of braincase, 11.3; nasals, 11.4; anterior palatine foramina, 4.8; palatal bridge, 5.2; upper molar series, 3.9.

Remarks.—O. a. caudatus was based on a single specimen which seems to indicate a subspecies still larger than *O. a. rhabdops* and *O. a. angusticeps*, but the extent of individual variation remains to be determined. Although not very widely differing from *angusticeps* it seems to be most closely allied to *O. a. chapmani*, the greater size being the chief distinguishing character. An immature example from 6,500 feet altitude at Totontepec, Oaxaca, is referable to the same form.

Specimens examined.—Total number, 2, as follows:

Oaxaca: Comaltepec, 1 (type); Totontepec, 1.

ORYZOMYS ALFAROI PALATINUS Merriam.

Teapa Rice Rat.

(Pl. III, figs. 5, 5a.)

Oryzomys palatinus Merriam, Proc. Washington Acad. Sci., III, p. 290, July 26, 1901.

Type locality.—Teapa, Tabasco, Mexico (altitude, 3,000 feet).

Type.—No. 99977, ♀ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, April 1, 1900.

Geographic distribution.—Forested mountain slopes in southern Tabasco and northwestern Chiapas; known altitudinal range from about 3,000 to 3,500 feet; Humid Upper Tropical Zone.

General characters.—A small form, similar to *O. a. chapmani* in color, but skull narrower, lighter, and more like that of the darker subspecies *O. a. saturatior.*

Color.—Type in fresh pelage: Upperparts rich ochraceous-tawny, finely and uniformly lined with black from nose over top of head and back to near base of tail, the tawny element becoming purer and paler on cheeks and along lower part of sides; underparts and feet dull whitish; tail dark brownish, except basal half of under side, which is dull yellowish. Specimens from Ocuilapa, Chiapas, apparently referable to this form, are indistinguishable in color from *O. a. chapmani.*

Skull.—Size small, general form long and narrow, structure light. Scarcely distinguishable from some of the narrower skulls of *O. a. saturatior;* zygomata very slender as in that form. Similar in general to that of *O. a. chapmani,* but narrower, maxillary arm of zygoma more slender.

Measurements.—Type: Total length, 209; tail vertebræ, 106; hind foot, 25. Adult from Tumbala, Chiapas: 222; 116; 27. *Skull* (type): Greatest length, 26.7; zygomatic breadth, 12.6; interorbital breadth, 4.8; width of braincase, 10.2; nasals, 10.2; anterior palatine foramina, 3.8; palatal bridge, 5.5; upper molar series, 3.8.

Remarks.—In *O. a. palatinus* the general color of *O. a. chapmani* seems to be combined with the narrower, lighter skull of the darker-colored form *O. a. saturatior.* The scanty material available indicates that intergradation of *palatinus* with *saturatior* is probable, since the differential characters are slight and both forms inhabit the northern slope of the same mountain range.

Specimens examined.—Total number, 5, as follows:

Chiapas: Ocuilapa, 3; Tumbala, 1.
Tabasco: Teapa, 1 (type).

ORYZOMYS ALFAROI SATURATIOR Merriam.

Dusky Rice Rat.

Oryzomys chapmani saturatior Merriam, Proc. Washington Acad. Sci., III, p. 290, July 26, 1901.

Type locality.—Tumbala, Chiapas, Mexico (altitude, 5,000 feet).

Type.—No. 76183, ♀ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, October 23, 1895.

Geographic distribution.—Forested northern slope of mountains of northern Chiapas, at 5,000 feet altitude, limits of range unknown; Humid Upper Tropical Zone.

General characters.—Size rather small—about as in *O. a. alfaroi* and *O. a. chapmani;* color very dark. Closely allied to *O. a. palatinus* and *chapmani,* but darker than either, the back blackish and underparts usually distinctly buffy.

Color.—Upperparts cinnamon brownish, very heavily mixed with black, the top of head and median dorsal area blackish; underparts,

except chin and throat, varying from light to dark ochraceous-buff; chin and throat more or less distinctly whitish, the fur in some examples pure white to roots along a narrow median line; ears black; feet brownish to toes, the toes dull yellowish, those of hind feet bearing the silvery terminal bristles present throughout the group; tail usually dark all around, but in some examples yellowish on under side at base. *Young* (in first pelage): Upperparts nearly black, the cinnamon brownish hairs inconspicuous and restricted mainly to the sides; underparts dark plumbeous, very thinly overlaid with ochraceous-buff; feet and tail blackish.

Skull.—Size small and structure light. About like that of *O. a. palatinus*, but usually broader. Similar to that of *O. a. chapmani*, but averaging slightly smaller, with less swollen rostrum and more slender zygomata.

Measurements.—Type: Total length, 218; tail vertebræ, 120; hind foot, 25.5. Average of 10 adults (type and 9 topotypes): 208.4 (195–225); 111.1 (105–122); 26.1 (25–28). *Skull* (average of 3 adults—type and 2 topotypes): Greatest length, 25.3 (25.2–25.4); zygomatic breadth, 12.8 (12.4–13.5); interorbital breadth, 4.7 (4.5–4.8); width of braincase, 10.1 (10–10.3); nasals, 9.8 (9.5–10.2); anterior palatine foramina, 4.2 (3.7–4.5); palatal bridge, 5.1 (4.9–5.3); upper molar series, 3.6 (3.5–3.6).

Remarks.—The very dark colors of *O. a. saturatior* appear to be directly due to environmental conditions. The area inhabited by this form is heavily forested and excessively humid; torrential rains occur during the wet season and fog enshrouds the mountains nearly throughout the year. Two specimens from Tumbala, with narrow skulls and slender rostra, approach *O. a. palatinus*, whose range is doubtless contiguous, and point to intergradation with that form.

Specimens examined.—Seventeen, from type locality.

ORYZOMYS ALFAROI CHAPMANI Thomas.

Chapman Rice Rat.

Oryzomys chapmani Thomas, Ann. Mag. Nat. Hist., ser. 7, I, p. 179, February, 1898.

Type locality.—Jalapa, Vera Cruz, Mexico (altitude, 4,400 feet).

Type.—97.9.9.30, British Museum; collected by Frank M. Chapman, March 31, 1897.

Geographic distribution.—Forested eastern slopes of the Mexico plateau region in central Vera Cruz; known altitudinal range from 4,400 to 6,000 feet; Humid Upper Tropical Zone.

General characters.—Closely resembling *O. a. alfaroi;* size and color very similar, but general tone of upperparts averaging slightly richer, more tawny; cranial characters distinctive. Size about as in *O. a. dilutior*, but color slightly more tawny; skull much less massive;

differing from *O. a. caudatus* in much smaller size and more tawny color.

Color.—Fresh pelage: Upperparts near ochraceous-tawny (becoming russet in some old adults), finely and abundantly mixed with black, the tawny element purer but somewhat paler and grading toward dark ochraceous-buff along cheeks and lower part of sides; underparts whitish or pale buffy, the plumbeous basal color showing through except over a narrow median area on throat and chest, where the fur in some specimens is pure white to roots; ears black, light subauricular spots usually present; feet and tail as given under *O. alfaroi*. *Young* (in first pelage): Upperparts blackish, inconspicuously mixed with ochraceous-tawny; underparts darker than in adults, the dark basal color less heavily overlaid with white; feet and tail brownish (becoming paler in adults).

Skull.—Size and general form much as in *O. a. alfaroi*, but tending to be shorter and relatively broader, the zygomata more widely or squarely spreading anteriorly; frontal region usually narrower; anterior palatine foramina longer, commonly reaching anterior plane of first molars; dentition about the same. Similar to that of *O. a. dilutior*, but less massive; rostrum less swollen and decurved; maxillary arm of zygoma more slender. Much like that of *O. a. caudatus*, but much smaller.

Measurements.—Average of 10 adult topotypes: Total length, 224 (202–265); tail vertebræ, 117.9 (108–132); hind foot, 25.1 (24–27). *Skull* (average of 7 adult topotypes): Greatest length, 26.4 (25.4–27.3); zygomatic breadth, 13.7 (13.1–14.4); interorbital breadth, 4.7 (4.4–4.8); width of braincase, 10.7 (10.2–11); nasals, 10.3 (9.6–10.9); anterior palatine foramina, 4.4 (4–4.7); palatal bridge, 5.3 (5–5.6); upper molar series, 3.8 (3.7–3.9).

Remarks.—The general resemblance of *O. a. chapmani* to *O. a. alfaroi* is noteworthy, in view of their geographic separation and the occurrence of apparently annectent forms that differ considerably from both. The annectent forms, however, inhabit diversified areas, some having ascended to high elevations, where their differentiation has probably been the result of rather local environmental conditions.

Specimens examined.—Total number, 25, as follows:

Vera Cruz: Jalapa, 17 (type and topotypes);[1] Jico, 6; Mirador, 1; Teocelo, 1.[2]

ORYZOMYS ALFAROI DILUTIOR Merriam.

Puebla Rice Rat.

(Pl. III, figs. 6, 6a.)

Oryzomys chapmani dilutior Merriam, Proc. Washington Acad. Sci., III, p. 290, July 26, 1901.

Type locality.—Huauchinango, Puebla, Mexico (altitude 5,000 feet).

[1] Thirteen in collection Amer. Mus. Nat. Hist. [2] Collection Mus. Comp. Zool.

Type.—No. 93124, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 10, 1898.

Geographic distribution.—Eastern slope of Mexican plateau region at 5,000 feet altitude in northern Puebla; limits of range unknown; Humid Upper Tropical Zone.

General characters.—Similar in size to *O. a. chapmani*, but color slightly paler, less tawny; skull more massive.

Color.—About as in *O. a. chapmani*, but slightly paler, the general tone less tawny.

Skull.—Most like that of *O. a. chapmani*, but more massive; rostrum more swollen, the upper outline more strongly decurved; maxillary arm of zygoma heavier.

Measurements.—Type: Total length, 223; tail vertebræ, 117; hind foot, 28. An adult topotype: 225; 125; 27.5. *Skull* (type and adult topotype): Greatest length, 27.6, 27.4; zygomatic breadth, 15, 14.2; interorbital breadth, 4.9, 4.6; width of braincase, 10.8, 10.4; nasals, 10.3, 10.5; anterior palatine foramina, 4.6, 4.4; palatal bridge, 5.2, 5; upper molar series, 4, 4.

Remarks.—The range of *O. a. dilutior* marks the northern limit of the *O. alfaroi* group. The subspecies appears to be a well-marked form, requiring close comparison only with *O. a. chapmani.*

Specimens examined.—Three, from type locality.

ORYZOMYS GUERRERENSIS Goldman.

Guerrero Rice Rat.

(Pl. III, figs. 7, 7a.)

Oryzomys guerrerensis Goldman, Proc. Biol. Soc. Washington, XXXVIII, p. 127, June 29, 1915.

Type locality.—Omilteme, Guerrero, Mexico (altitude 8,000 feet).

Type.—No. 127517, ♂ adult (molars moderately worn), United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, May 20, 1903.

Geographic distribution.—Forested Pacific slope of Sierra Madre in Guerrero and Oaxaca, Mexico; altitudinal range from 3,000 to about 8,000 feet; Humid Upper Tropical Zone.

General characters.—Size small; color averaging palest of the North American forms of the *O. alfaroi* group. Similar in general to *O. a. chapmani*, but color paler and skull smaller and flatter.

Color.—Upperparts varying from dark ochraceous-buff to dark ochraceous-tawny, purest on cheeks, shoulders, and sides; the face, top of head, and back darkened by a moderate admixture of black hairs; underparts dull grayish white, the dark basal color of the fur everywhere showing through, except in 2 examples out of 8, in which

the fur is pure white to roots along a narrow median line on chin and throat; outer and inner sides of ears well clothed with deep glossy black hairs; feet whitish; tail brownish above, irregularly yellowish below to near tip, which is dusky all around. *Young* (in first pelage): As in *O. a. chapmani*.

Skull.—Small and short, the braincase broad and somewhat flattened. Similar to that of *O. a. chapmani*, but usually smaller and flatter; zygomata tending to curve evenly outward, the sides less nearly parallel; sides of rostrum more tapering anteriorly; ascending branches of premaxillæ usually broader posteriorly; maxillary arm of zygoma more slender; incisors smaller.

Measurements.—Type: Total length, 220; tail vertebræ, 118; hind foot, 27. Adult from Pluma, Oaxaca: 221; 116; 26.5. *Skull* (type): Greatest length, 26.3; zygomatic breadth, 14; interorbital breadth, 4.9; width of braincase, 10.6; nasals, 10.1; anterior palatine foramina, 4; palatal bridge, 5.5; upper molar series, 3.8.

Remarks.—The range of *O. guerrerensis* marks the northern limit of the distribution of the *O. alfaroi* group along the western slope of the mountains bordering the Pacific coast of Mexico. As in other southern groups, the general range of *O. alfaroi* and its allies seems to bifurcate north of the Isthmus of Tehuantepec, the forms which pass farther to the northward along the eastern and western slopes of the interior plateau region being isolated and developing differential characters. The ranges of *O. guerrerensis* and *O. a. chapmani* appear to be completely separated, and while these forms differ appreciably in numerous details, they agree rather closely in the more essential features, and may prove to intergrade through the much larger form *O. a. caudatus*. The latter, however, as at present understood, exhibits so wide a departure from *guerrerensis* that close comparison seems unnecessary.

Specimens examined.—Total number, 8, as follows:

Guerrero: Omilteme, 6 (type and topotypes).
Oaxaca: Pluma, 2.

ORYZOMYS HYLOCETES Merriam.

Chiapas Rice Rat.

(Pl. III, figs. 8, 8a.)

Oryzomys hylocetes Merriam, Proc. Washington Acad. Sci., III, p. 291, July 26, 1901.

Type locality.—Chicharras, Chiapas, Mexico (altitude 3,500 feet).

Type.—No. 77605, ♂ old, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 14, 1896.

Geographic distribution.—Heavily forested Pacific slope, at 3,500 feet, of mountains along continental divide in extreme southern

Chiapas, and doubtless adjacent portions of Guatemala; Humid Upper Tropical Zone.

General characters.—Size small; color dark; pelage short; skull short and relatively broad across anterior roots of zygomata. Somewhat similar to *O. a. angusticeps* and *O. a. rhabdops*, but much smaller than either, and cranial characters distinctive.

Color.—About as in *O. a. saturatior.*

Skull.—General form short, with posteriorly narrow braincase and anteriorly divergent zygomata; anterior palatine foramina rather long, but not reaching anterior plane of first molars; molars small. In size the skull is perhaps nearest to that of *O. a. saturatior*, but it differs in the anterior expansion of the zygomata and departs from that of its larger and nearer geographic neighbor *O. a. angusticeps* in the same respect. The skull is similar in general outline, especially the form of zygomata, to that of *O. a. rhabdops*, but very much smaller.

Measurements.—Type: Total length, 217; tail vertebræ, 118; hind foot, 27. *Skull* (type): Greatest length, 26.2; zygomatic breadth, 13.6; interorbital breadth, 4.6; width of braincase, 9.9; nasals, 9.7; anterior palatine foramina, 4.5; palatal bridge, 5.3; upper molar series, 3.5.

Remarks.—Two examples only of *O. hylocetes* are known, one old and in worn pelage, the other very young, and the range of individual variation the form may present can not now be determined. The species inhabits the lower slope of the mountains, while the upper levels of the same range are occupied by *O. a. angusticeps*, a much larger form, with longer pelage and apparently representing a distinct specific type; but only through the accession of new material can the exact relationship of the two be made clear. The skull in general contour bears a striking resemblance to that of the otherwise different Guatemalan form, *O. a. rhabdops.*

Specimens examined.—Two, from type locality.

Oryzomys talamancæ Group.

Geographic distribution.—Forested districts in eastern Costa Rica and Panama, and south in South America at least to southern Brazil; altitudinal range from sea level to 3,000 feet in Panama; Arid and Humid Lower Tropical Zones (fig. 6).

General characters.—Size large; form rather slender; tail about equal to or somewhat exceeding head and body, scantily and indistinctly haired; ears large and conspicuous, thinly clothed externally and internally, with very short, fine, almost microscopic hairs, general pelage short, rather harsh, and lacking the woolly quality of *O. palustris;* vibrissæ about as long as head; toes of hind feet more or less distinctly webbed at base, the longest three bearing conspicuous

tufts of silvery bristles which extend beyond the points of the claws; claws short, recurved, compressed, and sharp pointed. Color of upperparts varying from rich ochraceous-tawny to cinnamon brown or russet, lined with black; underparts white or buffy whitish.

Skull.—Size large, with rostrum long and braincase low and somewhat flattened; maxillary arm of zygoma heavy; outer wall of antorbital foramen with projecting border rounded or sloping forward, the antorbital notch rather shallow as viewed from above; nasals and premaxillæ about conterminous posteriorly; frontal region wide, the lateral margins trenchant, a more or less conspicuous depression on median line close to posterior ends of nasals; temporal ridges moderately developed anteriorly along parieto-squamosal sutures, becoming indistinct posteriorly in crossing lateral wings of parietals; interparietal large; anterior palatine foramina short and broad, much shorter than palatal bridge, not reaching anterior plane of first molars; palatal pits small; spheno-palatine vacuities small; interpterygoid fossa broad; audital bullæ small, the inner sides largely overlapped by mastoids; basi-occipital broad; angle of mandible moderately broad, the inferior border strongly turned inward; coronoid process rather short and low; molars moderately heavy; the inner reentrant angles in upper molars and outer reentrant angles in lower molars, deeply cutting the crowns; mandibular tooth row decidedly narrower posteriorly than anteriorly; tubercle over root of lower incisor weakly developed. Contrasted with those of the *O. palustris* group, skulls of *O. talamancæ* and its allies differ especially in greater length of rostrum, shorter anterior palatine foramina in relation to length of palatal bridge, smaller size of audital bullæ, and in dental detail; the upper molars are more deeply cleft by inner reentrant angles and the lower molars by outer reentrant angles; the second upper molar differs especially in the more nearly equal size of the protocone and hypocone (protocone larger than hypocone in *palustris*), owing to more central position of inner reentrant angle, and in the absence of the large, elongated enamel island extending, in the moderately worn tooth of *palustris*, along the postero-internal base of the paracone, or the reduction of this island to a smaller one, appearing in *talamancæ* near the mesostyle; the third lower molar is more triangular in outline than in *palustris*, the posterior division being decidedly narrower than the anterior.

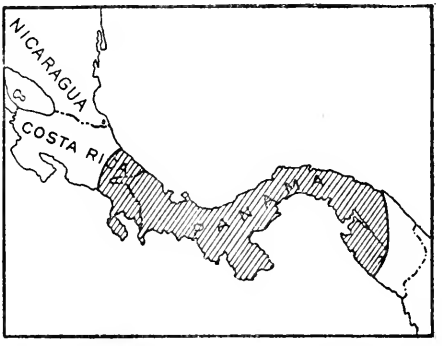


FIG. 6.—Geographic distribution of *Oryzomys talamancæ*.

Remarks.—The group name used is that of the single North American species, *O. talamancæ* of Costa Rica. This species typifies a series of wide distribution in South America; *O. mollipilosus* and *O. medius* are closely allied Colombian and Venezuelan forms, and others of this unrevised group range far south in Brazil.

The *O. talamancæ* group is more nearly related to the *O. bombycinus* group than to any other North American section of the genus, and representatives of the two sometimes share the same local habitat. Members of the *talamancæ* group are externally separable by the shortness of their pelage, while the heavier rostrum and the extension of the lateral wings of the parietals below the temporal ridges are distinguishing cranial characters. In dentition the two groups agree very closely.

ORYZOMYS TALAMANCÆ Allen.

Talamanca Rice Rat.

(Pl. IV, figs. 3, 3a; Pl. V, fig. 7; Pl. VI, figs. 4, 4a.)

Oryzomys talamancæ Allen, Proc. U. S. Nat. Mus., XIV, p. 193, July 24, 1891.

Oryzomys panamensis Thomas, Ann. Mag. Nat. Hist., ser. 7, VIII, p. 252, September, 1901. Type from City of Panama, Panama. No. 0.5.1.67, ♀, British Mus.; collected by E. André, February 25, 1899.

Oryzomys carrikeri Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 656, October 13, 1908. Type from Rio Sicsola, Talamanca, Costa Rica. No. 25976, ♀ ad., Amer. Mus. Nat. Hist.; collected by M. A. Carriker, jr., August 18, 1904.

Type locality.—Talamanca, Costa Rica (probably near Sipurio, in the valley of the Rio Sicsola).

Type.—No. $\frac{1}{2}\frac{2}{2}\frac{2}{7}\frac{2}{4}\frac{3}{2}$, ♂ adult (molars much worn), United States National Museum; collected by W. M. Gabb.

Geographic distribution.—Heavily forested regions from eastern Costa Rica eastward through Panama to near Colombian frontier; altitudinal range from sea level to 3,000 feet; Arid and Humid Lower Tropical Zones.

General characters.—Externally similar to *O. mollipilosus* of South America; skull narrower. (For additional general characters see under *O. talamancæ* group.)

Color.—General color of upperparts varying from pale ochraceous-tawny to cinnamon brown or russet, becoming lighter and in some specimens ochraceous-buffy on cheeks, shoulders, and sides; underparts dull white or buffy whitish, the plumbeous basal color showing through; ears brownish, indistinctly clothed externally with very short dusky hairs and internally with almost microscopic buffy or grayish hairs; feet (epidermis) dull yellowish, thinly covered above with short glossy white hairs, the hind feet with tufts of silvery bristles projecting beyond claws of longer digits; tail (epidermis) dark brownish above, varying from light brownish to dull yellowish.

Skull.—About like that of *O. mollipilosus*, but braincase and frontal region decidedly broader.

Measurements.—Type (dry skin): Total length, 233; tail vertebræ, 115; hind foot, 30. Average of three adults from Rio Sicsola, Costa Rica: 251 (240–265); 124 (118–133); 29.8 (29–30. 5). *Skull* (type): Greatest length, 31.5; zygomatic breadth, 15.5; interorbital breadth, 5.3; width of braincase, 11.2; nasals, 12.8; anterior palatine foramina, 4.3; palatal bridge, 7.1; upper molar series, 4.6.

Remarks.—Specimens from the Canal Zone and as far east as extreme eastern Panama seem referable to typical *O. talamancæ* of Costa Rica. Two examples from Gatun, Canal Zone, have been submitted to Mr. Oldfield Thomas for comparison with the type of "*O. panamensis*" in the British Museum. The result of his examination he has kindly written as follows: "We have only one specimen of *O. panamensis* [the type] and it is both larger and more rufous than your specimens. But it is older; the skull agrees in general characters and the toothrow is of exactly the same length. As to the colour I think the difference is only due to the coming on of the faded fulvous stage found in the old specimens of most species of *Oryzomys*. Personally I should certainly refer your specimens to *panamensis*." Since the examples used for comparison are regarded as fairly typical of *talamancæ* I conclude that *panamensis* must be placed in the synonymy of that species.

The type and two topotypes of "*O. carrikeri*" Allen agree essentially with the type of *talamancæ*. The exact locality of the latter is not definitely known, but Gabb, the collector, worked mainly near Sipurio and probably secured the specimen there. The Carriker collection came from about halfway between Cuabre and the mouth of the Rio Sicsola, the two localities being, on this assumption, not far apart in the same river valley.

The ranges of *talamancæ* and *O. alfaroi* overlap, and owing to their superficial resemblance the two have sometimes been confused; *talamancæ* is a larger animal than *alfaroi*, with a longer hind foot. The skulls, however, present the safest distinguishing characters, that of *talamancæ* being more massive, with heavier maxillary arms of zygomata, and heavier dentition; the first and second upper molars, besides differing in details of crown arrangement, are more deeply cleft by inner reentrant angles and all the lower molars by outer reentrant angles, while in *alfaroi* they more nearly approach the condition shown in *O. palustris*.

Specimens examined.—Total number, 20, as follows:

Costa Rica: Boruca, 1;[1] Rio Sicsola, 3 (including type of "*carrikeri*");[2] Talamanca, 1 (type).

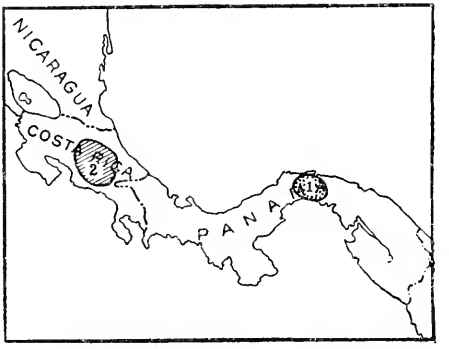
Panama: Cana, 7; Cerro Brujo, 1; Divala, 1;[1] Gatun, 6.

[1] Collection Mus. Comp. Zool. [2] Collection Amer. Mus. Nat. Hist.

Oryzomys bombycinus Group.

Geographic distribution.—Forested regions from southern Costa Rica south through Panama at least to northern Ecuador; altitudinal range from near sea level to at least 3,000 feet; Humid Lower Tropical Zone (fig. 7).

General characters.—Size large; form rather slender; tail about equal to or slightly longer than head and body, scantily and very indistinctly haired; pelage of upperparts very long (that of back measuring about 12 mm.), underfur not woolly as in *O. palustris;* supraorbital vibrissæ 50 to 70 mm. in length (exceeding those arising from the muzzle), reaching posteriorly to sides of body; ears rather large and naked appearing, the short, fine hairs scattered over inner and outer surfaces almost microscopic; hind feet slender, very scantily haired above, the plantar surface generally smooth, but in some examples indistinctly granular between interdigital tubercles; toes of hind feet more or less distinctly webbed at base, the longest three bearing conspicuous tufts of silvery bristles projecting beyond ends of claws as in the *O. talamancæ* group; claws short, recurved, compressed, and sharp pointed. Colors dark; upperparts near cinnamon brown or russet; underparts overlaid with dull white.



1. *O. b. bombycinus.* 2. *O. b. alleni.*

FIG. 7.—Geographic distribution of subspecies of *Oryzomys bombycinus.*

Skull.—Size rather large, with rostrum long and narrow, the nasals attenuate and slightly exceeding premaxillæ in posterior extent; braincase broad and moderately expanded; zygomata slender; outer wall of antorbital foramen with projecting upper anterior border well rounded, the antorbital notch broad but not deeply cutting zygoma as viewed from above; frontal region moderately broad and somewhat flattened, the small depression on median line near anterior border deep and conspicuous, and more or less involving ends of nasals; lateral margins of frontals rising in distinct, but narrow, compressed ridges; temporal ridges well developed, bounding parietals laterally as far as lateral extension of supraoccipital, where they turn abruptly and are continued downward along the anterior border of that segment; parietals without lateral wings extending across temporal ridges; interparietal large, reaching transversely nearly across posterior parietal border; anterior palatine foramina short, not reaching anterior plane of first molars; palatal pits small; spheno-palatine vacuities very small or absent; interpterygoid

fossa broad; audital bullæ small; basi-occipital broad; angle of mandible broad, the inferior border strongly turned inward; coronoid process rather large and broad across base; molars moderately heavy, the crown arrangement of the *O. talamancæ* type, the crowns deeply incised by reentrant angles and the mandibular toothrow much narrower posteriorly; second upper molar about as in *talamancæ*, the elongated enamel island present in *O. palustris*, *O. melanotis* and *O. alfaroi* groups, being absent or displaced by a bending backward of the commissure of the paracone and protocone; third lower molar long and narrow, the large outer reentrant angle extending more than halfway across the crown.

Remarks.—Forms of this group differing only subspecifically among themselves evidently range from Costa Rica to Ecuador and may extend much farther; the group, therefore, seems to be mainly South American in distribution. Owing to lack of definite knowledge of the relationships of the South American forms it seems best to treat the North American representatives as specifically distinct until a revision of the South American species can be undertaken.

In many important characters, especially of the skull and dentition, the *O. bombycinus* group approaches the *O. talamancæ* group and the two sometimes occur together in the same localities. The *bombycinus* group is easily recognizable externally by the much greater length of the pelage, while the skull is sufficiently distinguished by the slender rostrum and the absence of the lateral wings of the parietals, which in the *talamancæ* group extend across the temporal ridges at the expense of the squamosals. Unlike many groups of the genus which show a preference for open or partially open situations *O. bombycinus* seems to be at home in the depth of the forest.

ORYZOMYS BOMBYCINUS Goldman.

[Synonymy under subspecies.]

Geographic distribution.—Heavily forested areas from southern Costa Rica to eastern Panama, and probably western Colombia; altitudinal range from sea level to at least 3,000 feet; Humid Lower Tropical Zone.

General characters.—(See under *O. bombycinus* group).

Color.—General color of upperparts varying from ochraceous-tawny to cinnamon brown or russet finely mixed with black; darkest on face, top of head, and back, the lighter element restricted to tips of hairs and the dark basal color showing through, becoming lighter and approaching ochraceous-buff or pale ochraceous-tawny on cheeks, shoulders, and sides; underparts dull whitish; ears black, the outer and inner sides thinly clothed with very short dusky hairs; feet (epidermis) dull yellowish, the hairs whitish; tail dark brownish above, light brownish below. *Young* (about two-thirds grown): Upper-

parts blackish, nearly pure black on face, top of head, and back, becoming lighter and more distinctly lined with ochraceous-buffy hairs on cheeks, shoulders, and sides.

Skull.—(See under *O. bombycinus* group.)

Remarks.—Two closely allied forms inhabit Panama and Costa Rica, and may not improbably prove to be geographic races of *O. nitidus* of Peru, since Ecuadorean specimens believed to be near *nitidus* show close alliance to the North American forms.

Key to Subspecies of O. bombycinus.

a^1. Braincase less inflated. (Panama.).....**O. b. bombycinus** (p. 77).
a^2. Braincase more inflated. (Costa Rica.).....**O. b. alleni** (p. 78).

ORYZOMYS BOMBYCINUS BOMBYCINUS Goldman.

Long-Haired Rice Rat.

(Pl. II, figs. 7, 7a; Pl. V, fig. 8; Pl. VI, figs. 5, 5a.)

Oryzomys bombycinus Goldman, Smiths. Misc. Coll., LVI, No. 36, p. 6, February 19, 1912.

Type locality.—Cerro Azul, near headwaters of Chagres River, Panama (altitude, 2,500 feet).

Type.—No. 171105, ♂ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, March 26, 1911.

Geographic distribution.—Mountains of east-central Panama; altitudinal range from 1,000 to 3,000 feet; Humid Lower Tropical Zone.

General characters.—Size about as in *O. b. alleni*, color identical; skull with much flatter, less expanded braincase.

Color.—(See under *O. bombycinus.*)

Skull.—Similar to that of *O. b. alleni*, but braincase lower, flatter, much less distended, especially anteriorly; frontal region narrower posteriorly.

Measurements.—Type: Total length, 252; tail vertebræ, 127; hind foot, 32. *Skull* (type and adult topotype): Greatest length, 31.3, 31.7; zygomatic breadth, 15.4, 16.1; interorbital breadth, 5.5, 5.4; width of braincase, 11.2, 11.6; nasals, 12.2, 12.2; anterior palatine foramina, 5, 4.5; palatal bridge, 6.2, 6.1; upper molar series, 4.7, 4.4.

Remarks.—The Panama form apparently differs from the Costa Rican animal only in cranial characters, and the specimens on which it is based closely resemble Ecuadorean examples believed to be near *O. nitidus.* The four Panama specimens are very slightly paler in color than five from Ecuador, with skulls also similar, but the zygomata more strongly bowed outward, the sides less nearly parallel.

Specimens examined.—Total number, 4, as follows:

Panama: Cerro Azul, 3 (type and topotypes); Cerro Brujo, 1.

ORYZOMYS BOMBYCINUS ALLENI Goldman.

Allen Rice Rat.

(Pl. II, figs. 8, 8a.)

Oryzomys nitidus alleni Goldman, Proc. Biol. Soc. Washington, XXVIII, p. 128, June 29, 1915.

Type locality.—Tuis (about 35 miles east of Cartago), Costa Rica.

Type.—No. $\frac{96231}{19971}$, ♂ subadult (teeth slightly worn), American Museum of Natural History; collected by George K. Cherrie, July 15, 1894.

Geographic distribution.—Mountainous portions of southern Costa Rica; altitudinal range from 800 to about 2,000 feet; Humid Lower Tropical Zone.

General characters.—Size about as in *O. b. bombycinus;* color identical; skull with braincase higher, much more fully expanded.

Color.—As in *O. b. bombycinus.* (See under *O. bombycinus* group.)

Skull.—Similar to that of *O. b. bombycinus*, but braincase higher, more arched, much more distended, especially anteriorly; frontal region broader posteriorly.

Measurements.—Type (young): Total length, 218; tail vertebræ, 111, hind foot, 29. *Skull* (type): Greatest length, 28.2; zygomatic breadth, 14.3; interorbital breadth, 5.5; width of braincase, 11.6; nasals, 10.9; anterior palatine foramina, 3.5; palatal bridge 5.5; upper molar series, 4.3.

Remarks.—Cranial comparisons are necessary in order to distinguish this Costa Rican form from *O. b. bombycinus* of Panama. While the interorbital breadth is about the same, the greater anterior expansion of the braincase has resulted in broadening the posterior part of the frontal region.

Specimens examined.—Total number, 4, as follows

Costa Rica: Tuis, 3 (type and topotypes); Guapiles, 1.[1]

Oryzomys devius Group.

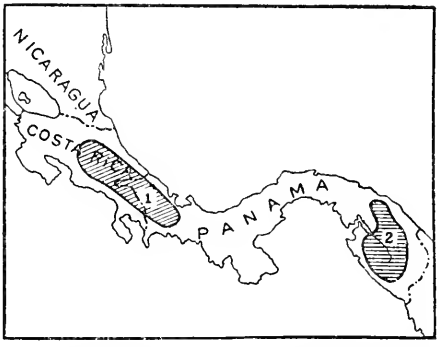
Geographic distribution.—High mountains of central Costa Rica to Colombia and Venezuela; altitudinal range from 4,000 to at least 5,000 feet; Humid Upper Tropical Zone (fig. 8).

General characters.—Size very large, but form rather slender; tail much longer than head and body, indistinctly haired; ears rather large, blackish, the short hairs, thinly distributed over inner and outer sides, of about the same color as the epidermis; pelage long, but somewhat rigid; vibrissæ long (about reaching shoulders); hind feet long and narrow, thinly haired above, the plantar surface between the large conspicuous tubercles smooth; toes of hind feet with the slight basal webbing usual in the genus, the longest three tufted with

[1] Collection Carnegie Mus.

silvery bristles as in *O. talamancæ* and other groups; claws short, recurved, compressed and sharp pointed as in other partially scansorial sections of the genus. Colors dark; upperparts between tawny and russet; underparts varying from ochraceous-tawny to dull white, the basal color plumbeous except in some examples, which tend to exhibit irregular areas on throat where the fur may be pure white to roots.

Skull.—Size very large, with rostrum long and heavy; nasals broad and reaching posteriorly slightly beyond premaxillæ; braincase moderately broad and inflated; zygomata heavy; the maxillary arm extensively overlapping outer side of jugal, in some examples in contact with squamosal, the gap usual in the genus being completely bridged; outer wall of antorbital foramen with projecting upper anterior border rounded, the antorbital notch broad as viewed from above, but less deeply cutting zygoma, the aperture appearing less evenly circular than in the *O. palustris* group; frontal region narrow, especially posteriorly, the anterior median depression rather inconspicuous; lateral margins of frontals smoothly rounded, or rising in slightly upturned ridges; temporal ridges moderately developed, crossing lateral wings of parietals to supraoccipital and continuing thence downward in prominent crests along occipito-squamosal border; interparietal very large, extending transversely nearly across posterior parietal border, pointed-elliptical in outline owing to convexity of anterior margin; anterior palatine foramina very short, not reaching anterior plane of first molars, narrow anteriorly, very broad and gaping widely open posteriorly, palatal pits large and irregular in form; spheno-palatine vacuities absent; interpterygoid fossa moderately broad and extending well forward, the anterior border closely approaching posterior plane of last molars; audital bullæ variable but rather small; angle of mandible broad, the inferior border strongly incurved; coronoid process large and strongly upturned, the high thin connecting ridge extending to near summit of condyle; molars heavy and approaching the *O. talamancæ* type, the crowns of the upper series deeply incised by inner reentrant angles, and of lower series by outer reentrant angles; as in the *talamancæ* group the second upper molar is evenly cleft by inner reentrant angle and lacks



1. *O. devius.* | 2. *O. pirrensis.*

FIG. 8.—Geographic distribution of the *Oryzomys devius* group.

the elongated enamel island extending in the moderately worn crown of *O. palustris* and other groups along the postero-internal base of the paracone; mandibular toothrow very narrow posteriorly, the third molar elongated and deeply cleft by outer reentrant angle.

Remarks.—The *O. devius* group, as it may be called, includes two northern representatives of a widely distributed South American section of the genus which in that country has sometimes been denominated the *O. meridensis* group, from the name of a Venezuelan species.

These northern forms generally lack the irregular but extensive pure white pectoral and inguinal areas exhibited by the allied Venezuelan and Colombian forms *O. meridensis* and *O. maculiventer*, although a tendency to develop them is shown in *O. devius*.

The North American species are externally easily recognizable among their congeners of the general region by the combination of large size with dark color and very long tails. Except for the more hispid pelage they are superficially much like the species of *Peromyscus* (subgenus *Megadontomys*) occurring at the same localities with them.

Key to Species of the O. devius Group.

a^1. Supraorbital ridges prominent. (Eastern Panama.).....**O. pirrensis** (p. 81).
a^2. Supraorbital ridges not prominent. (Western Panama.).....**O. devius** (p. 80).

ORYZOMYS DEVIUS Bangs.

Chiriqui Rice Rat.

(Pl. IV, figs. 1, 1a.)

Oryzomys devius Bangs, Bull. Mus. Comp. Zool., XXXIX, p. 34, figs, 13, 14, April, 1902.

Type locality.—Boquete, Volcan de Chiriqui, Panama (altitude, 5,000 feet).

Type.—No. 10324, ♀ adult, Museum of Comparative Zoology (Bangs collection); collected by W. W. Brown, jr., January 29, 1901.

Geographic distribution.—Forested slopes of high mountains in central Costa Rica and western Panama; altitudinal range from 4,000 to at least 5,000 feet; Humid Upper Tropical Zone.

General characters.—Size large, about as in *O. pirrensis* of eastern Panama, but color slightly paler, more tawny; skull more smoothly rounded; audital bullæ much larger.

Color.—Upperparts dark tawny, inclining toward russet and rather heavily mixed with black along median line of dorsum, becoming light tawny, or in the paler examples dark ochraceous-buffy along lower part of sides; throat whitish (the fur pure white to roots over a small area in one example), rest of underparts overlaid with ochraceous-buffy in three examples and with dull white in the other three examined; nose and ears blackish; feet dull yellowish or light brown-

ish; tail (epidermis) dark brownish above, paler below. *Young* (in first pelage): Upperparts blackish, the tawny element appearing rather inconspicuously along sides; underparts (in single specimen examined) thinly overlaid with dull white.

Skull.—Similar to that of *O. pirrensis*, but more smoothly rounded, the supraorbital and temporal ridges weakly developed or absent; nasals slightly longer, ending posteriorly in plane of lachrymals; zygomata less widely spreading; audital bullæ decidedly larger. Compared with that of *O. meridensis*, the skull is larger, with longer nasals and larger audital bullæ.

Measurements.—Type: Total length, 335; tail vertebræ, 180; hind foot, 33. Two adult topotypes: 345, 360; 185, 195; 36, 35. *Skull* (average of three adults, type, and two topotypes): Greatest length, 36.6 (35.8–37.5); zygomatic breadth, 18.4 (18–19); interorbital breadth, 5.7 (5.5–6); width of braincase, 12.6 (12.2–12.9); nasals, 14.3 (13.8–15); anterior palatine foramina, 5.4 (5.2–5.6); palatal bridge, 7.8 (7.8–7.9); upper molar series, 5.7 (5.6–5.8).

Remarks.—*O. devius* is clearly allied to *O. pirrensis* of eastern Panama, but possesses very distinctive cranial characters, and there is no hint of intergradation. Both are inhabitants of high mountains, and their ranges are apparently separated by the intervening lowlands in the vicinity of the Canal Zone.

Specimens examined.—Total number, 8, as follows:

Costa Rica: Volcan Irazu, 2.[1]
Panama: Boquete, 6 (type and topotypes).[2]

ORYZOMYS PIRRENSIS Goldman.

Mount Pirre Rice Rat.

(Pl. IV, figs. 2, 2a; Pl. V, fig. 9; Pl. VI, figs. 6, 6a.)

Oryzomys pirrensis Goldman, Smiths. Misc. Coll., LX, No. 22, p. 5, February 28, 1913.

Type locality.—Head of Rio Limon, Mount Pirre, Panama (altitude 4,500 feet).

Type.—No. 178993, ♂ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, April 29, 1912.

Geographic distribution.—Steep, heavily forested slopes of high mountains at 4,500 feet altitude in eastern Panama, and probably adjacent portions of Colombia; Humid Upper Tropical Zone.

General characters.—Size large, about as in *O. devius* of western Panama, but color slightly darker, more russet; skull more angular; audital bullæ decidedly smaller.

Color.—Fresh pelage: Upperparts between tawny and russet, heavily mixed with black along the broad median line from top of head to

[1] One specimen in Mus. Comp. Zool.
[2] Four specimens in Mus. Comp. Zool.; 2 in Field Mus. Nat. Hist.

base of tail, becoming lighter, purer tawny on cheeks, shoulders, and sides; throat whitish or grayish, rest of underparts usually overlaid with ochraceous-tawny, but varying to dull white, the basal color of the fur everywhere deep plumbeous; nose and ears blackish; fore feet blackish, becoming lighter on toes; hind feet dark brown, thinly clothed with short hairs to toes, the toes dull yellowish; epidermis of tail dark brown above, usually somewhat paler below. *Young* (in first pelage): Upperparts darker than in adults, the blackish element in the pelage predominant; underparts with a thinner ochraceous-tawny wash.

Skull.—Similar to that of *O. devius*, but more angular, the supraorbital and temporal ridges well developed; nasals slightly shorter, not reaching posteriorly to plane of lachrymals; zygomata more widely spreading; audital bullæ decidedly smaller. In small size of audital bullæ the skull agrees with those of *O. meridensis* and *O. maculiventer*, but contrasts with both in larger general size and angularity.

Measurements.—Type: Total length, 340; tail vertebræ, 185; hind foot, 38. Average of five adult topotypes: 314 (309–322); 164 (159–170); 35.7 (34–37). *Skull* (average of six adults, type, and five topotypes): Greatest length, 36.8 (34.9–38.5); zygomatic breadth, 19.2 (17.8–20); interorbital breadth, 5.8 (5.5–6); width of braincase, 12.4 (11.8–12.9); nasals, 13.7 (13–14); anterior palatine foramina, 5.8 (5.4–6); palatal bridge, 7.5 (7.3–7.8); upper molar series, 5.7 (5.5–5.9).

Remarks.—In external appearance *O. pirrensis* differs only slightly from *O. devius* of western Panama. The skull, however, combines the large general size of that species with the smaller general dimensions and small audital bullæ of *O. meridensis* and *O. maculiventer;* it differs from both in the development of the supraorbital and temporal ridges. In color of upperparts *O. pirrensis* is similar to the South American species, but the underparts show no trace of the pure white pectoral and inguinal areas which are so conspicuous in the latter forms.

Specimens examined.—Eight, from type locality.

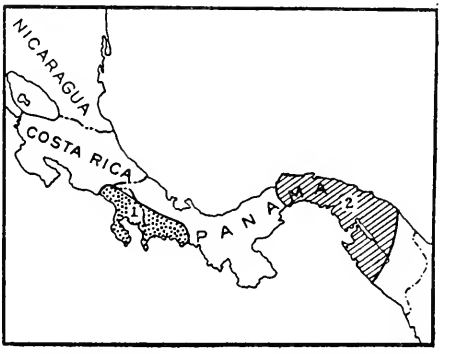
Oryzomys tectus Group.

Geographic distribution.—Southern Costa Rica and southeastward through Panama at least to Colombia and Venezuela; altitudinal range from near sea level to about 5,000 feet (fig. 9).

General characters.—Size large, form rather robust; tail about equal to or somewhat exceeding head and body, scantily haired, the epidermal scales small; ears small, moderately clothed externally and internally with comparatively coarse hairs of general body color; general pelage long, coarse, and rigid; vibrissæ somewhat longer than head; hind feet short and relatively broad, well haired above, the longest three toes bearing conspicuous tufts of silvery bristles, which

project beyond ends of claws; claws short, strongly curved, compressed, and sharp-pointed. Color of upperparts between rich tawny and ochraceous-tawny, mixed with black, the tawny element predominating; underparts varying from nearly pure white to warm buff.

Skull.—Size large and angular, with rostrum short and braincase low and flattened; outer wall of antorbital foramen rounded above, the forward projection moderate; nasals short, ending posteriorly in the anterior plane of orbits; premaxillæ about conterminous with nasals posteriorly, the ends slightly expanded, not beveled externally; frontals very broad, the lateral margins overhanging as supraorbital shelves; temporal ridges prominent, extending posteriorly to supraorbital border; mastoid process of squamosal short and stout, owing to slight excision of squamosal margin; interparietal large, pointed-elliptical, the anterior angle well developed; lachrymal very small; anterior palatine foramina short, moderately broad anteriorly and posteriorly, reaching or nearly reaching anterior plane of first molars; palatal pits normally small; sphenopalatine vacuities absent or very small; audital bullæ small; ramus of mandible short, the angle broad; coronoid process broad and strongly hooked, a high trenchant ridge connecting with condyle; tubercle over root of lower incisor large. Molars similar to those of the *O. talamancæ* group; approaching the *O. palustris* type in general characters, but second upper molar with inner lobes more nearly equal in extent (the anterior slightly the larger in *palustris*), and central enamel island present in *palustris* usually fused with enamel fold separating paracone and parastyle; third lower molar more triangular in outline, the posterior lobe narrower and the outer reentrant angle more nearly dividing crown.



1. *O. t. tectus.* | 2. *O. t. frontalis.*

FIG. 9.—Geographic distribution of subspecies of *Oryzomys tectus.*

Remarks.—*O. tectus* is typical of a group including also *O. flavicans*, *O. palmarius*, and other extralimital forms distinguished by rich coloration, coarsely haired ears, and short stout hind feet. In external appearance they are not very unlike some species of *Rhipidomys*, but have shorter, less hairy tails and lack the dark metapodial markings usually present in that genus; in general characters they apparently approach the section assigned to generic rank by Thomas under the name *Œcomys*,[1] but in the more essential respects scarcely exhibit

[1] Thomas, Oldfield, Ann. Mag. Nat. Hist., ser. 7, XVIII, p. 444, Dec. 1906.

a wider departure from typical *Oryzomys* than several groups usually assigned to the genus.

ORYZOMYS TECTUS THOMAS.

[Synonymy under subspecies.]

Geographic distribution.—Southern Costa Rica, Panama, and probably adjacent portions of Colombia; vertical range from near sea level to about 2,000 feet, mainly in Arid Lower Tropical Zone.

General characters.—Similar to *O. flavicans* of Venezuela, but larger; color darker; skull larger with laterally expanded frontal region. (For additional general characters see under *O. tectus* group.)

Color.—Fresh pelage: General color of upperparts varying shades of tawny and ochraceous-tawny, rather inconspicuously darkened on face, top of head, and back by an admixture of dusky hairs, becoming paler, more ochraceous-buffy on cheeks, shoulders, and sides; underparts varying from near pure white to warm buff; ears clothed internally and externally with short tawny hairs; feet whitish; tail varying from uniform dark brownish all around to dark brownish above, and whitish or yellowish below.

Skull.—Size large, with remarkably broad frontal region. Similar in general to *O. flavicans*, but decidedly larger; frontal region broader, the lateral margins shelving farther over orbits, not strongly upturned as in *flavicans*. (For additional characters see under *O. tectus* group.)

Remarks.—O. tectus is clearly allied to *O. flavicans flavicans, O. f. illectus*, and *O. palmarius*, all South American forms in which the supraorbital ridges are well developed, but are compressed and not widely expanded and *Tylomys*-like as in the forms of *tectus*. This difference, although rather striking, is a relative instead of absolute character, and close agreement in other essential respects even suggests probable intergradation.

Key to Subspecies of O. tectus.

a^1. Upperparts more distinctly tawny. (Western Panama and southern Costa Rica.).....**O. t. tectus** (p. 84).

a^2. Upperparts less distinctly tawny. (Eastern Panama.).....**O. t. frontalis** (p. 85).

ORYZOMYS TECTUS TECTUS THOMAS.

BUGABA RICE RAT.

Oryzomys tectus Thomas, Ann. Mag. Nat. Hist., ser. 7, VIII, p. 251, September, 1901.

Type locality.—Bugaba, Chiriqui, Panama (altitude 800 feet).

Type.—No. 0.7.11.43, ♂, British Museum; collected by H. J. Watson, September 15, 1898.

Geographic distribution.—Pacific slope of western Panama and southern Costa Rica at about 800 feet altitude, limits of altitudinal range unknown; Arid Lower Tropical Zone.

General characters.—Closely resembling *O. t. frontalis*, but upperparts richer tawny; underparts more extensively buffy; lips, chin, and throat buffy instead of white as in *frontalis;* skull differing in rather slight details.

Color.—Upperparts near tawny rather thinly mixed with black, general color darkest over dorsum, becoming paler and rich ochraceous-buffy on cheeks and sides; underparts, including lips, chin, and throat overlaid with warm buff; ears clothed with tawny hairs; feet whitish; tail (epidermis and hairs) brownish above, whitish or dull yellowish below to near tip, which is dark all around.

Skull.—Very similar to that of *O. t. frontalis*, but frontals more extended posteriorly on median line between parietals; interparietal smaller.

Measurements.—From original description of type: "Head and body, 140 millim.; tail, 142; hind foot, s. u. 27, c. u. 29.5; ear, 18. *Skull:* Tip of nasals to back of interparietal, 33; greatest breadth, 17; nasals, 11.6×4; interorbital breadth, 6.5; palate length, 13.8; diastema 8.1; palatal foramina, 5×2.2; length of upper molar series, 4.9." A rather young example from Boruca, Costa Rica: Total length, 258; tail vertebræ, 140; hind foot, 27.

Remarks.—The type of *O. t. tectus* has not been examined by me, but specimens from Boruca, Costa Rica, are believed to be typical. They are distinguished from *O. t. frontalis* of eastern Panama mainly by richer general coloration. No other member of the *O. tectus* group ranges so far into the Central American Subregion.

Specimens examined.—Two, as follows:

Costa Rica: Boruca, 2.

ORYZOMYS TECTUS FRONTALIS Goldman.

Corozal Rice Rat.

(Pl. IV, figs. 4, 4a; Pl. V, fig. 10; Pl. VI, figs. 7, 7a.)

Oryzomys frontalis Goldman, Smiths. Misc. Coll., LVI, No. 36, p. 6, February 19, 1912.

Type locality.—Corozal, Canal Zone, Panama (altitude 100 feet).

Type.—No. 171531, ♀ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, June 20, 1911.

Geographic distribution.—Forested Pacific slope of Panama from the Canal Zone to near Colombian frontier, and probably adjacent Colombian territory; altitudinal range from sea level to about 2,000 feet; Arid and Humid Lower Tropical Zones.

General characters.—Similar in general to *O. t. tectus*, but upperparts duller, less distinctly tawny; underparts less extensively buffy; lips, chin, and throat white instead of buffy as in *tectus;* skull differing in rather slight details.

Color.—Upperparts between tawny and ochraceous-tawny, rather sparingly mixed dorsally with black, the general color becoming paler, purer, and ochraceous-buffy on cheeks and sides; underparts in general white in some examples, thinly overlaid with warm buff across the abdomen in others, the lips, chin, and throat in all specimens examined nearly pure white to roots of hairs; ears and feet as in *O. t. tectus;* tail usually unicolor, dark brownish, but in some examples becoming lighter on under side near base.

Skull.—Closely resembling that of *O. t. tectus,* but frontals less extended posteriorly on median line between parietals; interparietal larger.

Measurements.—Type: Total length, 309; tail vertebræ, 161; hind foot, 30. Average of five adults from Cana, Panama: 288 (281–293); 156 (152–164); 27.8 (26.5–29). *Skull* (average of same): Greatest length, 32.8 (31.1–34.1); zygomatic breadth, 17.1 (16.6–17.5); interorbital breadth, 6.1 (5.3–6.8); width of braincase, 12.2 (12–12.6); nasals, 11.4 (10.5–12.4); anterior palatine foramina, 5.3 (4.9–5.6); palatal bridge, 6.4 (5.6–6.9); upper molar series, 5.2 (4.8–5.3).

Remarks.—Two specimens of *O. t. frontalis* from eastern Panama have been submitted to Mr. Oldfield Thomas, who has kindly compared them with the type and topotypes of *O. t. tectus* in the British Museum. While inclined to regard them as referable to the same form he writes that "they are not quite so rich in colour as our specimens." Two examples from Boruca, Costa Rica, not far from the type locality and in the same general faunal area, and believed to be fairly typical of *tectus,* exhibit a type of coloration and slight cranial details indicating that eastern and western Panama are inhabited by closely allied but easily recognizable forms.

Specimens examined.—Total number, 12, as follows:

Canal Zone: Corozal, 1 (type).
Panama: Cana, 11.

ORYZOMYS VICTUS[1] THOMAS.

ST. VINCENT RICE RAT.

Oryzomys victus Thomas, Ann. Mag. Nat. Hist., ser. 7, I, p. 178, February, 1898.

Type locality.—St. Vincent, Lesser Antilles.

Type.—No. 97.12.26.1, ♀ adult, British Museum; collected by H. H. Smith, presented by F. DuCane Godman.

Geographic distribution.—Known only from St. Vincent.

General characters.—From original description of type: "Size and proportions about as in the larger members of the *O. longicaudatus* group. General colour dark rufous, but evidently affected by the spirit in which the specimen has been preserved. Under surface

[1] Group association undetermined.

buffy white, the bases of the hairs slate-colour. Eyes without darker rims. Ears short, the anterior part of their backs brown, not strikingly contrasting with the general colour of the head. Hands and feet thinly clothed with fine silvery hairs. Tail almost naked, brown above, slightly paler below. Mammæ 2–2 = 8."

Skull.—From original description of type: "Skull with the general shape of the South-American *O. longicaudatus*, the braincase being similarly lengthened as compared with the broadened braincase of the Central-American *O. melanotis* and its allies. Compared with a Rio Janeiro example it is larger, more rounded, the supraorbital edges less sharply square, but the parietal ridges thicker and better developed. Molars larger and stouter, palate ending only just behind the back of m^3."

Measurements.—From original description of type (measured in spirit): "Head and body, 96 millim.; tail, 121; hind foot without claws, 25; with claws, 26.7; ear, 14. *Skull:* Basilar length, 21.4; basal length, 23.8; greatest breadth, 15.1; nasals, 11.2x3.4; interorbital breadth, 4.5; interparietal, 3.2x10; palate length from henselion, 12.3; diastema, 7.8; palatal foramina, 5.4x1.8; length of upper molar series, 4.1."

Remarks.—The type of *O. victus* has not been examined by me. It was originally compared mainly with a South American species, but the true affinities remain to be determined. As in the case of *O. antillarum*, of Jamaica, this rice rat seems likely to be endangered by the presence of the mongoose, if it has not already been exterminated since the introduction of that indiscriminately destructive animal.

Subgenus OLIGORYZOMYS Bangs.

Oligoryzomys Bangs, Proc. New England Zool. Club., I, p. 94, February 23, 1900 (subgenus). Type *Oryzomys navus* Bangs.

Geographic distribution.—Southern Mexico south through Central America to undetermined limits in South America.

Subgeneric characters.—Size very small; hind foot usually less than 25; form slender and *Reithrodontomys*-like; ears rather large and coarsely haired; tail much longer than head and body; four longer toes of hind feet bearing tufts of silvery bristles projecting beyond ends of claws.

Skull delicate in structure, smoothly rounded; supraorbital and temporal ridges absent; interorbital region narrow, the constriction about equal to width of rostrum between antorbital foramina; outer wall of antorbital foramen projecting slightly forward, as viewed from above; angle of mandible placed well within vertical plane of condyle; molars with small accessory cusps present as in subgenus *Oryzomys*, but reentrant angles usually broader, the salient angles formed by worn crowns of tubercles less evenly rounded; upper molars early

exhibiting small, circular central enamel islands which persist until obliterated by wear in extreme old age; second upper molar with protocone and hypocone of about equal size, the inner reentrant angle central in position; third lower molar with outer reentrant angle extending less than halfway across crown; tubercle over root of lower incisor large.

Remarks.—The subgenus *Oligoryzomys* includes a series of forms easily distinguishable among their North American congeners by diminutive size and external resemblance to species of the genus *Reithrodontomys*. *Oligoryzomys*, however, departs from the subgenus *Oryzomys*, as currently restricted, mainly in a combination of relative rather than absolute characters. The molar crowns differ in details of enamel arrangement, the second upper especially, in the early appearance of a single, persistent, normally circular enamel island in the broad central space between the apex of the inner reentrant angle and the base of the paracone. In the subgenus *Oryzomys* this molar crown varies in pattern; the more typical forms normally present, in early stages of wear, an elongated, crescentic enamel island in the central space, but in more divergent forms the enamel island may be absent or tend to unite with the long, deep enamel fold between the paracone and parastyle. Several groups seem at least as fully entitled to subgeneric recognition as *Oligoryzomys*, but the problem of further subgeneric divisions can best be solved when more comprehensive study of the genus is undertaken.

ORYZOMYS FULVESCENS (SAUSSURE).

[Synonomy under subspecies.]

Geographic distribution.—From southern Mexico south through Guatemala, Honduras, Nicaragua, and Costa Rica to Panama, and probably portions of Colombia; altitudinal range from near sea level to about 5,500 feet; mainly Arid and Humid Lower Tropical Zones (fig. 10).

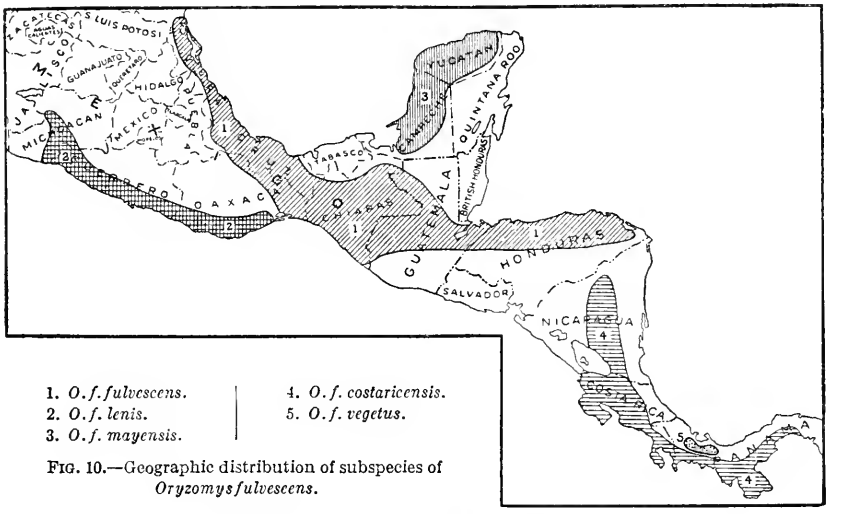
General characters.—(See subgeneric characters under subgenus *Oligoryzomys*.)

Color.—Upperparts varying from light ochraceous-buff to ochraceous-buff or tawny, most intense on rump, palest and purest on cheeks, shoulders, and sides; the face, top of head, and back moderately darkened by blackish hairs; underparts varying from nearly pure white in general to light ochraceous-buff on abdomen, inguinal region, and inner sides of hind limbs; the lips, throat, and fore limbs white; outer sides of ears blackish, inner sides clothed with ochraceous-buffy hairs; vibrissæ black (about as long as head); feet white, the hind feet with tufts of silvery hairs projecting beyond claws of longest four digits; tail dark brownish above, lighter brown or yellowish below, except toward tip, which is dusky all around. *Young*

(in first pelage): Usually darker than adults, the ochraceous-buff or tawny element less developed.

Skull.—(See subgeneric characters under subgenus *Oligoryzomys*.)

Remarks.—The North American forms of the subgenus are all referable to a single species whose range probably extends well into South America. They agree closely among themselves in essential characters, and by small size and slender form are sufficiently distinguished from other sections of the genus inhabiting the same region.



1. *O. f. fulvescens.*
2. *O. f. lenis.*
3. *O. f. mayensis.*
4. *O. f. costaricensis.*
5. *O. f. vegetus.*

FIG. 10.—Geographic distribution of subspecies of *Oryzomys fulvescens.*

Key to Subspecies of O. fulvescens.

a^1. Size smaller; hind foot less than 24.

b^1. Upperparts darker ochraceous-buff.

c^1. Upper molar series shorter. (Southern Tamaulipas; eastern Oaxaca; Chiapas; northern Honduras.)..... **O. f. fulvescens** (p. 89).

c^2. Upper molar series longer. (Southwestern Panama; Costa Rica; Nicaragua.) **O. f. costaricensis** (p. 92).

b^2. Upperparts paler ochraceous-buff.

c^1. Skull broader; zygomatic breadth 11.5 or more. (Michoacan; Guerrero; southern Oaxaca.)..... **O. f. lenis** (p. 91).

c^2. Skull narrower; zygomatic breadth less than 11.5. (Yucatan; Campeche.) **O. f. mayensis** (p. 92).

a^2. Size larger; hind foot 24 or more. (Mountains of western Panama.) **O. f. vegetus** (p. 93).

ORYZOMYS FULVESCENS FULVESCENS (SAUSSURE).

VERA CRUZ PYGMY RICE RAT.

[Pl. IV, figs. 5, 5a; Pl. V, figs. 2, 11; Pl. VI, figs. 8, 8a.]

Hesperomys fulvescens Saussure, Rev. et Mag. Zool., ser. 2, XII, p. 102, March, 1860.
Oryzomys fulvescens Allen and Chapman, Bull. Amer. Mus. Nat. Hist., IX, p. 204, June 16, 1897.

Type locality.—Orizaba,[1] Vera Cruz, Mexico.

[1] Type locality fixed by Merriam, Proc. Washington Acad. Sci., III, p. 295, July 26, 1901.

Type.—In Geneva Museum of Natural History.

Geographic distribution.—Southern Tamaulipas, Vera Cruz, eastern Oaxaca, Chiapas, and east through central Guatemala to eastern Honduras; altitudinal range from near sea level to about 5,500 feet; mainly Arid and Humid Lower Tropical Zones.

General characters.—Size small; molar tooth series short. Similar to *O. f. lenis* but upperparts darker ochraceous-buff, the general tone less yellowish; skull narrower and less massive. Size about as in *O. f. costaricensis*, but upperparts usually less tawny; molar series shorter.

Color.—Fresh pelage: Upperparts near ochraceous-buff, most intense and in some examples suffused with tawny on rump, palest and purest on cheeks, shoulders, and sides; the face, top of head, and back moderately darkened by blackish hairs; underparts varying from nearly pure white throughout in rare examples to warm buff on abdomen, inguinal area, and inner sides of hind limbs, the white appearing only on lips, chin, and inner sides of hind limbs; outer sides of ears blackish, inner sides clothed with ochraceous-buffy hairs; feet whitish; tail brownish above, yellowish below, except toward tip, which is dusky all around. *Young* (in first pelage): Darker than adults, the ochraceous-buff of upperparts restricted to narrow tips of hairs, thus permitting plumbeous basal color to show through and alter general tone.

Skull.—About like that of *O. f. costaricensis*, but molar tooth series shorter. Contrasted with *O. f. lenis*, the skull is narrower, with less widely spreading zygomata; maxillary arms of zygomata and ascending branches of premaxillæ less broad and heavy.

Measurements.—Average of 10 adults from Orizaba, Vera Cruz: Total length, 174.7 (168–205); tail vertebræ, 107.1 (96–118); hind foot, 22 (21–23). *Skull* (average of same): Greatest length, 21.9 (21.1–22.5); zygomatic breadth, 11.5 (11–11.7); interorbital breadth, 3.5 (3.4–3.9); width of braincase, 9.5 (9.3–9.8); nasals, 7.9 (7.6–8.3); anterior palatine foramina, 3.5 (3.3–3.6); palatal bridge, 3.7 (3.5–4); upper molar series, 2.9 (2.9–3).

Remarks.—The differential characters are rather slight, and *O. f. fulvescens* may safely be assumed to intergrade with *O. f. lenis* near the Pacific coast in the vicinity of the Isthmus of Tehuantepec, with *O. f. costaricensis* in eastern Honduras or western Nicaragua, and with the paler form inhabiting the Yucatan Peninsula, in southern Campeche. A single specimen from Patuca, Honduras, the only one available from that country, has a short molar series and seems referable to the subspecies *fulvescens*, the known range of which is thus materially extended eastward from western Guatemala.

Specimens examined.—Total number, 73, as follows:

Chiapas: Huehuetan, 4; Ocuilapa, 1; Tumbala, 11; Yajalon, 1.

Guatemala: Jacaltenango, 3; Nenton, 1.

Honduras: Patuca, 2.
Oaxaca: Santo Domingo (mountains near), 2; Tuxtepec, 1.
Tamaulipas: Alta Mira, 1.
Vera Cruz: Jalapa, 24;[1] Jico, 2; Mirador, 1; Orizaba (type locality by fixation), 17; Pasa Nueva, 1;[2] Santiago Tuxtla, 1.

ORYZOMYS FULVESCENS LENIS Goldman.

Los Reyes Pygmy Rice Rat.

(Pl. IV, figs. 6, 6a.)

Oryzomys fulvescens lenis Goldman, Proc. Biol. Soc. Washington, XXVIII, p. 130, June 29, 1915.

Type locality.—Los Reyes, Michoacan, Mexico.

Type.—No. 125941, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, February 14, 1903.

Geographic distribution.—Coastal plains and basal mountain slopes in Michoacan, Guerrero, and Oaxaca; altitudinal range from near sea level to about 3,000 feet, mainly in Arid Lower Tropical Zone.

General characters.—Similar to *O. f. fulvescens*, but upperparts paler ochraceous-buff, the general tone more yellowish; skull broader and more massive.

Color.—Fresh pelage: Upperparts between ochraceous-buff and light ochraceous-buff becoming warm buff on cheeks, shoulders, and lower part of sides; the face, top of head, and back sparingly lined with dark hairs; underparts, ears, feet, and tail as in *O. f. fulvescens*.

Skull.—Broader than that of *O. f. fulvescens;* zygomata more widely spreading; maxillary arms of zygomata and ascending branches of premaxillæ broader and heavier; dentition rather heavy, but equaled in some examples of *O. f. fulvescens*.

Measurements.—Type: Total length, 198; tail vertebræ, 115; hind foot, 23. Adult topotype: 188; 115; 23. Skull (type and adult topotype): Greatest length, 22.6, 21.8; zygomatic breadth, 12.3, 11.9; interorbital breadth, 3.4, 3.5; width of braincase, 10, 10.3; nasals, 8.6, 7.8; anterior palatine foramina, 3.9, 3.5; palatal bridge, 4.1, 3.7; upper molar series, 3, 3.

Remarks.—The general distribution area of *O. fulvescens* is divided north of the Isthmus of Tehuantepec by the high, interior plateau region, the western arm representing the range of *O. f. lenis*. Specimens from Guerrero and Oaxaca approach subspecies *fulvescens* in characters.

Specimens examined.—Total number, 4, as follows:

Guerrero: Ometepec (near), 1.
Michoacan: Los Reyes, 2 (type and topotypes).
Oaxaca: Pluma, 1.

[1] Sixteen in Amer. Mus. Nat. Hist.; 2 in Mus. Comp. Zool. [2] Collection Amer. Mus. Nat. Hist.

ORYZOMYS FULVESCENS MAYENSIS, SUBSP. NOV.

MAYA PYGMY RICE RAT.

Type locality.—Apazote (near Yohaltum), Campeche, Mexico (altitude 200 feet).

Type.—No. 107979, ♂ adult, United States National Museum (Biological Survey collection); collected by E. W. Nelson and E. A. Goldman, January 5, 1901. Original number 14405.

Geographic distribution.—Peninsula of Yucatan and Campeche; altitudinal range from near sea level to about 300 feet; Arid Lower Tropical Zone.

General characters.—Similar to *O. f. fulvescens*, but paler colored; skull slightly narrower.

Color.—Fresh pelage: Upperparts near ochraceous-buff shading toward light ochraceous-buff, darkest and rather sparingly lined with black over dorsum, becoming clearer and paler on cheeks, shoulders, and sides; underparts, ears, feet, and tail as in *O. f. fulvescens*.

Skull.—About like that of *O. f. fulvescens*, but zygomata and braincase slightly narrower.

Measurements.—Type: Total length, 177; tail vertebræ, 101, hind foot, 22. Average of three adult topotypes: 189 (184–196); 113 (108–119); 23 (22–24). *Skull* (average of three adults, type and two topotypes): Greatest length, 21.1 (20.4–21.8); zygomatic breadth, 11 (10.8–11.2); interorbital breadth, 3.6 (3.5–3.8); width of braincase, 9 (8.9–9.1); nasals, 8.1 (7.4–8.4); anterior palatine foramina, 3.3 (3.1–3.5); palatal bridge, 4 (3.6–4.4); upper molar series, 2.9 (2.9–3).

Remarks.—The pale color of this form seems to be due to the same environmental conditions that have been operative in the evolution of pallid races in other mammalian groups inhabiting Yucatan. In this region pale coloration is apparently associated with the arid climate and white limestone formation, outcropping or thinly overlaid with soil over large areas which have risen less than 300 feet above the level of the sea. At Chichen Itza the pygmy rice rat was taken in the vicinity of imposing Maya Indian ruins, a circumstance that suggested the subspecific name.

Specimens examined.—Total number, 7, as follows:

Campeche: Apazote, 4 (types and topotypes).
Yucatan: Chichen Itza, 1; Tunkas, 2.

ORYZOMYS FULVESCENS COSTARICENSIS ALLEN

COSTA RICAN PYGMY RICE RAT.

Oryzomys costaricensis Allen, Bull. Amer. Mus. Nat. Hist., V, p. 239, September 22, 1893.

Oryzomys (*Oligoryzomys*) *nicaraguæ* Allen, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 100, April 30, 1910. Type from Vijagua, Nicaragua, No. 29543, ♂ ad., Amer. Mus. Nat. Hist.; collected by W. B. Richardson, March 24, 1909.

Type locality.—El General, Costa Rica (altitude, 2,150 feet).

Type.—No. $\frac{8581}{7923}$, ♀ subadult, American Museum of Natural History, collected by H. Pittier, February, 1891.

Geographic distribution.—Southwestern Panama east to Canal Zone, Costa Rica, and north to northern Nicaragua; altitudinal range from near sea level to at least 2,000 feet.

General characters.—Similar to *O. f. fulvescens*, but upperparts usually more tawny; molars larger. Also similar to *O. f. vegetus*, but smaller and averaging paler.

Color.—About as in *O. f. fulvescens*, but upperparts usually more distinctly tawny.

Skull.—Closely resembling that of *O. f. fulvescens*, but molars larger, the toothrows decidedly longer. General size smaller than that of *O. f. vegetus*; molars about the same.

Measurements.—Two adults from Buenos Aires, Costa Rica: Total length, 183, 190; tail vertebræ, 100, 108; hind foot, 20, 23. *Skull* (same): Greatest length, 21.1, 21.5; zygomatic breadth, 11.4, 11.4; interorbital breadth, 3.7, 3.7; width of braincase, 9.9, 9.6; nasals, 8.2, 8; anterior palatine foramina, 3.6, 3.7; palatal bridge, 4, 4.2; upper molar series, 3.2, 3.2.

Remarks.—The general dimensions of *O. f. costaricensis* are about the same as those of *O. f. fulvescens*; the color difference is slight but the upperparts are usually more distinctly tawny. The most distinctive feature seems to be the larger molars and resulting elongation of the toothrows, a character shared with the larger and darker form *O. f. vegetus*. "*O. nicaraguæ*" was based on scanty material from Nicaragua which is not satisfactorily separable from *costaricensis*. The type, apparently full grown but with molars rather slightly worn, is not so tawny as most examples of *costaricensis*, but this color element is usually less distinct in younger individuals. The toothrows are long, as in *costaricensis*.

Specimens examined.—Total number, 19, as follows:

Costa Rica: Boruca, 7;[1] Buenos Aires, 2;[2] Cerro de Buena Vista, 1;[2] El General, 3 (type and topotypes);[2] La Carpintera, 1.[2]
Nicaragua: San Rafael del Norte, 1;[2] Vijagua, 1 (type of "*nicaraguæ*").[2]
Panama: La Chorrera, 1;[2] Old Panama, 2.[2]

ORYZOMYS FULVESCENS VEGETUS Bangs.

Volcan Chiriqui Pygmy Rice Rat.

Oryzomys (*Oligoryzomys*) *vegetus* Bangs, Bull. Mus. Comp. Zool., XXXIX, text fig. 15, p. 35, April, 1902.

Type locality.—Boquete, Volcan de Chiriqui, Panama (altitude, 4,000 feet).

[1] Six in Amer. Mus. Nat. Hist.; 1 in Field Mus. Nat. Hist. [2] Collection Amer. Mus. Nat. Hist.

Type.—No. 10298, ♀ old adult, Museum of Comparative Zoology (Bangs collection); collected by W. W. Brown, jr., April 16, 1901.

Geographic distribution.—Known only from the vicinity of type locality; Upper Tropical Zone.

General characters.—Size larger and color usually darker than in *O. f. costaricensis;* skull larger, but molar teeth relatively small.

Color.—About as in *O. f. fulvescens* and *O. f. costaricensis,* but general tone averaging darker than either, the tawny element in upperparts distinct as in *costaricensis;* abdomen varying in the darkest examples to a shade darker than light ochraceous-buff of Ridgway.

Skull.—Decidedly larger than that of *O. f. costaricensis,* with molar teeth actually about the same size, therefore relatively smaller.

Measurements.—Type: Total length, 210; tail vertebræ, 120; hind foot, 25. Average of six adult topotypes: 216 (205–235); 122 (115–130); 24.2 (24–25). *Skull* (average of 5 adults—type and 4 topotypes): Greatest length, 23.6 (22.7–24.3); zygomatic breadth, 12.3 (11.9–12.8); interorbital breadth, 3.8 (3.7–4.2); width of braincase, 10.3 (10–10.5); nasals, 8.7 (8.3–9.3); anterior palatine foramina, 3.6 (3.4–3.9); palatal bridge, 3.9 (3.8–4.3); upper molar series, 3.1 (3.1–3.1).

Remarks.—Larger average size and tendency toward darker coloration usually distinguish *O. f. vegetus* from the more northern forms of the group, but there seems to be no sharp line of demarcation between it and *O. f. costaricensis.* Both share the heavier dentition as compared with *O. f. fulvescens.* Four specimens in the topotype series were referred by Bangs to *costaricensis.* They are the paler examples and in color apparently do not differ from *costaricensis,* but the larger size of the skulls indicates that they belong with the remainder of the series of *vegetus.*

Specimens examined.—Twenty-two,[1] from type locality.

Subgenus MELANOMYS Thomas.

Melanomys Thomas, Ann. Mag. Nat. Hist., ser. 7, X, p. 248, Sept., 1902; Novitates Zool., X, no. 1, p. 41, Apr. 20, 1903 (subgenus). Type *Oryzomys phæopus* Thomas.

Melanomys Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 533, Nov. 17, 1913 (genus).

Geographic distribution.—Andean region of northwestern South America from southern Ecuador to northern Colombia, and northwestward through Panama and Costa Rica to northern Nicaragua; altitudinal range from near sea level to about 8,000 feet; mainly in Upper and Lower Tropical Zones.

Subgeneric characters.—Color very dark, upperparts and underparts not strongly contrasted; form robust; tail about three-fourths length of head and body, black all around; feet (epidermis and hair) blackish to base of claws, which are light horn color; hind feet broad, stout, the digital bristles not projecting beyond ends of claws.

[1] Fifteen in Mus. Comp. Zool.; 7 in Field Mus. Nat. Hist.

Skull rotund; rostrum short, nearly straight; braincase large and inflated; frontals broad, the lateral margins projecting as supraorbital shelves; zygomata slender, but maxillary root decidedly expanded above along frontal and premaxillary sutures; antorbital foramen rather narrow above, but little compressed and opening widely below, the outer wall projecting slightly forward as viewed from above; lachrymal articulating mainly with maxilla; mastoid process of squamosal short and broad owing to slight excision of squamosal border. Molars slightly hypsodont; parastyle and protocone of first upper molar with oblique commissures; secondary parastyle rudimentary or fused with main element; incisors thin and weak, the upper ones descending about perpendicularly from premaxillæ, the points not decidedly curved backward.

Remarks.—This group of dark-colored forms, segregated by Thomas under the name *Melanomys* as a subgenus of *Oryzomys*, was elevated to generic rank by Allen in 1913. In general characters, and especially dentition, however, it approaches typical *Oryzomys* so closely that subgeneric recognition seems better to express the relationship. The most notable dental differences appear to be shown in the rather high molar crowns, comparatively straight, thin upper incisors, and the tendency toward suppression of the secondary parastyle normally present in typical *Oryzomys*. The secondary parastyle is normally fused with the parastyle, which is correspondingly enlarged. Among the more important cranial details are the expansion of the maxillary root of the zygoma over the antorbital foramen and the resulting alteration in the position of the lachrymal as compared with typical *Oryzomys*. The lachrymal in *Melanomys* articulates almost entirely with the maxilla, its position being anterior to the fronto-maxillary suture, while in typical *Oryzomys* it bridges this suture and about evenly overlaps the maxilla and frontal.

The subgenus *Melanomys* differs so strikingly from the subgenus *Oligoryzomys* in appearance that no close comparison is necessary, although most of the characters of the latter are found in varying combinations in the subgenus *Oryzomys*.

ORYZOMYS CALIGINOSUS (Tomes).

Hesperomys caliginosus Tomes, Proc. Zool. Soc. London, 1860, p. 263. Type from coast of Ecuador, probably Esmeraldas.[1] Type No. 7.1.1.128, British Museum; collected by Louis Fraser.

Akodon caliginosus Allen, Bull. Amer. Mus. Nat. Hist., XIV, p. 45, Jan. 31, 1901.

Hesperomys (Melanomys) caliginosus Thomas, Ann. Mag. Nat. Hist. ser. 8, XI, p. 406, Apr. 1913.

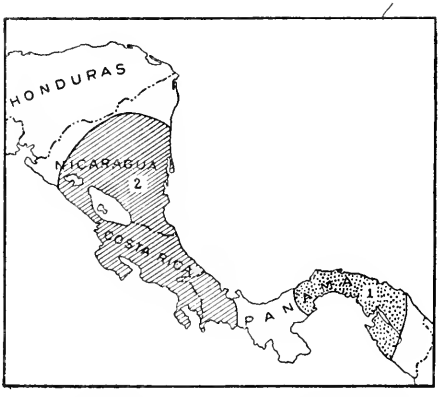
Melanomys caliginosus caliginosus [et al. subsp.] Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 537, Nov. 17, 1913.

[1] See Allen (op. cit., pp. 533-554, 1913) for locality and revision of group regarded as generically distinct.

Geographic distribution.—(See under subgenus *Melanomys*) (fig. 11).

General characters.—(See subgeneric characters under subgenus *Melanomys*.)

Color.—Fresh pelage: Upperparts varying from tawny to russet, abundantly but finely mixed with black, the black tending to become predominant especially on rump; underparts overlaid with varying shades from dark ochraceous-tawny to cinnamon brown, the dark plumbeous basal color showing through; vibrissæ black, scarcely reaching posteriorly to ears; ears, feet, and tail thinly clothed with short hairs, the hairs and epidermis blackish. *Young* (in first pelage): Similar to adults, but upperparts usually more distinctly blackish, and underparts less heavily overlaid with ochraceous-tawny or cinnamon brown.



1. *O. c. idoneus.* | 2. *O. c. chrysomelas.*

FIG. 11.—Geographic distribution of subspecies of *Oryzomys caliginosus* (exclusive of South American forms).

Skull.—(See subgeneric characters under subgenus *Melanomys*.)

Remarks.—In a revision of the "*Melanomys*" group, Allen[1] assigns the component parts to several specific types on the basis of characters which seem comparatively unimportant; the slight departures exhibited either in color or cranial details, in examples from widely separated regions, point to the probable inclusion of most, if not all, of the forms in the species *O. caliginosus*. Two subspecies range within the limits of the region under review.

Key to Subspecies of O. caliginosus (Exclusive of South America).

a^1. Upperparts tending toward tawny; frontal region narrower. (Eastern Panama.) **O. c. idoneus** (p. 96).

a^2. Upperparts tending toward russet; frontal region broader. (Western Panama; Costa Rica; Nicaragua.)..... **O. c. chrysomelas** (p. 97).

ORYZOMYS CALIGINOSUS IDONEUS Goldman

CERRO AZUL DUSKY RICE RAT.

(Pl. IV, figs. 7, 7a; Pl. V, figs. 3, 12; Pl. VI, figs. 9, 9a.)

Oryzomys idoneus Goldman, Smiths. Misc. Coll., LVI, No. 36, p. 5, January 19, 1912.
Melanomys idoneus Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 548, November 17, 1913.

Type locality.—Cerro Azul, near headwaters of Chagres River, Panama (altitude, 2,500 feet).

Type.—No. 171106, ♀ adult, United States National Museum (Biological Survey collection); collected by E. A. Goldman, March 26, 1911.

[1] See Allen (op.cit., pp. 533–554, 1913) for locality and revision of group regarded as generically distinct.

Geographic distribution.—Heavily forested mountain slopes in eastern Panama; known altitudinal range from 1,800 to 2,800 feet; Humid Lower Tropical Zone.

General characters.—Similar to *O. c. caliginosus*, of Ecuador, but upperparts paler, more tawny, instead of russet in color. Closely resembling *O. c. chrysomelas*, but color paler; skull narrower between orbits.

Color.—Fresh pelage: Upperparts near tawny (becoming most intense in worn pelage), heavily and finely mixed with black, the mixture usually uniform, but black predominating on rump in some examples; underparts, including inner sides of limbs, dark ochraceous-tawny; inner sides of ankles black; ears, feet, and tail thinly clothed with short hairs, the hairs and epidermis blackish. *Young* (in first pelage): Upperparts usually more distinctly blackish than adults, the tawny element restricted to narrower tips of hairs.

Skull.—Similar to that of *O. c. caliginosus*, but frontal region narrower; molars slightly larger, the toothrows longer; anterior palatine foramina usually shorter. Closely resembling that of *O. c. chrysomelas*, but frontal region more constricted, the supraorbital borders less projecting laterally.

Measurements.—Type: Total length, 218; tail vertebræ, 88; hind foot, 30. Average of 10 adults from Cana, Panama: 217.9 (196–240); 93.3 (85–105); 26.7 (26–27.5). *Skull* (average of same): Greatest length, 30.1 (28.6–30.3); zygomatic breadth, 16.2 (15.1–16.7); interorbital breadth, 6.3 (5.9–6.5); width of braincase, 11.8 (11.2–12.3); nasals, 11.4 (10.7–12.6); anterior palatine foramina, 4.6 (4.4–5); palatal bridge, 6.1 (5.4–6.8); upper molar series, 4.7 (4.4–5).

Remarks.—While *O. c. idoneus* differs from typical *O. c. caliginosus* very appreciably in color, close relationship is evidenced in cranial characters, some skulls being scarcely distinguishable. In color it closely approaches *O. c. columbianus*, of the Santa Marta region of Colombia, but is slightly darker; the tail is usually shorter. In cranial characters similarity to *columbianus* is also shown, but the ascending branches of the premaxillæ are narrower posteriorly, the ends externally beveled in outline along the interdigitating fronto-premaxillary line of contact.

Specimens examined.—Total number, 47, as follows:

Panama: Cana, 46; Cerro Azul, 1 (type).

ORYZOMYS CALIGINOSUS CHRYSOMELAS (Allen).

Costa Rican Dusky Rice Rat.

(Pl. IV, figs. 8, 8a.)

Hesperomys (Habrothrix) caliginosus Allen, Bull. Amer. Mus. Nat. Hist., III, p. 210, Apr. 17, 1891 (Costa Rica).

Oryzomys chrysomelas Allen, Bull. Amer. Mus. Nat. Hist., IX, p. 37, Mar. 11, 1897.

Oryzomys (Melanomys) chrysomelas Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 654, Oct. 13, 1908 (Nicaragua).

Zygodontomys chrysomelas Bangs, Bull. Mus. Comp. Zool., XXXIX, p. 37, April, 1902 (Panama).

Melanomys chrysomelas Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 547, Nov. 17, 1913.

Zogodontomys (sic) chrysomelas Allen, Bull. Amer. Mus. Nat. Hist., XXXII, p. 547, Nov. 17, 1913.

Type locality.—Suerre, Costa Rica (altitude probably between 3,000 and 4,000 feet).

Type.—No. $\frac{10707}{9076}$, ♂ adult, American Museum of Natural History; collected by Anastasio Alfaro, July 16, 1895.

Geographic distribution.—Western Panama, Costa Rica, and north to northern Nicaragua; altitudinal range from near sea level to about 3,000 feet, mainly in Humid Lower Tropical Zone.

General characters.—Most closely allied to *O. c. idoneus*, but slightly darker in color; skull broader between orbits.

Color.—About as in *O. c. idoneus*, but rufescent element in upperparts darker and inclining toward the russet tone of the paler species of *O. c. caliginosus*.

Skull.—Similar to that of *O. c. idoneus*, but frontal region less constricted, the supraorbital borders more projecting laterally.

Measurements.—Average of five adults from Escondido River (45 miles from Bluefields), Nicaragua: Total length, 210 (202–217); tail vertebræ, 89 (87–90); hind foot, 25.9 (25–27). *Skull* (average of four adults from same locality): Greatest length, 29.1 (28.2–29.5); zygomatic breadth, 15.9 (15.8–16.1); interorbital breadth, 6.6 (6.3–6.8); width of braincase, 11.8 (11.4–12.2); nasals, 10.9 (10.1–11.5); anterior palatine foramina, 4.9 (4.8–5.1); palatal bridge, 5.6 (5.3–5.8); upper molar series, 4.5 (4.3–4.7).

Remarks.—The range of *O. c. chrysomelas* marks the northern limit of the species in Central America. The Costa Rican subspecies is most closely allied to its near geographic neighbor in eastern Panama, although in color the darker specimens approach some of the paler examples of *O. c. caliginosus* and other South American forms.

Specimens examined.—Total number, 61, as follows:

Costa Rica: Pacuare, 5; Port Limon, 1; San Carlos, 1;[1] Suerre, 5 (type and topotypes);[2] Talamanca (probably near Sipurio), 4.

Nicaragua: Chontales, 3;[1] Escondido River (45–50 miles from Bluefields), 14; Greytown, 1; Savala, 2;[1] Pena Blanca, 3;[1] Rio Coco, 3;[1] Rio Grande, 1;[1] Rio Tuma 5;[1] Tuma, 6:[1] Vijagua, 6.[1]

Panama: Mosca, 1.

Plate I.

[All subgenus *Oryzomys*. Natural size; all in U. S. Nat. Mus., Biological Survey collection, except figs. 2, 2*a*.]

Figs. 1, 1*a*. *Oryzomys palustris palustris* (Harlan). Georgetown, South Carolina. ♂ adult. (No. 71367.)

2, 2*a*. *Oryzomys palustris coloratus* Bangs. Type. Cape Sable, Florida. ♂ adult. (No. 4470, Mus. Comp. Zool.)

3, 3*a*. *Oryzomys couesi couesi* (Alston). Yaruca, Honduras. ♂ adult. (No. 131814.)

4, 4*a*. *Oryzomys couesi rogillus* Goldman. Type. Los Reyes, Michoacan. ♂ adult. (No. 125945.)

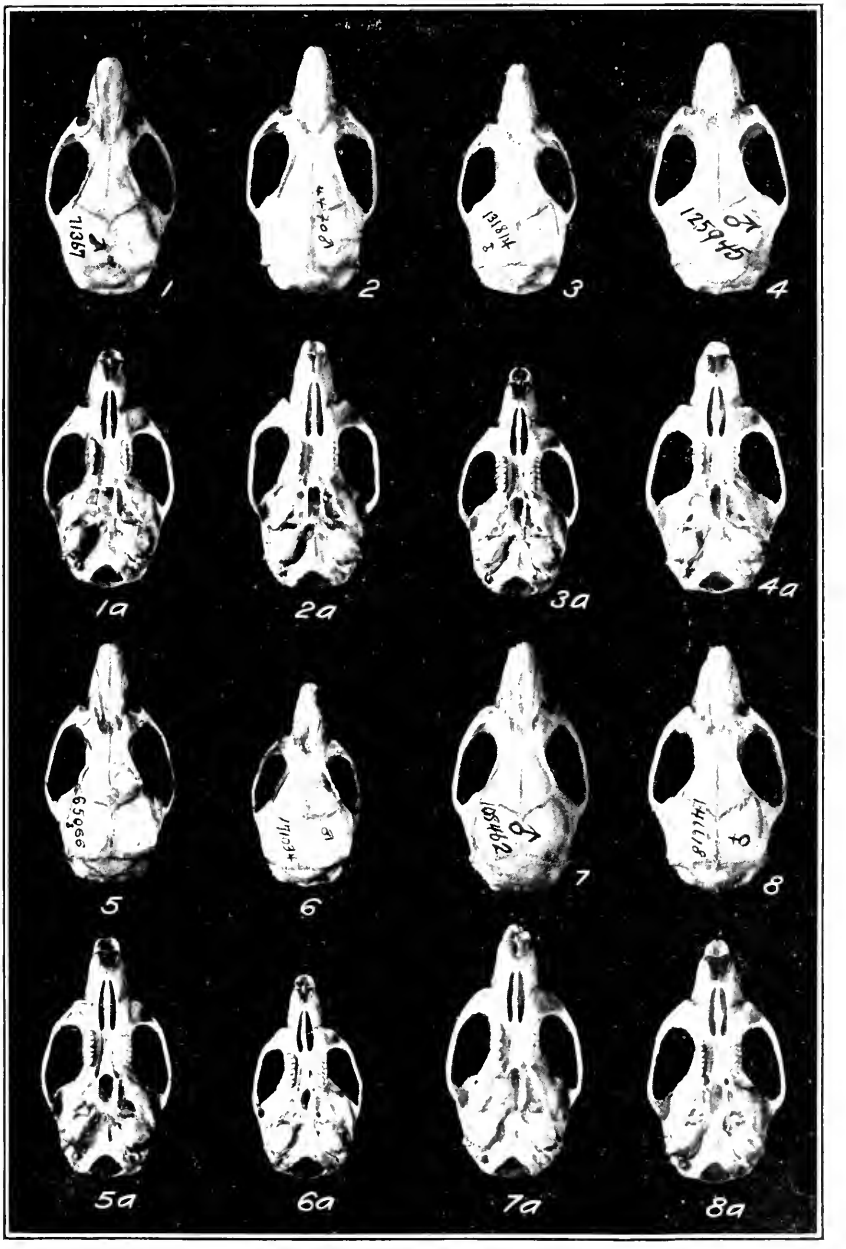
5, 5*a*. *Oryzomys couesi aquaticus* Allen. Topotype. Brownsville, Texas. ♂ adult. (No. 65066.)

6, 6*a*. *Oryzomys gatunensis* Goldman. Type. Gatun, Canal Zone. ♂ young. (No. 171034.)

7, 7*a*. *Oryzomys cozumelæ* Merriam. Type. Cozumel Island, Mexico. ♂ adult. (No. 108462.)

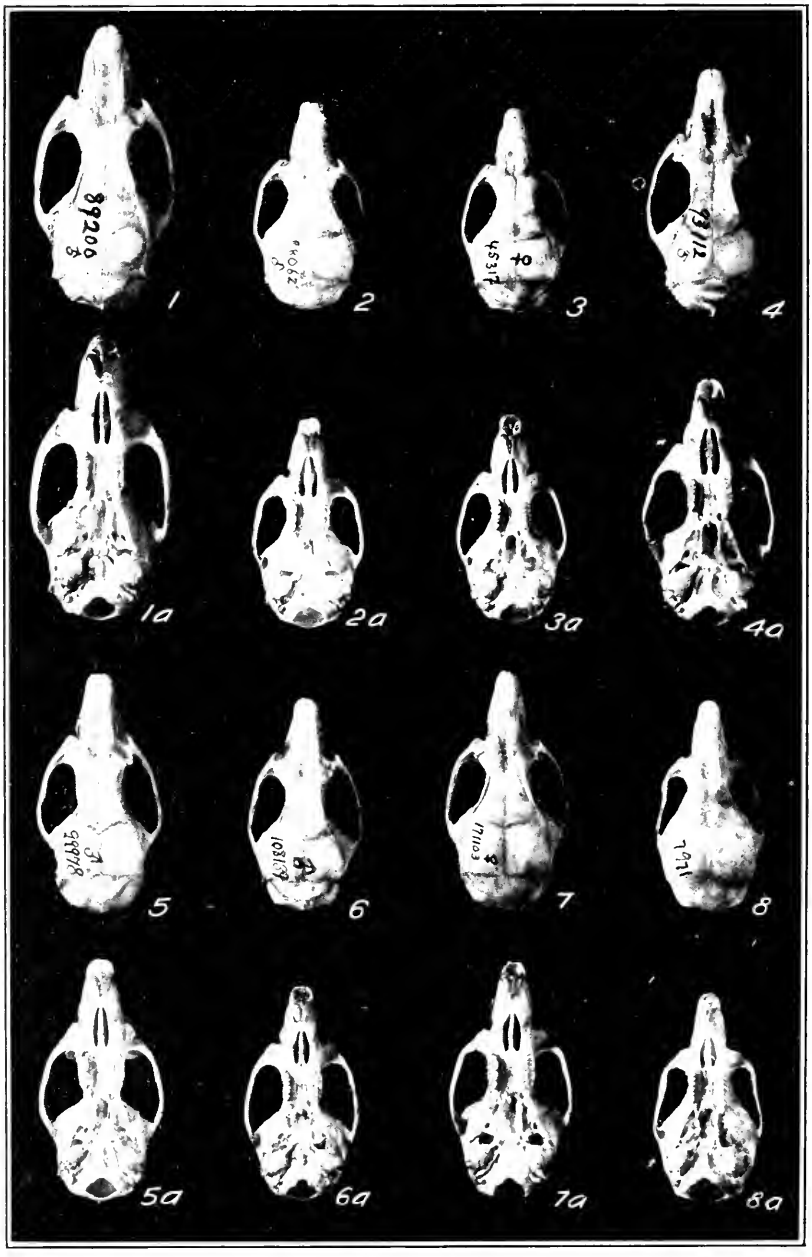
8, 8*a*. *Oryzomys peninsulæ* Thomas. San Jose del Cabo, Lower California. ♀ adult. (No. 146618.)

[1] Collection Amer. Mus. Nat. Hist.
[2] Four (including type) in Amer. Mus. Nat. Hist.; 1 in Field Mus. Nat. Hist.



SKULLS OF ORYZOMYS.

1, 1a. O. p. palustris.
2, 2a. O. p. coloratus.
3, 3a. O. c. couesi.
4, 4a. O. c. regillus.
5, 5a. O. c. aquaticus.
6, 6a. O. gatunensis.
7, 7a. O. cozumelæ.
8, 8a. O. peninsulæ.



SKULLS OF ORYZOMYS.

1, 1a. O. nelsoni.
2, 2a. O. m. melanotis.
3, 3a. O. m. colimensis.
4, 4a. O. r. rostratus.
5, 5a. O. r. megadon.
6, 6a. O. r. yucatanensis.
7, 7a. O. b. bombycinus.
8, 8a. O. b. alleni.

Plate II.

[All subgenus *Oryzomys* Natural size; all in U. S. Nat. Mus., Biological Survey collection, except figs. 8, 8*a*.]

Figs. 1, 1*a*. *Oryzomys nelsoni* Merriam. Type. Maria Madre Island, Mexico. ♂ adult. (No. 89200.)

2, 2*a*. *Oryzomys melanotis melanotis* Thomas. Topotype. San Sebastian, Jalisco. ♂ adult. (No. 88062.)

3, 3*a*. *Oryzomys melanotis colimensis*, subsp. nov. Type. Armeria, Colima. ♀ adult. (No. $\frac{3\,3\,2\,8\,9}{4\,5\,3\,1\,7}$.)

4, 4*a*. *Oryzomys rostratus rostratus* Merriam. Type. Metlatloyuca, Puebla. ♀ adult. (No. 93112.)

5, 5*a*. *Oryzomys rostratus megadon* Merriam. Type. Teapa, Tabasco. ♂ adult. (No. 99978.)

6, 6*a*. *Oryzomys rostratus yucatanensis* Merriam. Type. Chichen Itza, Yucatan. ♂ adult. (No. 108139.)

7, 7*a*. *Oryzomys bombycinus bombycinus* Goldman. Topotype. Cerro Azul, Panama. ♀ adult. (No. 171103.)

8, 8*a*. *Oryzomys bombycinus alleni* Goldman. Type. Tuis, Costa Rica. ♂ subadult. (No. $\frac{9\,6\,3\,3\,1}{7\,5\,7\,1}$, Amer. Mus. Nat. Hist.)

Plate III.

[All subgenus *Oryzomys*. Natural size; all in U. S. Nat. Mus., Biological Survey collection.

Figs. 1, 1*a*. *Oryzomys alfaroi alfaroi* (Allen). Yaruca, Honduras. ♀ adult. (No. 131817.)

2, 2*a*. *Oryzomys alfaroi dariensis* Goldman. Type. Cana, Panama. ♀ adult. (No. 178660.)

3, 3*a*. *Oryzomys alfaroi rhabdops* Merriam. Type. Calel, Guatemala. ♂ adult. (No. 76813.)

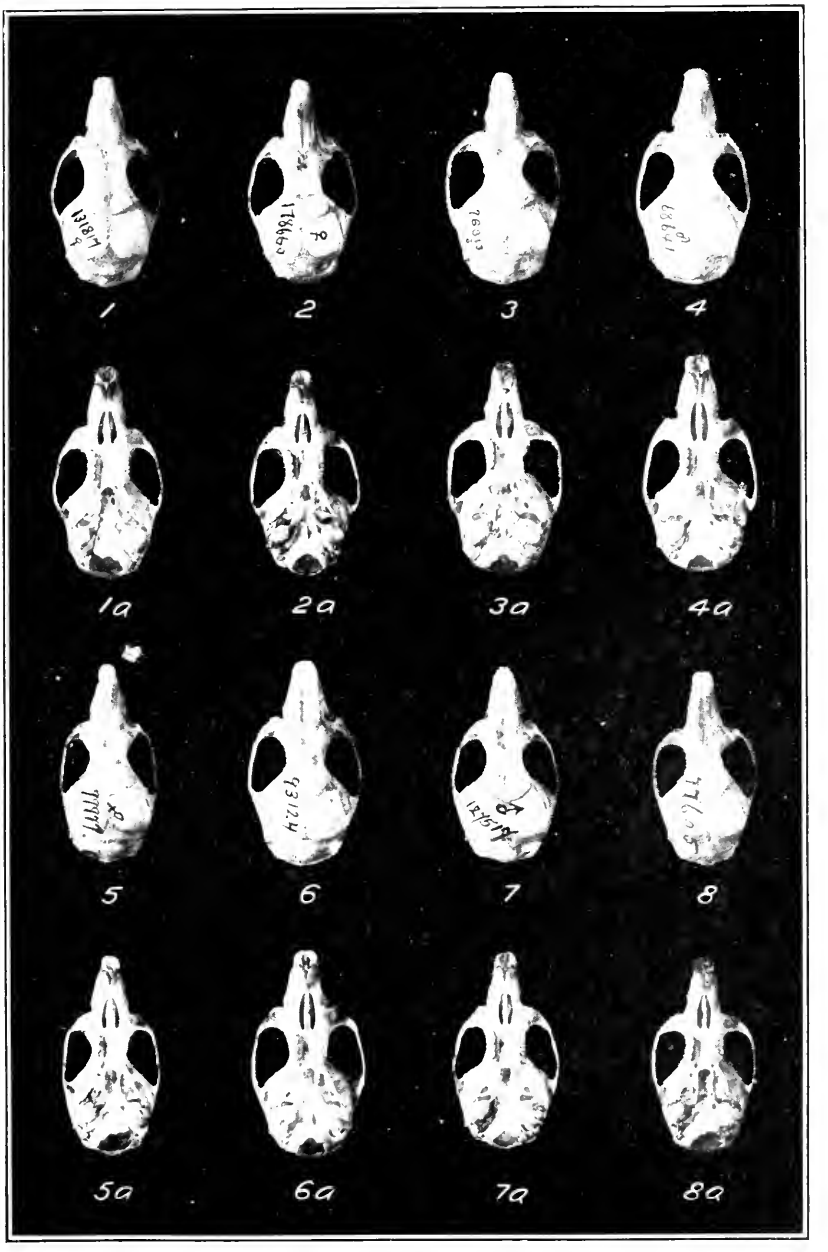
4, 4*a*. *Oryzomys alfaroi caudatus* Merriam. Type. Comaltepec, Oaxaca. ♂ adult. (No. 68641.)

5, 5*a*. *Oryzomys alfaroi palatinus* Merriam. Type. Teapa, Tabasco. ♀ adult. (No. 99977.)

6, 6*a*. *Oryzomys alfaroi dilutior* Merriam. Type. Huauchinango, Puebla. ♂ adult. (No. 93124.)

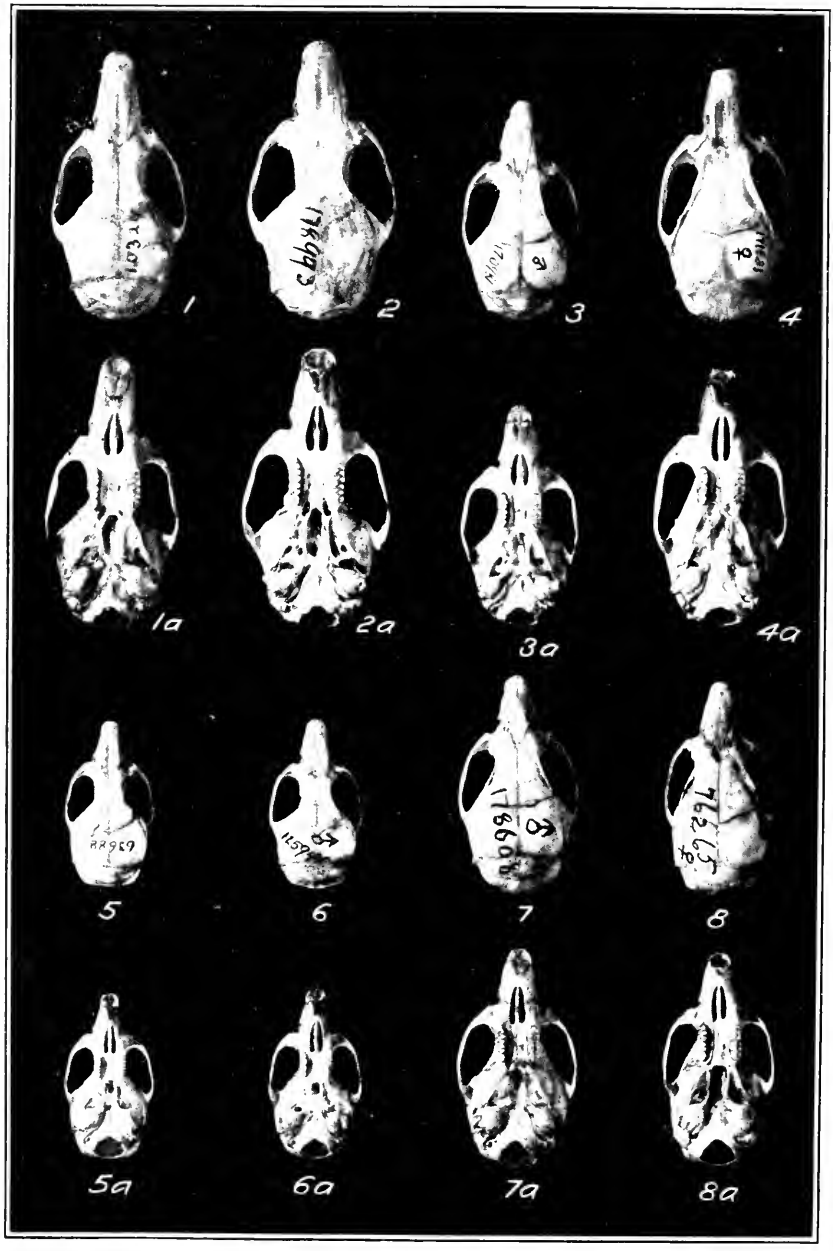
7, 7*a*. *Oryzomys guerrerensis* Goldman. Type. Omilteme, Guerrero. ♂ adult. (No. 127517.)

8, 8*a*. *Oryzomys hylocetes* Merriam. Type. Chicharras, Chiapas. ♂ adult. (No. 77605.)



SKULLS OF ORYZOMYS.

1, 1a. O. a. alfaroi.
2, 2a. O. a. dariensis.
3, 3a. O. a. rhabdops.
4, 4a. O. a. caudatus.
5, 5a. O. a. palatinus.
6, 6a. O. a. dilutior.
7, 7a. O. guerrerensis.
8, 8a. O. hylocetes.



SKULLS OF ORYZOMYS.

1, 1a. O. devius.
2, 2a. O. pirrensis.
3, 3a. O. talamancæ.
4, 4a. O. t. frontalis.
5, 5a. O. f. fulvescens.
6, 6a. O. f. lenis.
7, 7a. O. c. idoneus.
8, 8a. O. c. chrysomelas.

PLATE IV.

[Natural size; all in U. S. Nat Mus., Biological Survey collection, except figs. 1, 1*a*.]

FIGS. 1, 1*a*. *Oryzomys* (*Oryzomys*) *devius* Bangs. Type. Boquete, Panama. ♀ adult. (No. 10324, Mus. Comp. Zool.)

2, 2*a*. *Oryzomys* (*Oryzomys*) *pirrensis* Goldman. Type. Mount Pirre, Panama. ♂ adult. (No. 178993.)

3, 3*a*. *Oryzomys* (*Oryzomys*) *talamancæ* Allen. Gatun, Canal Zone. ♂ adult. (No. 170981.)

4, 4*a*. *Oryzomys* (*Oryzomys*) *tectus frontalis* Goldman. Type. Corozal, Canal Zone. ♀ adult. (No. 171531.)

5, 5*a*. *Oryzomys* (*Oligoryzomys*) *fulvescens fulvescens* (Saussure). Orizaba, Vera Cruz. ♂ adult. (No. 63688.)

6, 6*a*. *Oryzomys* (*Oligoryzomys*) *fulvescens lenis* Goldman. Type. Los Reyes, Michoacan. (No. 125941.)

7, 7*a*. *Oryzomys* (*Oligoryzomys*) *caliginosus idoneus* Goldman. Cana, Panama. ♂ adult. (No. 178608.)

8, 8*a*. *Oryzomys* (*Oligoryzomys*) *caliginosus chrysomelas* (Allen). Port Limon, Costa Rica. ♂ adult. (No. 76265.)

PLATE V.

[Natural size; all in U. S. Nat. Mus., Biological Survey collection.]

FIG. 1. *Oryzomys* (*Oryzomys*) *palustris palustris* (Harlan). Georgetown, South Carolina. ♂ adult. (No. 71367.)

2. *Oryzomys* (*Oligoryzomys*) *fulvescens fulvescens* (Saussure). Orizaba, Vera Cruz. ♂ adult. (No. 58248.)

3. *Oryzomys* (*Melanomys*) *caliginosus idoneus* Goldman. Cana, Panama. ♂ adult. (No. 178663.)

4. *Oryzomys* (*Oryzomys*) *palustris palustris* (Harlan). Greenwich, New Jersey. ♂ adult. (No. 117384.)

5. *Oryzomys* (*Oryzomys*) *melanotis melanotis* Thomas. San Sebastian, Jalisco. ♂ adult. (No. 88061.)

6. *Oryzomys* (*Oryzomys*) *alfaroi dariensis* Goldman. Cana, Panama. ♂ adult. (No. 178657.)

7. *Oryzomys* (*Oryzomys*) *talamancæ* Allen. Gatun, Canal Zone. ♀ adult. (No. 170979.)

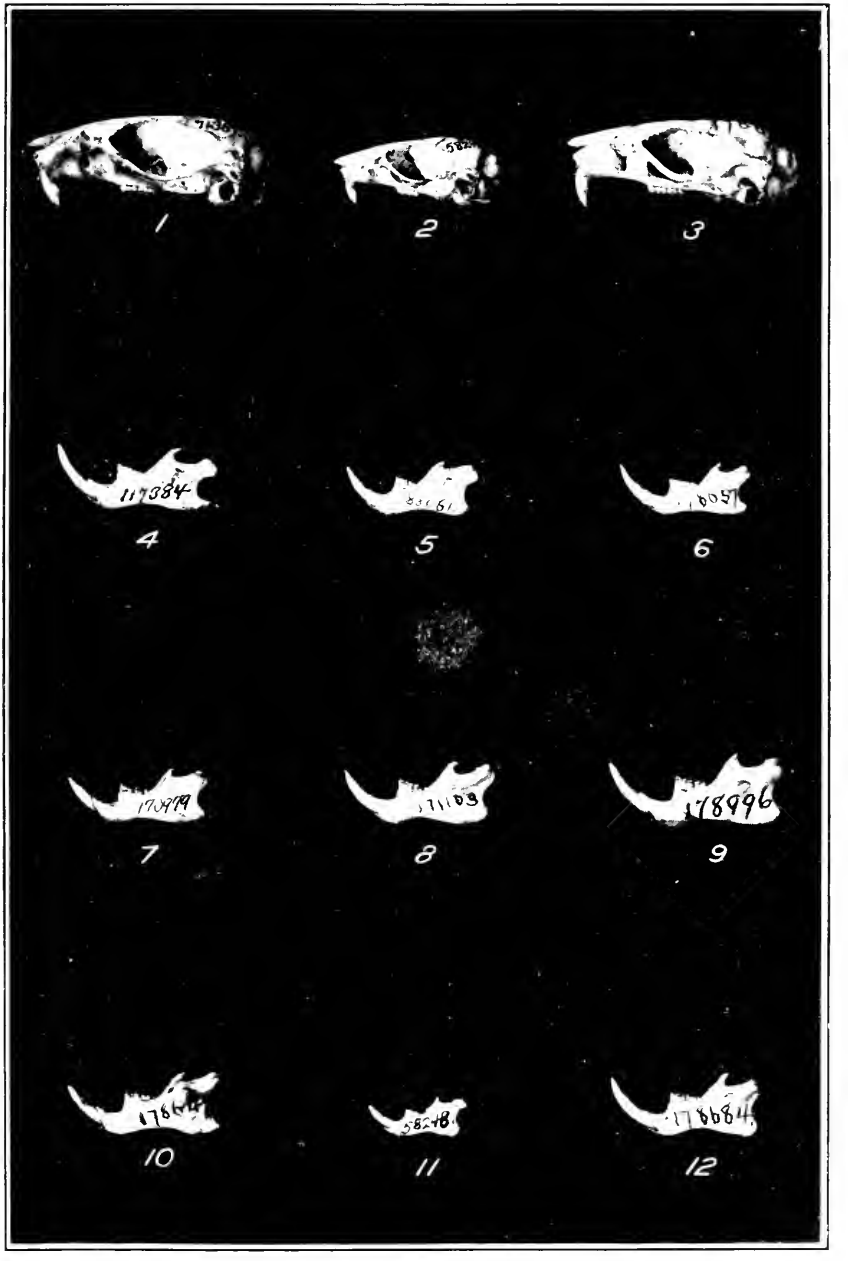
8. *Oryzomys* (*Oryzomys*) *bombycinus bombycinus* Goldman. Cerro Azul, Panama ♀ adult. (No. 171103.)

9. *Oryzomys* (*Oryzomys*) *pirrensis* Goldman. Mount Pirre, Panama. ♂ adult. (No. 178996.)

10. *Oryzomys* (*Oryzomys*) *tectus frontalis* Goldman. Cana, Panama. ♂ adult. (No. 178649.)

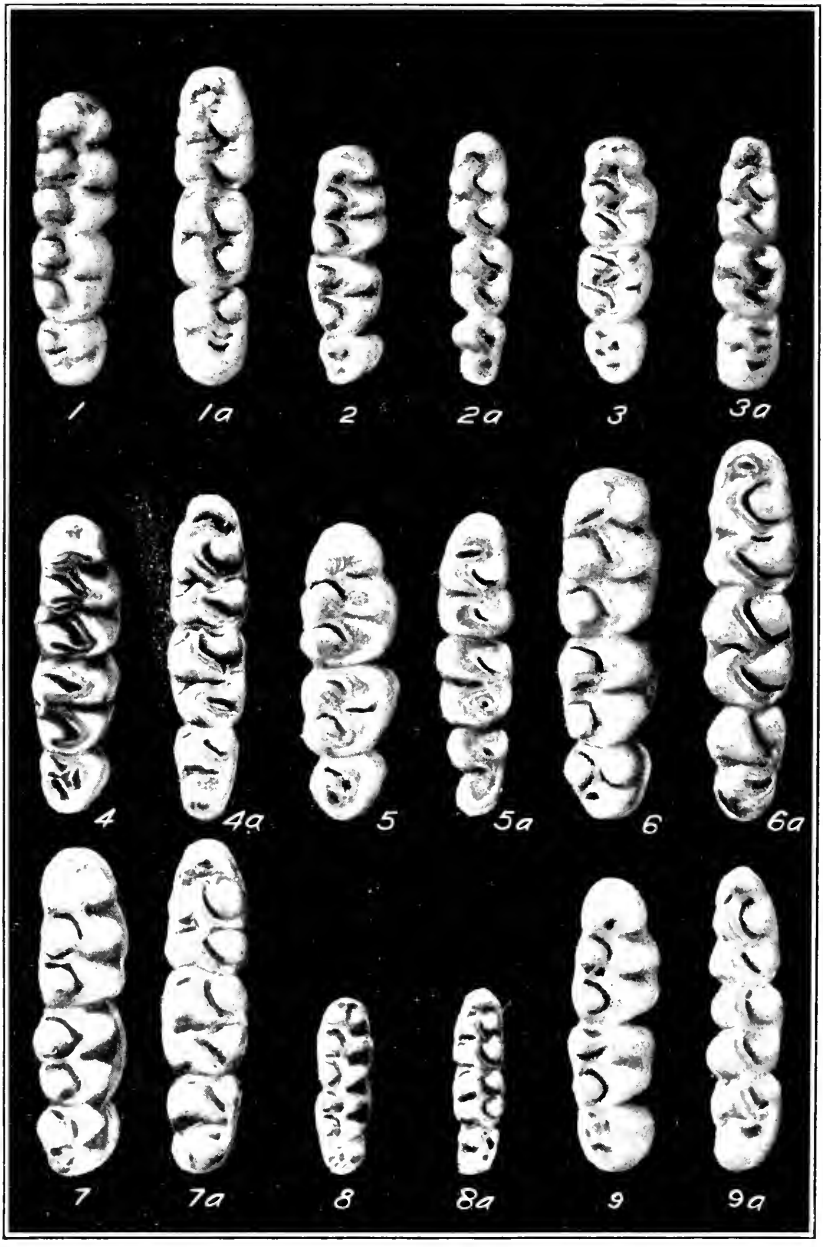
11. *Oryzomys* (*Oligoryzomys*) *fulvescens fulvescens* (Saussure). Orizaba, Vera Cruz. ♂ adult. (No. 58248.)

12. *Oryzomys* (*Melanomys*) *caliginosus idoneus* Goldman. Cana, Panama. ♂ adult. (No. 178684.)



SKULLS AND MANDIBLES OF ORYZOMYS.

1, 4. O. p. palustris.
2, 11. O. f. fulvescens.
3, 12. O. c. idoneus.
5. O. m. melanotis.
6. O. a. dariensis.
7. O. talamancæ.
8. O. b. bombycinus.
9. O. pirrensis.
10. O. t. frontalis.



MOLARS OF ORYZOMYS.

1, 1a. O. p. palustris.
2, 2a. O. m. melanotis.
3, 3a. O. a. dariensis.
4, 4a. O. talamancæ
5, 5a. O. b. bombycinus.
6, 6a. O. pirrensis.
7, 7a. O. t. frontalis.
8, 8a. O. f. fulvescens.
9, 9a. O. c. idoneus.

PLATE VI.

Slightly retouched and enlarged about eight diameters; all in U. S. Nat. Mus., Biological Survey collection.]

FIGS. 1, 1*a*. *Oryzomys* (*Oryzomys*) *palustris palustris* (Harlan). Dismal Swamp, Virginia. ♂ subadult. (No. 75203.)

2, 2*a*. *Oryzomys* (*Oryzomys*) *melanotis melanotis* Thomas. Ixtapa, Jalisco. ♂ subadult. (No. 88068.)

3, 3*a*. *Oryzomys* (*Oryzomys*) *alfaroi dariensis* Goldman. Cana, Panama. ♂ subadult. (No. 178653.)

4, 4*a*. *Oryzomys* (*Oryzomys*) *talamanca* Allen. Cana, Panama. ♀ subadult. (No. 179601.)

5, 5*a*. *Oryzomys* (*Oryzomys*) *bombycinus bombycinus* Goldman. Cerro Azul, Panama. ♀ adult. (No. 171103.)

6, 6*a*. *Oryzomys* (*Oryzomys*) *pirrensis* Goldman. Mount Pirre, Panama. ♀ subadult. (No. 179030.)

7, 7*a*. *Oryzomys* (*Oryzomys*) *tectus frontalis* Goldman. Cana, Panama. ♀ subadult. (No. 178646.)

8, 8*a*. *Oryzomys* (*Oligoryzomys*) *fulvescens fulvescens* (Saussure). Orizaba, Vera Cruz. ♂ subadult. (No. 58244.)

9, 9*a*. *Oryzomys* (*Melanomys*) *caliginosus idoneus* Goldman. Cana, Panama. ♀ subadult. (No. 178668.)

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[New names in **bold-faced type;** synonyms in *italics;* principal references in **bold-faced figures.**]

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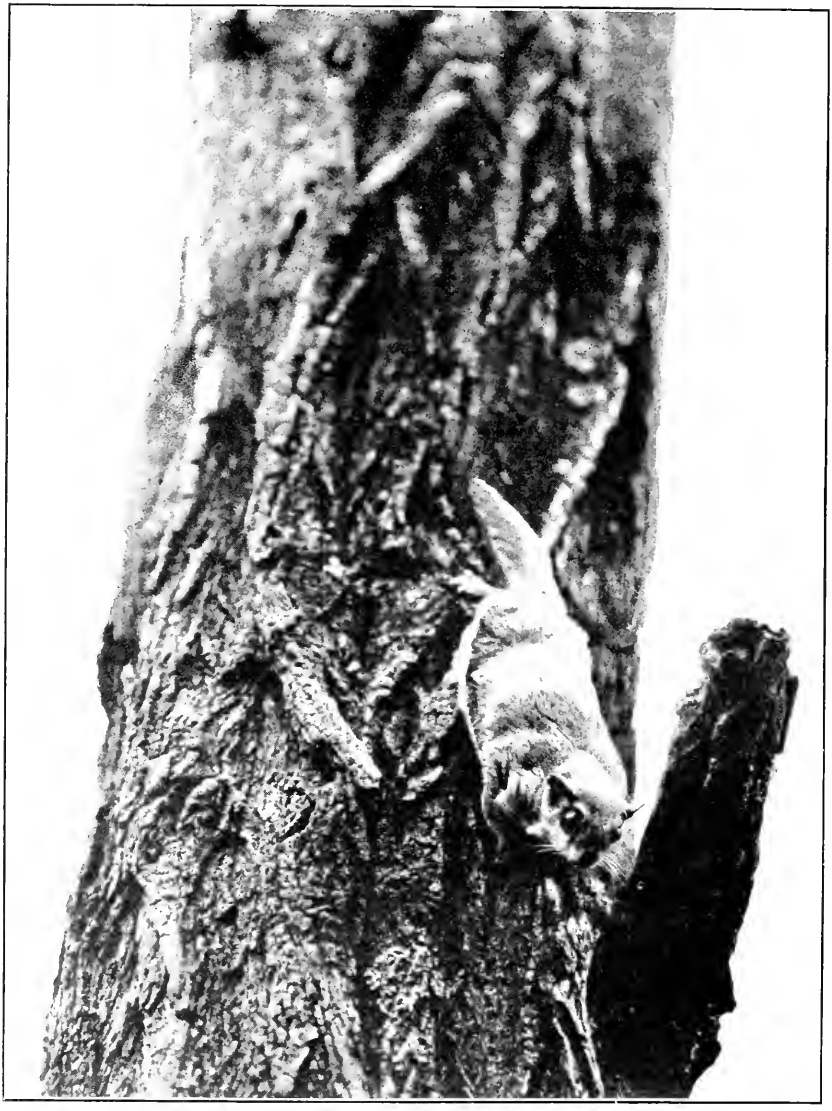


B634M

SMALL EASTERN FLYING SQUIRREL (GLAUCOMYS VOLANS VOLANS).

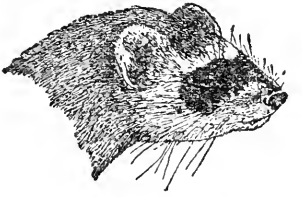
From life; Coram, N. Y., August, 1915; photographed by Francis Harper.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
E. W. NELSON, *Chief*

NORTH AMERICAN FAUNA

No. 44

[Actual date of publication, June 13, 1918]



REVISION OF THE AMERICAN FLYING SQUIRRELS

BY

ARTHUR H. HOWELL

ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., March 9, 1917.

SIR: I have the honor to transmit for publication as North American Fauna No. 44 a revision of the American flying squirrels (genus *Glaucomys*), by Arthur H. Howell, assistant biologist of this bureau. The revision is based largely upon material in the collection of the Biological Survey. Flying squirrels are found over much of North America, and this report on the group gives needed information concerning the number of forms and their distribution.

Respectfully,

E. W. NELSON,
Chief Biological Survey.

Hon. DAVID F. HOUSTON,
Secretary of Agriculture.

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No. 44. NORTH AMERICAN FAUNA. June 13, 1918.

REVISION OF THE AMERICAN FLYING SQUIRRELS.

By Arthur H. Howell.

INTRODUCTION.

The American flying squirrels comprise two distinct groups—the small species (*Glaucomys volans*) of eastern United States and Mexico; and the larger species (*G. sabrinus*) occupying western United States and Canada, with one form ranging into New England and the border States along the Great Lakes (fig. 1).

HABITS.

Flying squirrels are almost exclusively arboreal, seldom descending to the ground and apparently never running for any distance on its surface. They are unsuspicious and, being easily tamed, make very attractive pets.[1] Possessed of intense activity, their movements are the acme of grace and agility. They do not fly, in the usual sense of the term, but progress from tree to tree by gliding with outstretched membranes from an elevated position to a point lower down, usually near the ground. Just before alighting, the animal checks its momentum by sweeping upward in a gentle curve and alights on the tree trunk with its head up. Ascending the tree by climbing, it is ready for another flight. In these gliding leaps, which may extend for a distance of 50 yards or more, the squirrel is able to change its course to one side or the other with perfect ease.

Unlike all other American squirrels, the flying squirrels are strictly nocturnal. During the daytime they remain concealed in their nests and are never seen abroad unless frightened from their retreats. Usually they may be driven readily from their holes by pounding with an ax or club on the base of the tree in which they are

[1] A pair of flying squirrels regularly visit the sixth floor of an apartment house fronting the National Zoological Park, Washington, D. C., and although usually averse to the glare of an electric light, they will when hungry eat nuts in apparent unconcern within 5 or 6 feet of an observer. They run up and down the stuccoed sides of the building with perfect ease, doubtless reaching the middle stories by jumping from a near-by tree. Their visits usually are between dark and midnight.

sleeping. Woodchoppers frequently scare them out when felling timber, and anyone who camps frequently in the woods is likely to hear them at night running or jumping about in the trees or dropping nuts to the ground.

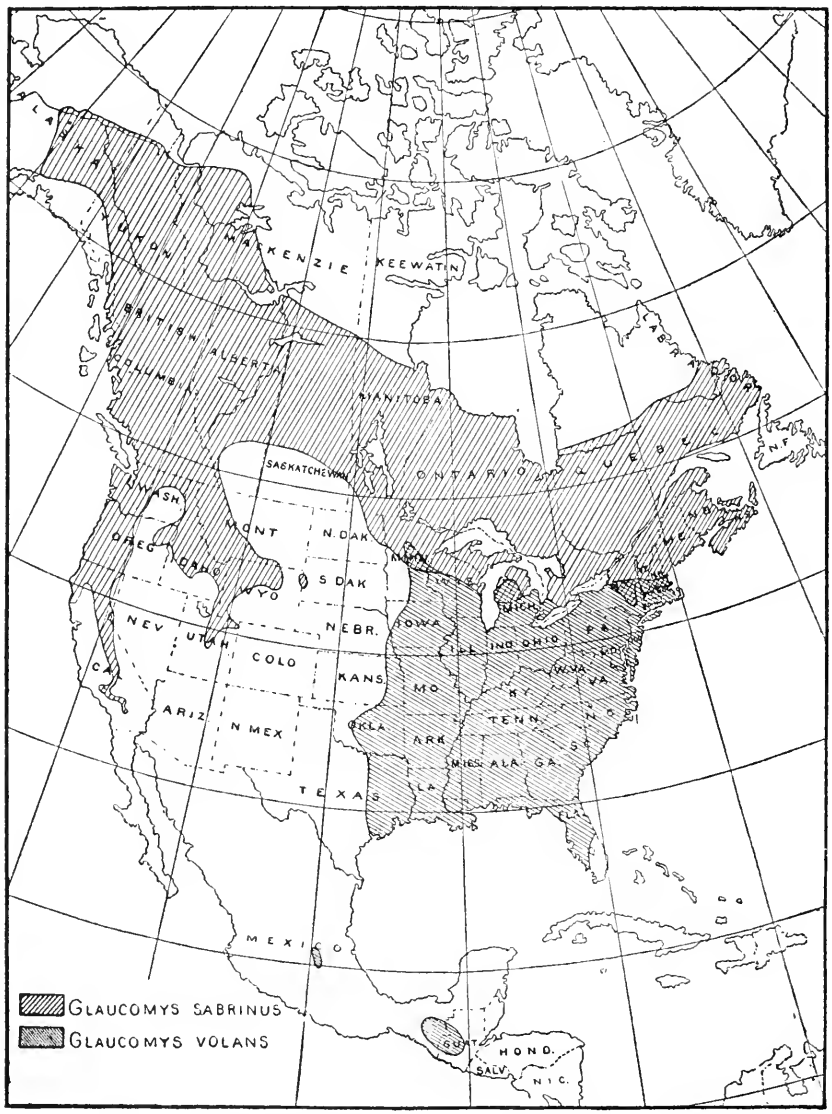

FIG. 1.—Map showing the distribution of *Glaucomys sabrinus* and *G. volans*, based on specimens examined and reports of occurrence.

VOICE.

The notes of *Glaucomys volans* are described by Vernon Bailey as a "fine, whistling squeak," and Wood says of the same species: "The

flying squirrel has three quite diverse calls or cries. It utters the usual 'chuck-chuck' of squirrels, the usual quick, sharp squeak when scolding, and also, more rarely, a clear musical note, commonly melodious and pleasant, but occasionally shrill. This resembles the chirp of a bird and may be kept up for ten minutes at a time."[1] Seton, writing of the northern flying squirrel, *G. sabrinus*, in Manitoba, says: "The cry of this species is said to be like that of *volans*, which is a prolonged squeak not unlike the complaint of a red-eyed vireo whose nest is threatened."[2]

NESTS.

These squirrels are found only in wooded regions, and for homes they depend chiefly on hollow trees or stubs and deserted woodpecker nests. They often take up their abode, also, in attics, in outbuildings, or in boxes constructed for martins or other birds. Audubon and Bachman mention finding a number of flying squirrels in crevices of rock at Red Sulphur Springs, Va. In the cavity chosen for a home a nest is constructed of shreds of bark, dry leaves, moss, feathers, fur, or other soft material. Outside nests are often built, or the deserted nests of birds or of other squirrels utilized. Concerning this habit (in *Glaucomys volans*) Mearns says:

> Not infrequently it builds outside nests, and even lives in them during the winter. Some resemble the leaf nests of the gray squirrel externally, though there is always a warm lining within; other nests are indistinguishable from those of red squirrels; and others still are deftly woven of the softest possible materials.[3]

Helme,[4] writing from Long Island, N. Y., and Rhoads,[5] writing from Pennsylvania, both mention this habit in *volans*, and both state that an evergreen tree usually is selected as a site for the nest. Evermann and Clark[6] speak of finding in Indiana a large globular nest of fibrous material situated in the crotch of a small oak; and King[7] describes a summer nest built of small twigs and oak leaves, and lined with grass, situated about 10 feet from the ground in a small oak.

The larger squirrels of the *sabrinus* group also occasionally construct outside nests, although, as is the case with *volans*, hollow trees usually are preferred. J. Ellis McLellan, at Gold Beach, Oreg., once found a flying squirrel occupying a small spherical nest made of sticks and moss placed in a small fir tree. Vernon Bailey, at McKenzie Bridge, Oreg., found soft nests of the flying squirrel in the

[1] Wood, F. E., Bull. Illinois State Lab. Nat. Hist., VIII, pp. 535–536, 1910.
[2] Seton, E. T., Life Hist. Northern Anim., I, p. 441, 1909.
[3] Mearns, E. A., Bull. Amer. Mus. Nat. Hist., X, p. 342, 1898.
[4] Helme, A. H., Abstr. Proc. Linn. Soc. New York, Nos. 13–14, p. 23, 1902.
[5] Rhoads, S. N., Proc. Acad. Nat. Sci. Philadelphia, p. 389, 1894.
[6] Proc. Washington Acad. Sci., XIII, p. 15, 1911.
[7] King, F. H., Amer. Nat., XVII, p. 36, 1883.

masses of tree moss (*Hypnum*) which cover the trunks and branches of maple and ash trees in the deepest forest. There were runways up the trunks under the mossy fleece and others where the moss had been worn away by constant use. At Elk River, Minn., in November, 1904, Charles Bailey found two of the large flying squirrels (*G. sabrinus macrotis*) occupying a nest of sticks and moss in a small tamarack. At Florence, Mont., on June 11, 1910, Clarence Birdseye found in a pile of cordwood a flying squirrel's nest containing 4 young with eyes not yet open.

Flying squirrels apparently do not hibernate, but are known to lay up stores of food and to remain for a large part of the winter within their nests. During the winter and to some extent, also, at other seasons they are somewhat gregarious in habit. At Mullan, Idaho, in June, Clark P. Streator started 8 adults (*G. s. latipes*) from a hollow tree and secured 6 of them, all of which proved to be males. Seton mentions finding 9 adults (*G. s. canescens*) in a hollow stub at Carberry, Manitoba.[1] The same habit is possessed by *G. volans;* Prof. U. O. Cox, of Farmland, Ind., found, in November, 15 of these squirrels in a small rotten stub a little higher than a man's head,[2] and at Dothan, Ala., in March, the writer started 6 from a similar stub in a wooded swamp. Audubon and Bachman record finding 20 in a martin box having 8 or 10 apartments, placed on top of a large locust tree, the box being occupied, also, by bats and screech owls.[3] Dr. J. Schneck states that he once ran as many as 50 out of one den.[4] Audubon and Bachman narrate an interesting experience with flying squirrels near Philadelphia, Pa., where not less than 200 were observed at once about sunset engaged in sportive gambols in a grove of trees.[5]

BREEDING.

The number of young produced at a birth varies from 3 to 6—usually 4 or 5. The period of gestation is said to be one month,[6] but no definite evidence on this point is available. In the Northern States the young of *Glaucomys volans* are brought forth in April, and a second brood may be produced in August or September. Evermann and Clark[7] describe finding small naked young ones in Indiana on August 19, and Langdon[8] records young with eyes not yet open at Madisonville, Ohio, September 7.

---

[1] Seton, E. T., Life Hist. Northern Anim., I, p. 441, 1909.
[2] Evermann and Clark, Proc. Washington Acad. Sci., XIII, p. 16, 1911.
[3] Audubon and Bachman, Quadr. North Amer., I, p. 220, 1846.
[4] Wood, F. E., Bull. Illinois State Lab. Nat. Hist., VIII, p. 534, 1910.
[5] Audubon and Bachman, Quadr. North Amer., I, p. 218, 1846.
[6] D. W. C., On the Habits of the American Flying Squirrels (*Pteromys volucella* Cuv.). Mag. Nat. Hist., IX, pp. 569–572, 1836.
[7] Evermann and Clark, Proc. Washington Acad. Sci., XIII, p. 15, 1911.
[8] Langdon, Frank W., Journ. Cincinnati Soc. Nat. Hist., III, p. 303, 1881.

The large flying squirrels of the *sabrinus* group apparently breed somewhat later than *volans*. Seton records a specimen taken at Winnipeg, Manitoba, on April 21, which contained 6 young ready for birth; and a nest of 4 young, with eyes not opened, found May 15[1]. Merriam found nursing young of *G. s. macrotis* about a month old in northern New York on June 18. In the Bitterroot Mountains, Mont., at 4,500 feet altitude, Clarence Birdseye took a female of *G. s. bangsi*, May 17, 1910, containing two large embryos; and in the Bitterroot Valley, near Florence, Mont., found a nest of small nursing young on June 11.

FOOD.

The food of flying squirrels consists in large part of nuts, including, probably, most of the native species—chestnuts, acorns, beechnuts, hickory nuts, pecans, and others. Catesby includes pine seeds and persimmon berries in their diet, and Prof. D. E. Lantz states that they frequently gather and store seeds of the cultivated cherry. Stomachs of three specimens of *volans* taken in Virginia in January contained finely chewed chestnut meats, a few pieces of acorn, and several beetle larvæ—probably secured with the nuts. Several stomachs taken at Red Fork, Okla., in June contained only remains of insect larvæ. Buds of trees are said to be eaten in winter, and corn or other grain sometimes is taken. Beetles and perhaps other insects constitute a part of the animals' fare. They have a decided taste for meat, and are so frequently caught by fur trappers in meat-baited traps set for larger game as to constitute a nuisance. Rowley states that he has known the small eastern species (*volans*) to gnaw the edges of meat hung from the rafters of an outhouse.[2] Flying squirrels are suspected by some observers of destroying the eggs of wild birds, and Merriam remarks that the eagerness with which these animals seize and feast upon a dead bird placed within their reach would indicate that they are not strangers to such a repast.[3] King states that in confinement they eat birds' eggs with great satisfaction, and relates an instance of the instant killing by them of a nestling chipping sparrow placed in their cage. A large moth introduced alive was also quickly captured and eaten.[4]

A writer in "Forest and Stream," describing the habits of flying squirrels in captivity, states that they were fond of parsley, pansy flowers, and apple-tree twigs, the last being devoured with great avidity, the leaves and bark stripped clean from the wood. This writer states also that the squirrels were fond of moths and grass-

[1] Seton, E. T., Life Hist. Northern Anim., p. 442, 1909.
[2] Rowley, J., Abstr. Proc. Linn. Soc. New York, Nos. 13–14, p. 40, 1902.
[3] Merriam, C. Hart., Trans. Linn. Soc. New York, II, p. 100, 1884.
[4] King, F. H., Amer. Nat., XVII, pp. 40–41, 1883.

hoppers, but refused crickets, and their preference in nuts was for acorns, filberts, and pecans.[1]

Stores of food laid up by flying squirrels for winter use have occasionally been found, indicating that the hoarding habit is probably general. Audubon and Bachman record an instance of a martin box occupied by a considerable number of flying squirrels, in which was found a quantity of hickory nuts, chestnuts, acorns, and corn.[2]

ECONOMIC STATUS.

The food habits of the flying squirrels are such that they are almost entirely harmless. So far as known they do not damage farm crops, and the relatively small number of nuts which they consume does not seriously affect the total supply. They have been suspected of destroying the eggs and young of wild birds, but no definite evidence on this point is forthcoming. Occasionally they may take possession of bird boxes or enter the lofts of dwelling houses and thus become objectionable, but ordinarily their gentle and confiding ways and their interesting habits make them desirable neighbors.

PELAGE AND MOLT.

The pelage in members of this genus is of moderate length, very dense, fine, and silky in texture. Apparently only one complete molt occurs in a year, in the autumn, from September to November. The new pelage usually appears first on the sides and spreads thence over the back, the head and shoulders being the last parts to be renewed. The effects of wear usually are not noticeable until March, but from then till November many worn specimens are to be found, though apparently a considerable proportion retain the winter pelage throughout the summer with little indication of wear. The head, nape, and rump are first subject to wear, though frequently the entire upperparts and tail become much worn. In summer there is a general tendency to a reddening of the hairs on the upperparts.

In *Glaucomys volans* and in most, if not all, of the races of *G. sabrinus* the middle portion of the soles in summer is naked, the same portions being furred in winter pelage in all forms except the southern races of *volans*. In one race (*G. volans volans*) the hind toes are conspicuously marked with white in winter, but are brown in summer. The exact manner of this change is not apparent, but it probably is accomplished by a partial spring molt.[3]

[1] "C. C. H.," Forest and Stream, LII, pp. 125–126, 1899.
[2] Audubon and Bachman, Quad. North Amer., I, p. 220, 1846.
[3] For a detailed account of the molt in *G. volans* see, under that species, pp. 20–22.

EXPLANATION OF CRANIAL MEASUREMENTS.

The following measurements of skulls of this genus have been taken in millimeters:

Greatest length.—From anterior border of nasals to posterior border of supraoccipital in median line.

Zygomatic breadth.—Greatest breadth across zygomata.

Mastoidal breadth.—Greatest breadth across mastoids.

Interorbital breadth.—Shortest distance across frontals in front of postorbital processes.

Postorbital breadth.—Shortest distance across frontals behind postorbital processes.

Length of nasals.—Greatest length of nasals, measured along median line.

Maxillary toothrow.—Alveolar length of maxillary molar-premolar toothrow.

MATERIAL EXAMINED.

For the present revision the writer has assembled for study 1,052 specimens. About half of these are contained in the United States National Museum, including the Biological Survey and Merriam collections. The remainder have been borrowed from other American museums and from private collections, so that practically all the available material in this country has been at the disposal of the reviser.[1]

Genus GLAUCOMYS Thomas.

Mus Linnæus, Syst. Nat., Ed. 10, p. 63 (part), 1758.

Sciurus Pallas, Nov. Spec. Glires, p. 350 (part), 1778. Not *Sciurus* Linnæus, 1758.

Pteromys Tiedemann, Zool., I, p. 451 (part), 1808. Not *Pteromys* G. Cuvier, 1800.

Sciuropterus Lesson, Manuel de Mamm., p. 242, 1827 (part); Desmarest, Dict. Sci. Nat., p. 140, 1827 (part). Not *Sciuropterus*, F. Cuvier, 1825.

Glaucomys Thomas, Ann. and Mag. Nat. Hist. (ser. 8), I, p. 5, 1908. Type, *Mus volans* Linnæus.

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[1] For the loan of this material the writer desires to extend thanks to the owners and custodians as follows: Dr. J. A. Allen, of the American Museum of Natural History; Messrs. Samuel Henshaw and Outram Bangs, of the Museum of Comparative Zoology; Dr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia; Messrs. Charles B. Cory and W. H. Osgood, of the Field Museum of Natural History; Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology, University of California; Mr. P. A. Taverner, of the Victoria Memorial Museum; Mr. F. Kermode, of the Provincial Museum, Victoria, British Columbia; Dr. W. J. Holland and Mr. W. E. Clyde Todd, of the Carnegie Museum; Dr. A. G. Ruthven, of the University of Michigan; Mr. C. D. Bunker, of the Kansas University Museum; Mr. Myron H. Swenk, of the University of Nebraska; Mr. J. D. Figgins, of the Colorado Museum of Natural History; Mr. J. O. Snyder, of Leland Stanford, Jr., University; Dr. Barton W. Evermann, of the California Academy of Sciences; Mr. Henry L. Ward, of the Milwaukee Public Museum; Mr. W. E. Saunders, of London, Ontario; Mr. Edward R. Warren, of Colorado Springs, Colo.; Mr. G. L. Kirk, of Rutland, Vt., and Dr. H. V. Ogden, of Milwaukee, Wis.; and to Mr. Francis Harper for the photograph from which the frontispiece was made.

HISTORY AND NOMENCLATURE.

The small eastern flying squirrel (*Glaucomys volans*), which is very common in Virginia and the other South Atlantic States, attracted the notice of the earliest colonists and through their descriptions early became known to naturalists. Captain John Smith, in his History of Virginia, published originally in 1624, refers to the animal in the following words:

> A Small beast they have they call Assapanick, but we call them flying Squirrels, because spreading their legs, and so stretching the largenesse of their skins, that they have beene seene to fly 30 or 40 yards.[1]

This species was described more or less fully also in the seventeenth and eighteenth centuries by numerous other writers, including Ray,[2] Catesby,[3] and Edwards.[4] Both Catesby and Edwards figured the animal, and Catesby described its habits in the following words:

> These Squirrels are gregarious, travelling from one Tree to another in companies of ten, or twelve together. When I first saw them, I took them for dead Leaves, blown one Way by the Wind, but was not long so deceived, when I perceived many of them to follow one another in one Direction: They will fly fourscore Yards from one Tree to another. They can not rise in their Flight, nor keep in a horizontal Line, but descend gradually, so that in Proportion to the Distance the Tree, they design to fly to, is from them, so much the higher they mount on the Tree they fly from * * *.

The species of eastern Canada was briefly described by Sagard-Théodat in 1636,[5] and that of southern Mexico by Hernandez in 1651.[6]

GENERIC NAMES.

Placed first by Linnæus in the genus *Mus*, the American flying squirrels were later associated with *Sciurus* by Gmelin, Pallas, and Shaw. In 1800 G. Cuvier proposed a new genus, *Pteromys*, to include the European flying squirrel (*Sciurus volans* Linnæus) and the large East Indian species (*Sciurus petaurista* Gmelin). The American forms were referred by later writers to this genus. F. Cuvier, in 1823,[7] pointed out the characters distinguishing the American and European flying squirrels from the large Asiatic species, and in 1825 proposed the name *Sciuropterus* for the European animal,[8] but this name was not generally accepted until Allen adopted it for the American species in his monograph of the Sciuridæ (1877).[9] This

[1] Smith, John, The Generall Historie of Virginia, &c., p. 27, 1624.
[2] Ray, John, Synop. Quad., p. 215, 1693.
[3] Catesby, Mark, Nat. Hist. Carolina, II, p. 76–77, 1743.
[4] Edwards, George, Nat. Hist. Birds, IV, p. 191, 1751.
[5] Sagard-Théodat, Gabriel, Hist. Canada, III, p. 745, 1636.
[6] Hernandez, F., Hist. Anim. et Min. Novæ., Hisp., p. 9, 1651: In Rerum Med. Novæ Hisp. Thesaurus.
[7] Cuvier, F., Mem. Mus. Hist. Nat., Paris, pp. 125–127, 1823.
[8] Cuvier, F., Dents des Mamm., p. 255, 1825.
[9] Allen, J. A., Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr., XI, p. 653, 1877.

name continued in current use until 1914, when Miller[1] showed that according to modern rules for fixing types it must give place to *Pteromys* of earlier date, the type of the latter having been fixed by Fleming,[2] in 1822, on *Sciurus volans*—the European flying squirrel. Thomas,[3] in 1908, in a revision of the genera of flying squirrels separated the American forms subgenerically from the European members of the genus under the name *Glaucomys*, and in 1915 the present writer raised the group to generic rank.[4]

SPECIFIC NAMES.

Linnæus, in the 10th edition of his Systema Naturæ,[5] described the smaller American species under the name *Mus volans*, basing his description mainly on the account of the animal as given by Ray. Curiously enough, on a later page of the same work he described the European flying squirrel as *Sciurus volans*. The two species naturally were united in one genus by later authors, and the duplication of the name *volans* necessitated the renaming of one of them. Pallas, therefore, in 1778,[6] proposed the name *volucella* for the American animal, which designation remained in general use until 1890, when Jordan revived the original name *volans*.[7] The larger American species was named *Sciurus hudsonius*, in 1788, by Gmelin,[8] but this name proved to be preoccupied by Erxleben's *Sciurus vulgaris hudsonicus* applied to the American chickaree, so, in 1801, Shaw proposed in its place the name *sabrinus*.[9] During the nineteenth century both these names were used for the northern flying squirrel—*hudsonius* by Baird, Allen, and others and *sabrinus* by Richardson, Audubon and Bachman, and others. Finally, in 1894, the nomenclatural question involved having been settled, Rhoads[10] revived the name *sabrinus*, which has remained current ever since. In addition to Pallas's name *volucella*, the small species *Mus volans* Linnæus was several times renamed during the early years of the nineteenth century. Tiedemann, in 1808, proposed for it the name *Pteromys virginianus*,[11] and Oken, in 1816, called the species *Pteromys americana*.[12]

Richardson, in 1828,[13] described a new species, *alpinus*, from material collected by Thomas Drummond in western Canada, but the fol-

[1] Miller, G. S., Proc. Biol. Soc. Washington, XXVII, p. 216, 1914.
[2] Fleming, J., Philos. Zool., II, p. 190, 1822.
[3] Thomas, O., Ann. and Mag. Nat. Hist. (ser. 8), I, p. 5, 1908.
[4] Howell, A. H., Proc. Biol. Soc. Washington, XXVIII, p. 109, 1915.
[5] Linnæus, Syst. Nat., Ed. 10, I, p. 63, 1758.
[6] Pallas, Nov. Spec. Glires, p. 351, 1778.
[7] Jordan, D. S., Man. Vert. U. S., Ed. 5, 321, 1890.
[8] Gmelin, J. F., Syst. Nat., I, p. 153, 1788.
[9] Shaw, Gen. Zool., II, p. 157, 1801.
[10] Rhoads, S. N., Amer. Nat., XXVIII, p. 525, 1894.
[11] Tiedemann, F., Zool., I, p. 451, 1808.
[12] Oken, Lorenz, Lehrb. der Naturg., II, p. 865, 1816.
[13] Richardson, J., Zool. Journ., III, p. 519, 1828.

lowing year he reduced the form to a subspecies of *sabrinus*.[1] Bachman, in 1839, named *oregonensis*, a new species from the lower Columbia River, and after this date no new names were proposed for the group for a period of more than 50 years.

Audubon and Bachman in their great work, the Quadrupeds of North America,[2] treated the four species already described—*volucella*, *sabrinus*, *alpinus*, and *oregonensis*. Baird, in his Mammals of North America,[3] recognized the same four species (using the name *hudsonius*, however, in place of *sabrinus*), but was able to add very little to the history of the group. Allen, in his Monograph of the Sciuridæ,[4] united the four forms into one species, *volucella*, with *hudsonius* as a variety, placing *alpinus* and *oregonensis* in synonymy. Bangs, in 1896, revised the eastern members of the genus, raising *sabrinus* again to the rank of a species and describing as new, *querceti*, a southern race of *volans*, and *silus*, a supposed new species from West Virginia.[5] Rhoads, in 1897, revised the western forms of the genus, reviving *alpinus* as a full species with *oregonensis* as a subspecies and describing three additional races—*fuliginosus* from the Cascade Mountains, Washington; *bangsi* from central Idaho; and *californicus* from the San Bernardino Mountains, California.[6]

During the next eight years 9 new forms were added by various authors to the 9 already recognized—one (*goldmani*) as a race of *volans* from southern Mexico, two (*macrotis* and *makkovikensis*) as races of *sabrinus*, five (*klamathensis*, *olympicus*, *lascivus*, *stephensi*, and *zaphæus*) as races of *alpinus*, and one (*yukonensis*) as a full species.

In 1915 Swenk proposed as new *Pteromys volans nebrascensis*, and the present writer described two races of *volans*, four of *sabrinus*, and one full species, *bullatus*,[7] thus raising the total number of recognized forms to 26. In the present revision all of these are recognized except *silus* of Bangs and *nebrascensis* of Swenk, which are referred to *G. volans volans*.

GENERIC CHARACTERS.

Form sciurine; fore and hind limbs connected by a broad fold of skin extending from wrists to ankles, supported anteriorly by a

[1] Fauna Boreali-Amer., I, p. 195, 1829.

[2] Audubon and Bachman, Quad. North Amer., I, pp. 132, 216, 1846; III, pp. 202, 206, 1854.

[3] Baird, S. F., Mamm. North Amer.: Rept. Expl. and Surv. R. R. Pac., VIII, pp. 286–290, 1857.

[4] Allen, J. A., Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr., XI, pp. 653–666, 1877.

[5] Bangs, O., Proc. Biol. Soc. Washington, X pp. 162–166, 1896.

[6] Rhoads, S. N., Proc. Acad. Nat. Sci. Philadelphia, pp. 314–327, 1897.

[7] Howell, A. H., Proc. Biol. Soc. Washington, XXVIII, pp. 109–114, 1915; in the present paper *bullatus* is treated as a subspecies of *sabrinus*.

slender cartilaginous process growing from the wrist. Tail broad, much flattened, densely haired, its sides usually nearly parallel or slightly narrowed at each end, the tip evenly rounded. Soles with 4 tubercles at base of toes; no metatarsal pad; palms with 5 tubercles—3 at base of fingers, one at base of the rudimentary thumb, and one opposite the latter on outside of wrist. Mammæ, 8, as follows: Pectoral, $\frac{1}{1}$; abdominal, $\frac{2}{2}$; inguinal, $\frac{1}{1}$. Skull with smoothly rounded braincase, flattened in some species, subglobular in others; nasals abruptly depressed at tip; dorsal outline of skull from nasals to postfrontal region nearly straight, then abruptly depressed to occiput; frontals long and narrow, the interorbital region decidedly longer than broad; interorbital constriction pronounced, usually with a distinct notch at anterior base of postorbital processes; postorbital processes broad at base, tapering abruptly to a point, slightly depressed at tip; zygomata moderately expanded posteriorly, less widely anteriorly; audital bullæ large, subcircular in outline, smoothly rounded; pterygoids slender and rather low, the hamular processes usually touching audital bullæ; dentition, $I, \frac{1}{2}$; PM, $\frac{4}{2}$; M, $\frac{6}{6}=22$; maxillary toothrows approximately parallel; anterior upper premolar very small, terete, its crown simple; transverse ridges of upper molariform teeth continuous.

The skull of *Glaucomys* differs from that of *Pteromys*[1] in the following particulars (see Pl. VII, figs. 11–14): Rostrum with sides not parallel, but tapering gradually from tip to point of union with the zygomata; nasal branches of premaxillæ relatively much wider; zygomata narrower anteriorly, not standing out squarely from the rostrum; maxillary arm of zygoma much weaker, the median portion of the arch nearly vertical (nearly horizontal in *Pteromys*); frontals relatively longer and narrower, the surface nearly flat or with a very slight depression; postorbital processes broader at the base and less attenuate; braincase more swollen, its outlines smooth and rounded; occiput not noticeably depressed; anterior palatine foramina relatively smaller; mandible relatively longer and more slenderly built, the masseteric ridge less strongly developed, terminating at a point slightly posterior to the premolar; angular process weaker, its border forming a regular curve (not abruptly bent outwards, as in *Pteromys*); coronoid process larger and longer; enamel pattern of molariform teeth simple, the transverse ridges of the upper molars complete (in *Pteromys* PM^4, M^1, and M^2 having the posterior ridge cut by a deep reentrant fold).

[1] As restricted to the small palæarctic species *P. volans, P. büchneri,* and related forms.

List of Species and Subspecies, with Type Localities.

Glaucomys volans group:

Glaucomys volans volans (Linnæus)——Virginia.
volans saturatus Howell——Dothan, Alabama.
volans querceti (Bangs)——Citronelle, Florida.
volans texensis Howell——Sour Lake, Texas (7 miles northeast).
volans goldmani (Nelson)——Teopisca, Chiapas (20 miles southeast).

Glaucomys sabrinus group:

Glaucomys sabrinus sabrinus (Shaw)——Mouth of Severn River, Ontario.
sabrinus makkovikensis (Sørnborger)——Makkovik, Labrador.
sabrinus macrotis (Mearns)——Hunter Mountain (Catskills), Greene County, New York.
sabrinus canescens Howell——Portage la Prairie, Manitoba.
sabrinus bangsi (Rhoads)——Idaho County, Idaho.
sabrinus alpinus (Richardson)——Jasper House, Alberta.
sabrinus yukonensis (Osgood)——Camp Davidson, Yukon River, Yukon.
sabrinus zaphæus (Osgood)——Helm Bay, Cleveland Peninsula, Alaska.
sabrinus oregonensis (Bachman)——"Pine woods of the Columbia, near the sea"—probably near the present site of St. Helens, Oregon.
sabrinus columbicusis Howell——Okanogan, British Columbia.
sabrinus fuliginosus (Rhoads)——Cascade Mountains, near Martin Station, Kittitas County, Washington.
sabrinus latipes Howell——Glacier, British Columbia.
sabrinus olympicus (Elliot)——Happy Lake, Olympic Mountains, Washington.
sabrinus bullatus Howell——Sawtooth [Alturas] Lake, Idaho.
sabrinus klamathensis (Merriam)——Fort Klamath, Oregon.
sabrinus flaviventris Howell——Head of Bear Creek, Trinity County, California.
sabrinus lascivus (Bangs)——Tallac, Eldorado County, California.
sabrinus californicus (Rhoads)——Squirrel Inn, San Bernardino Mountains, California.
sabrinus stephensi (Merriam)——Sherwood, Mendocino County, California.

Key to Species and Subspecies.

a^1. Hairs on belly white at roots (*volans* group).
  b^1. Colors paler (drab, pinkish cinnamon, or yellowish wood brown).
    c^1. Size larger; hind toes white in winter pelage——**volans** (p. 19).
    c^2. Size smaller; hind toes not white in winter.
      d^1. Skull relatively short and broad (greatest length, 32.7–34 mm.); bullæ smaller——**texensis** (p. 27).
      d^2. Skull relatively long and narrow (greatest length, 33.2–35.3); bullæ larger——**querceti** (p. 26).

b^2. Colors darker (dark sayal brown; hair brown; pale snuff brown).
c^1. Sides of face marked with fuscous----------**goldmani** (p. 28).
c^2. Sides of face not marked with fuscous----------**saturatus** (p. 24).
a^2. Hairs on belly gray at roots (*sabrinus* group).
b^1. Bullæ very large----------**bullatus** (p. 51).
b^2. Bullæ medium or small.
c^1. Soles yellowish.
d^1. Underparts strongly yellowish----------**flaviventris** (p. 54).
d^2. Underparts not strongly yellowish.
e^1. Underparts tinged with yellow or cream-buff.
f^1. Under side of tail darker (deep pinkish cinnamon), **columbiensis** (p. 45).
f^2. Under side of tail paler (light pinkish cinnamon or colonial buff)----------**klamathensis** (p. 52).
e^2. Underparts tinged with avellaneous----------**lascivus** (p. 55).
c^2. Soles not yellowish.
d^1. Underparts heavily washed with wood brown or some shade of cinnamon or buff.
e^1. Upperparts strongly rufescent (mikado brown or pecan brown), **oregonensis** (p. 44).
e^2. Upperparts not strongly rufescent.
f^1. Tail strongly clouded with fuscous beneath------**zaphæus** (p. 43).
f^2. Tail not strongly clouded with fuscous beneath.
g^1. Size larger (greatest length of skull usually more than 42 mm.), **latipes** (p. 48).
g^2. Size smaller (greatest length of skull usually less than 42 mm.).
h^1. Colors darker (wood brown to snuff brown), **olympicus** (p. 49).
h^2. Colors paler (pale sayal brown)----------**fuliginosus** (p. 47).
d^2. Underparts whitish, or moderately washed with wood brown or some shade of cinnamon or buff.
e^1. Upperparts vinaceous or brownish (pinkish cinnamon, vinaceous-cinnamon, or sayal brown).
f^1. Upperparts very pale (light pinkish cinnamon)---**canescens** (p. 37).
f^2. Upperparts darker (vinaceous-cinnamon to sayal brown).
g^1. Underparts white or faintly washed with pinkish cinnamon or wood brown.
h^1. Size larger (greatest length of skull in adults more than 39 mm.).
i^1. Under side of tail strongly washed with fuscous or dark brown.
j^1. Size larger (greatest length of skull usually more than 40.4 mm.)----------**makkovikensis** (p. 34).
j^2. Size smaller (greatest length of skull usually less than 40.4 mm.)----------**sabrinus** (p. 31).
i^2. Under side of tail not strongly washed with fuscous (pale or deep pinkish cinnamon).
j^1. Upperparts vinaceous-cinnamon-----**columbiensis** (p. 45).
j^2. Upperparts sayal brown----------**stephensi** (p. 57).
h^2. Size smaller (greatest length of skull less than 39 mm.), **macrotis** (p. 35).

g^2. Underparts moderately washed with pinkish cinnamon or avellaneous.
h^1. Size larger (average length of tail about 165 mm.), **yukonensis** (p. 41).
h^2. Size smaller (average length of tail about 142 mm.), **bangsi** (p. 38).
e^2. Upperparts drab, gray, or wood brown.
f^1. Size larger; tail heavily marked with fuscous---**alpinus** (p. 40).
f^2. Size smaller; tail not heavily marked with fuscous.
g^1. Under side of tail deep pinkish cinnamon---**bangsi** (p. 38).
g^2. Under side of tail pinkish buff or pale olive-buff.
h^1. Skull with deeper braincase; soles never washed with yellow or buff---**stephensi** (p. 57).
h^2. Skull with shallower braincase; soles often washed with yellow or buff.
i^1. Larger and darker---**lascivus** (p. 55).
i^2. Smaller and paler---**californicus** (p. 56).

DESCRIPTIONS OF SPECIES AND SUBSPECIES.

Glaucomys volans Group.

GLAUCOMYS VOLANS (LINNÆUS).

[Synonymy under subspecies.]

General characters.—Size small (hind foot 32 mm. or less); hairs on underparts white to the roots, except on hind legs and flying membranes, where they are plumbeous at base.

Cranial characters.—Skull small (greatest length 35.7 mm. or less); rostrum short; audital bullæ moderately inflated.

Color.—Upperparts drab, pinkish cinnamon, sayal brown, pale snuff brown, hair-brown, or yellowish wood brown, the bases of the hairs deep neutral gray; sides of face smoke gray, often shaded with fuscous or buff; borders of flying membrane above, fuscous, clove brown, or blackish brown; fore feet buffy white, hair-brown, or grayish buff; hind feet hair-brown, fuscous, or mouse gray, the toes in one race white in winter; tail above, hair-brown, snuff brown, verona brown, fuscous, or drab; beneath, pinkish cinnamon, vinaceous-cinnamon, or pinkish buff; underparts creamy white, the sides often edged with pinkish cinnamon, vinaceous-cinnamon, or pinkish buff.

Geographic distribution.—Eastern United States and extreme southern Canada, from southern New Hampshire, northern New York (Lewis County), southern Ontario (London), central Michigan, northern Wisconsin (Burnett County), and central Minnesota (Aitkin County), south to the Gulf coast and southern Florida (Fort Myers); west to eastern Nebraska (Otoe and Nemaha Counties), eastern Kansas (Douglas and Woodson Counties), southwestern Oklahoma (Wichita Mountains), and eastern Texas (Parker, Bastrop, and DeWitt Counties); also the highlands of Chiapas and

Guatemala and probably locally throughout eastern Mexico. Zonal range from the Transition through Upper and Lower Austral Zones (fig. 2).

GLAUCOMYS VOLANS VOLANS (LINNÆUS).

SMALL EASTERN FLYING SQUIRREL.

[Pl. I; Pl. II, fig. 2; Pl. IV, fig. 2; Pl. VI, fig. 1.]

[*Mus*] *volans* Linnæus, Syst. Nat., ed. 10, p. 63, 1758 (based chiefly on Ray and Edwards).

Sciurus volucella Pallas, Nov. Spec. Glires, p. 351, 1778 (apparently a renaming of *Mus volans* Linnæus, but based primarily on Edwards and Catesby).

Pteromys virginianus Tiedemann, Zool., I, p. 451, 1808 (renaming of *Mus volans* Linnæus).

Pteromys americana Oken, Lehrb. der Naturg., II, p. 865, 1816 (renaming of *Sciurus volucella* Pallas).

Pteromys volucella Desmarest, Nouv. Dict. d'Hist. Nat., XXVII, p. 406, 1818; Audubon and Bachman, Quad. North Amer., I, p. 216, 1846, plate XXVIII; Baird, Mamm. North Amer.: Rept. Expl. and Surv. R. R. Pac., VIII, p. 286, 1857.

Sciuropterus volucella Lesson, Manual de Mamm., p. 242, 1827.

Sciuropterus americanus Desmarest, Dict. Sci. Nat., p. 140, 1827.

FIG. 2.—Map showing the distribution of the subspecies of *Glaucomys volans*, based on specimens examined.

? *Pteromys cucullatus* Fischer, Synop. Mamm., p. 365, 1829 (type locality, Virginia (?); based on the "*Sciurus, Virginianus, volans*" of Seba).[1]

Sciuropterus volucella var. *volucella* Allen, Proc. Boston Soc. Nat. Hist., XVI, p. 189, 1874; Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr., XI, p. 655, 1877.

[1] Seba's figure does not agree with any known species of flying squirrel; Thomas (Proc. Zool. Soc. London, p. 148, 1911) has identified it as a young *Petaurista*, but the flattened tail strongly suggests *Glaucomys;* Linnæus cites Seba's description in the synonymy of *Mus volans.*

S[ciuropterus] volans Jordan, Man. Vert. U. S., ed. 5, p. 321, 1890.

Sciuropterus silus Bangs, Proc. Biol. Soc. Washington, X, p. 163, 1896. Type, No. 4931, Mus. Comp. Zool. (formerly in collection E. A. & O. Bangs); from top of Katis Mountain, near White Sulphur Springs, West Virginia; September 2, 1895.

Pteromys volans nebrascensis Swenk, University Studies (Lincoln, Nebraska), XV, p. 151, "April" [= Sept. 25], 1915. Type, No. 286, Coll. State Entomologist, Univ. Nebraska; from Nebraska City, Nebr., Nov. 26, 1914.

Type locality.—Virginia.[1]

Distribution.—Northeastern United States and extreme southern Canada, from central Minnesota, Wisconsin, and Michigan, southern Ontario, northern New York (Lewis County), and southern New Hampshire south to North Carolina (Raleigh), Tennessee (Nashville), and northern Arkansas and Oklahoma (Boston Mountains); west to eastern Nebraska (Otoe and Nemaha Counties) and eastern Kansas (Douglas and Woodson Counties).

Characters.—Size large (for the group); colors pale; upperparts varying from drab to pinkish cinnamon; toes, in winter, usually strongly marked with white and soles haired to the bases of the toes.

Color.—*Winter pelage:* Upperparts varying from drab through numerous intermediate shades to pinkish cinnamon, shaded along sides with pinkish buff; hairs on back with an indistinct, subterminal band of brown (not visible on the surface), their bases deep neutral gray; sides of face smoke gray, often washed with pinkish buff; eye-ring fuscous or clove brown; ears hair-brown or drab, scantily haired; upper surface of flying membrane fuscous to blackish brown; under surface edged with light pinkish cinnamon; underparts white, with a creamy tinge, the hairs white to the roots (except on hind legs, where their bases are neutral gray); tail, above, snuff brown to drab, shading on sides to hair-brown; beneath, light pinkish cinnamon to pinkish buff, shaded in some specimens with drab-gray; front feet buffy white or hair-brown, sometimes shaded with gray; hind feet hair-brown (rarely mouse gray), the toes and inner borders of feet white. *Summer pelage:* Similar to the winter pelage, but general tone of upperparts usually darker, caused in part by reddening of the hairs and in part by wearing away of the tips, thus exposing portions of the underfur; toes without white markings; middle portion of soles naked.

Molt.—From the large series of skins of this race which have been examined it has been possible to assemble a series of 97 specimens representing every month in the year and showing fully all the pelage gradations from one season to another. The following notes on the

[1] Fixed by Elliot, Synop. Mamm. North Amer.: Field Columb. Mus., Zool. Ser., II, p. 109, 1901 (see also Thomas, Proc. Zool. Soc. London, p. 148, 1911).

pelage of these specimens, arranged chronologically, will serve to make clear the time and manner of molting:

December.—Five specimens, all in full unworn pelage; hind feet white, the soles fully haired.

January.—Seven specimens, all in full unworn pelage excepting one (Virginia, January 18), which is slightly worn on rump; hind feet of all, white; soles haired.

February.—Eight specimens, all in full unworn pelage; hind feet white and soles haired.

March.—Fourteen specimens; ten in full unworn pelage; four adults (Washington, D. C., March 1) show considerable wear on head, nape, and rump; one immature specimen (White Sulphur, West Virginia, March 1) is slightly worn on head; all have white feet and hairy soles.

April.—Thirteen specimens; four in full pelage showing little wear; six much worn on head and nape; two considerably worn on entire upperparts and one on flanks; all but one have white feet and all but one (Long Island, New York, April 15), hairy soles.

May.—Seven specimens; two young individuals (Maryland, May 13) in much-worn pelage have brown feet, the soles hairy; one young from Wisconsin (June 10) is similar, but shows little wear; one adult (West Virginia, May 17) is in full pelage, but has brown feet and naked soles; two adults in full unworn pelage, except on head, have white feet but naked soles; one adult (Mount Graylock, Mass., May 6) is slightly worn on head, having white feet and hairy soles.

June.—Eight specimens; four moderately worn; three in full unworn pelage; one worn on head only; one (Washington, D. C., June 20) practically same as winter specimens (except feet); feet dusky, without white markings (except in one from Massachusetts, June 27, in which white on toes is faintly indicated.)

July.—Eleven specimens; three young nearly full grown (July 23, 27); two from Massachusetts (July 3, 26), practically full-grown young, show considerable wear; adults show only moderate wear on body, considerable on tail; one (July 28, Washington, D. C.) has pelage as full as in winter, but redder; feet dusky; soles naked.

August.—Two specimens; one (Lake George, New York, August 30) is somewhat worn on head, very little on body; another (Massachusetts, August 30) shows considerable wear on upperparts and tail; feet dusky.

September.—Eight specimens; four show little wear; two young are considerably worn; one adult (September 6, Maryland) is much worn, especially on nape and tail; one (Lake George, New York, September 15) has practically completed the body molt, except on head and a small area in middle of hinder back; feet dusky and soles naked.

October.—Five specimens; one young (October 21) shows little wear; one adult (Sing Sing, N. Y., October 17) apparently still retains the old pelage, which is little worn except on head and tail; feet noticeably whitened, but soles naked; three adults (Massachusetts, October 21; Virginia, October 19) are molting all over the upperparts, the feet still dusky and soles naked.

November.—Nine specimens; two immature individuals from Maryland are much worn and in process of molting; one adult from Maryland (♂, November 9) still retains old pelage on back, being much worn on head and nape, but fresh pelage seems to be coming in on sides of body; feet drab without white markings and soles naked; one adult (Washington, D. C., November 1) has completed the body molt except on head and a patch on nape; the toes on hind

feet are slightly whitened, and the hair is encroaching on the soles; five adults from Connecticut (November 26) are in full winter pelage, with white feet and hairy soles.

Skull.—Largest of the group; superior outline straight from nasals to postfrontal region; braincase moderately depressed, squarish in general outline.

Measurements.—Average of 16 adults from District of Columbia and adjacent parts of Virginia and Maryland: Total length, 232 (220–240); tail vertebræ, 101 (90–110); hind foot, 30.4 (29–32). *Skull:* Average of 12 adults from District of Columbia: Greatest length, 34.9 (34.1–35.6); zygomatic breadth, 21 (20.4–22.2); mastoidal breadth, 17.1 (16.5–17.7); least interorbital breadth, 6.9 (6.2–7.6); least postorbital breadth, 9.1 (8.6–9.6); length of nasals, 9.6 (9.2–10.1); maxillary toothrow, 6.4 (6.2–6.7).

Type specimen.—None known to exist.

Remarks.—This flying squirrel has an extensive range, and although individual variation within the subspecies is considerable, there is practically no variation which can be correlated with faunal areas. Large series of specimens are available from nearly all parts of its range, and careful comparison fails to reveal any appreciable differences between those of the New England States on the one hand and those of Minnesota, Iowa, Kansas, and Nebraska on the other. On the southern border of the range, however, a gradual darkening of the color of the upperparts is noticeable, and also a tendency toward elimination of white on the toes in winter pelage. Specimens from Virginia (the type region), however, do not differ appreciably from New England and New York individuals. Specimens from Raleigh, N. C., and from Stillwell, Okla., show decided approach in characters to *saturatus;* a single winter specimen from Gainesville, Tex., although approaching *texensis* in skull characters, agrees almost exactly with typical *volans* in color and in having white toes. Since this specimen shows no approach to *saturatus* (which occurs at Red Fork, in the Arkansas Valley), it seems probable that typical *volans* ranges from Kansas into western Oklahoma, perhaps as far as the Wichita Mountains, and thence into northern Texas. A single specimen in summer pelage from Oklahoma City, although somewhat indeterminate in characters, seems to bear out this theory of distribution. Additional material from that part of Oklahoma is needed to settle the question.

The type of *Sciuropterus silus* Bangs has been examined and proves to be an immature individual of *volans*, evidently a runt. A considerable series is now available from the type locality of *silus*, and all are perfectly typical of *volans*.

The type of *Pteromys volans nebrascensis* Swenk has been examined and found to agree essentially with typical specimens of *volans*

from the vicinity of Washington, D. C. It is a rather pronounced example of the gray phase, and, although taken on November 26, the hind toes have not yet acquired the clear white which characterizes the winter pelage. The hind feet are somewhat darker than the average of *volans*—in this respect agreeing with *saturatus*. The tail measurement of the type (115 mm.) is about 14 mm. more than the average, but only 5 mm. more than the extremes of *volans*. In the dried skin, however, the tail does not measure any longer than in dozens of typical specimens. The skull and hind feet measure exactly as in typical examples.

Specimens examined.—Total number, 356, as follows:

Connecticut: East Hartford, 5;[1] Liberty Hill, 8.[2]

District of Columbia: Cleveland Park, 13; Washington, 23.

Illinois: Belleville, 1; Chicago, 2; Golconda, 1;[3] Olive Branch, 1;[3] Olney, 2; Parkersburg, 1; Warsaw, 8; Willow Springs, 1.[3]

Indiana: Denver, 2;[2, 4] Kankakee, 1;[3] La Porte, 1;[3] Wheatland, 1.

Iowa: Hillsboro, 2; Iowa City, 1;[5] Knoxville, 3; Thayer, 2.[5]

Kansas: Douglas County, 5;[6] Lawrence, 11;[5] Topeka, 4;[6] Woodson County, 1.[7]

Kentucky: Eubanks, 3.

Maryland: Bacon Hill, 3;[8] Branchville, 1; Capitol View, 1; Garrett Park, 1; Kensington, 2; Laurel, 3; Marlboro, 1; Marshall Hall, 2; Oxon Hill, 1; Plummer Island, 2; Prince Georges County, 3; Silver Spring, 2.

Massachusetts: Ipswich, 1; Mount Graylock, 1; Wareham, 4;[2] Waverly, 2;[2] Wilmington, 2; Woburn, 1.

Michigan: Ann Arbor, 4;[4] Brooklyn, 1;[4] Dexter, 1;[4] Iosca, 1;[4] Ithaca, 2;[4] Kavanagh Lake, 3;[4] Lodi Township, Washtenaw County, 1;[4] Napoleon, 1;[4] Portage Lake, 2;[4] Sand Point, 10;[4] Ypsilanti, 1.[4]

Minnesota: Aitkin, 1;[3] Bridgman, 2; Elk River, 19; Fort Snelling, 3; Steele County, 2.[8]

Missouri: Independence, 1; Stotesbury, 1.[2]

New Hampshire: Hancock, 2.[2]

New Jersey: Cape May County, 1;[9] Culvers Gap, Sussex County, 1;[8] Ellenville, 1; Haddonfield, 5;[8] Lake Hopatcong, 4;[8] Seaville, 2.[8]

New York: Ardsley, 3;[3, 9] Geneva, 1; Hastings, 7;[9] Jamaica, 1; Lake George, 5; Lake Grove, 2; Locust Grove, 5; Miller Place, 5;[9] Sing Sing, 7; Suffolk County, 1.[3]

North Carolina: Apex, 1;[3] Raleigh, 20.[10]

Ohio: Fort Ancient, 1;[9] Madisonville, 3; Ravenna, 1.[9]

Oklahoma: Oklahoma City, 1; Stilwell, 7.

Ontario: Kingsville, 1;[11] London, 7.[11]

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[1] Three in collection Acad. Nat. Sci. Philadelphia.
[2] Collection Mus. Comp. Zool.
[3] Collection Field Mus. Nat. Hist.
[4] Collection Univ. Michigan.
[5] Collection D. Stoner, Iowa City, Iowa.
[6] Collection Kansas Univ. Mus.
[7] Collection Colorado Mus. Nat. Hist.
[8] Collection Acad. Nat. Sci. Philadelphia.
[9] Collection Amer. Mus. Nat. Hist.
[10] Nine in collection Amer. Mus. Nat. Hist.
[11] Collection W. E. Saunders, London, Ont.

Pennsylvania: Carlisle, 1; Chester County, 2; Drury Run, Clinton County, 1; Huntingdon Furnace, 1;[1] Leasuresville, 3;[1] Moon Township, Allegheny County, 1;[2] Pine Grove Furnace, 1.[2]

Tennessee: Nashville, 1.[3]

Texas: Gainesville, 2.

Vermont: Castleton, 1;[4] Rutland, 2.[4]

Virginia: Cherrydale, 1; Dranesville, 1; Dunn Loring, 4; Falls Church, 8; Fort Myer, 1; Henrico County, 1; Maywood, 1; Mount Rodgers, Grayson County, 2; Mount Vernon, 7; Nelson County, 2;[3] Suffolk, 1; Warwick County, 2.

West Virginia: Travellers Repose, 2; White Sulphur Springs, 13.[5]

Wisconsin: Beaver Dam, 2;[6,7] Cassville, 1;[3] Delavan, 1; Lake Koshkonong, 1;[7] Racine, 1.

GLAUCOMYS VOLANS SATURATUS Howell.

Southeastern Flying Squirrel.

[Pl. II, fig. 1; Pl. IV, fig. 1; Pl. VI, fig. 3.]

Glaucomys volans saturatus Howell, Proc. Biol. Soc. Washington, XXVIII, p. 110, May 27, 1915.

Type locality.—Dothan, Alabama.

Distribution.—Southeastern United States (excepting peninsular Florida and the coast region of Georgia) from South Carolina and western North Carolina west to central Oklahoma and north in the Mississippi Valley to southwestern Kentucky.

Characters.—Similar in size and skull characters to *volans*, but upperparts darker at all seasons; toes not conspicuously whitened in winter. Compared with *querceti:* Colors averaging darker, face grayer (less buffy), and hind feet grayer (less brownish); soles haired in winter.

Color.—*Winter pelage:* Upperparts pale snuff brown or dark sayal brown, varying to hair-brown; sides of face smoke gray, rarely with a tinge of buff; upper surface of flying membrane dark clove brown or blackish brown; hind feet hair-brown, the toes washed with buff; fore feet grayish buff; tail above, snuff brown, shaded with bister or dark hair-brown (rarely solid hair-brown); beneath, pinkish cinnamon or vinaceous-cinnamon (rarely light hair-brown, washed with pinkish cinnamon); underparts creamy white, the under surface of the membranes edged with light pinkish cinnamon or light vinaceous cinnamon. *Summer pelage:* Essentially as in winter, but hind feet

[1] Collection Acad. Nat. Sci. Philadelphia.
[2] Collection Carnegie Mus.
[3] Collection Mus. Comp. Zool.
[4] Collection G. L. Kirk, Rutland, Vt.
[5] Ten in collection Mus. Comp. Zool.; two in Field Mus. Nat. Hist.
[6] Collection Mus. Vert. Zool., Univ. California.
[7] Collection E. R. Warren, Colorado Springs, Colo.

fuscous. *Variation* (March specimens from Milton, Florida): Upperparts rich pecan brown.

Skull.—Closely similar to that of *volans*, but averaging smaller; practically same size as that of *querceti*, but bullæ averaging smaller.

Measurements.—Average of 12 adults from southern Alabama:[1] Total length, 226 (211–244); tail vertebræ, 100 (84–109); hind foot, 30 (28–33). *Skull:* Average of 10 adults from southern Alabama:[2] Greatest length, 34 (32.8–34.9); zygomatic breadth, 20.3 (19.9–21.1); mastoidal breadth, 17 (16.6–17.5); least interorbital breadth, 7 (6.7–7.8); least postorbital breadth, 8.9 (8.3–10); length of nasals, 9.4 (8.8–10); maxillary tooth row, 6.4 (6.2–6.8).

Type specimen.—No. 178366, U. S. Nat. Mus. (Biological Survey collection); ♀ ad., skin and skull; collected March 13, 1912, by A. H. Howell.

Remarks.—This race is the darkest form in the *volans* group, differing in this respect both from the Florida form (*querceti*) and from the Texas form (*texensis*). It is much darker than *volans*, both in winter and in summer. Its range is chiefly in the Lower Austral Zone, but extends into the Upper Austral in the mountains of eastern Tennessee and western North Carolina. Intergradation with *volans* is shown by a series from Magnetic City, foot of Roan Mountain, North Carolina, and with *querceti* by a series from Pinetucky, Ga. The Pinetucky specimens are typical of *saturatus* in skull characters, but average paler in color. By reason of lack of material from Louisiana, the relationship of this race to *texensis* and its western limits in that State can not be defined. Specimens from Red Fork, Okla., are typical but in the Boston Mountains intergradation with *volans* occurs.

Two specimens in full winter pelage from Milton, Fla., differ from typical *saturatus* in having the upperparts pecan brown instead of snuff brown. These at first were thought to represent an undescribed race, but the recent acquisition of 3 adult specimens from Muscogee, Fla., only a few miles from Milton, which do not differ in any way from typical *saturatus*, leads to the conclusion that the Milton specimens represent a color phase of this race.

Specimens examined.—Total number, 89, as follows:

Alabama: Ardell, 4; Autaugaville, 10; Carlton, 2; Dothan, 6; Greensboro, 2; Mobile, 4; Perdido River, 1; Sand Mountain, near Carpenter, 2; York, 1.

Arkansas: Delight, 2.

Florida: Milton, 2; Muscogee, 2.

Georgia: Columbus, 1; Okefenokee Swamp, 2; Pinetucky, 13; Reidsville, 2; Young Harris, 1.

Kentucky: Hickman, 1.

[1] Dothan, Autaugaville, Carlton, and York.
[2] Dothan, Autaugaville, Carlton, and Greensboro.

Louisiana: Mer Rouge, 2; Powhatan Plantation, near Gibson, 1.[1]
Mississippi: Columbus, 1; Washington, 1.
North Carolina: Cranberry, 1; Magnetic City, foot of Roan Mountain, 9.
Oklahoma: Red Fork, 4.
South Carolina: Calhoun Falls, 4;[2] Cleora, 1; Greenville, 1; Plantersville, 3; Santee, 1.
Tennessee: Watauga Valley, 2.

GLAUCOMYS VOLANS QUERCETI (BANGS).

FLORIDA FLYING SQUIRREL.

[Pl. II, fig. 9; Pl. IV, fig. 9; Pl. VI, fig. 2.]

Sciuropterus volans querceti Bangs, Proc. Biol. Soc., Washington, X, p. 166, Dec. 28, 1896.
[*Sciuropterus volucella*] *querceti* Trouessart, Cat. Mamm., I, p. 402, 1897.

Type locality.—Citronelle, Florida.

Distribution.—Peninsular Florida (south at least to Fort Myers) and the coast region of Georgia.

Characters.—Very similar in size and color to *volans*, but upperparts averaging slightly darker; toes without conspicuous white markings in winter; soles partly naked at all seasons; skull with larger audital bullæ.

Color.—*Winter pelage:* Upperparts sayal brown to yellowish wood brown, shaded on sides and fore legs with pinkish buff or light pinkish cinnamon; upper surface of flying membrane blackish brown; ears fuscous; sides of face smoke gray, often clouded with fuscous or buff; hind feet pale fuscous, the toes grayish buff; front feet whitish buff; tail above, snuff brown or verona brown, shading (when worn) to dark hair-brown; beneath, pinkish buff or pinkish cinnamon: underparts creamy white, often irregularly shaded with pinkish buff or pinkish cinnamon, particularly along edges of flying membranes. *Summer pelage:* Essentially the same as in winter, but averaging slightly browner (less drab) above.

Skull.—Closely similar to that of *volans*, but averaging slightly smaller, with larger audital bullæ.

Measurements.—Average of 8 adults from Florida:[3] Total length, 229 (221–253); tail vertebræ, 94 (81–115); hind foot, 31 (30–32). *Skull:* Average of 13 adults from Florida:[4] Greatest length, 34.3 (33.2–35.3); zygomatic breadth, 20.5 (19.1–21.3); mastoidal breadth, 17.4 (16.8–18.4); least interorbital breadth, 7 (6.5–7.3); least postorbital breadth, 8.5 (8.2–8.9); length of nasals, 9.4 (8.7–10); maxillary toothrow, 6.4 (5.9–7.1).

[1] Collection Mus. Comp. Zool.
[2] Collection Field Mus. Nat. Hist.
[3] Citronelle and Enterprise.
[4] Citronelle, Enterprise, Lake Harney, and New Berlin.

Type specimen.—No. 2451, Mus. Comp. Zool. (formerly same number, collection E. A. and O. Bangs); ♀ ad., skin and skull; collected September 17, 1894, by F. L. Small.

Remarks.—The Florida flying squirrel resembles *volans* very closely in color, but is easily distinguished in winter pelage by the absence of white markings on the toes and by naked soles. Compared with *saturatus* it averages considerably paler. The large size of the audital bullæ seems to be only an average character, for while pronounced in some specimens, others do not differ in this respect from typical *volans*. The type specimen has larger bullæ than have two topotypes and, indeed, can scarcely be matched in this character by any of the Florida specimens examined. Intergradation with *saturatus* takes place in southeastern Georgia. Specimens from St. Marys, Ga., agree in color with *querceti*, but have smaller bullæ; some individuals in the series have the hind toes marked with buffy white, but less extensively than in *volans*. Considerably more material from Florida and Georgia is needed to show the average characters and exact distribution of this race.

Specimens examined.—Total number, 67, as follows:

Florida: Citronelle, 3;[1] Enterprise, 10;[2] Fort Myers, 1;[1] Gainesville, 2;[3] Hernando County, 2; Lake Harney, 2; Nassau County, 2;[3] New Berlin, 13;[1] Ocala, 1; Shell Hammock, 2; Tarpon Springs, 9.[4]

Georgia: McIntosh County, 1;[1] Montgomery, 4;[1] St. Marys, 15.[1, 3, 5, 6]

GLAUCOMYS VOLANS TEXENSIS Howell.

Texas Flying Squirrel.

[Pl. II, fig. 5; Pl. IV, fig. 5; Pl. VI, fig. 4.]

Glaucomys volans texensis Howell, Proc. Biol. Soc. Washington, XXVIII, p. 110, May 27, 1915.

Type locality.—Sour Lake, Texas (7 miles northeast).

Distribution.—Eastern Texas, west to Aledo, Gurley, Elgin, and Cuero; eastern limits of range unknown.

Characters.—Similar in color and size to *volans;* upperparts slightly more ochraceous; toes without conspicuous white markings; skull decidedly shorter and broader. Compared with *querceti:* Similar in color, but skull shorter, with smaller bullæ. Compared with *saturatus:* Colors much paler; skull shorter and broader.

Color.—*Winter pelage* (March): Upperparts yellowish wood brown to drab, shaded on sides and fore legs with pinkish buff; upper surface of flying membrane fuscous-black; ears fuscous; front feet

[1] Collection Mus. Comp. Zool.
[2] Three in collection Amer. Mus. Nat. His.; two in Field Mus. Nat. Hist.
[3] Collection Amer. Mus. Nat. Hist.
[4] Four in collection Amer. Mus. Nat. Hist.; three in Acad. Nat. Sci. Philadelphia.
[5] Collection Field Mus. Nat. Hist.
[6] Collection Mus. Vert. Zool., Univ. California.

buffy white; hind feet hair-brown or drab, the toes washed with buffy white; tail above, fuscous, shaded with snuff brown; beneath, light pinkish cinnamon; underparts creamy white. *Summer pelage:* A specimen from Colmesniel, Tex. (July 30), agrees essentially with the grayest April specimen from Sour Lake; a much worn specimen from Tarkington (November 23) is slightly more ochraceous than spring specimens.

Skull.—Similar to that of *saturatus*, but shorter and relatively broader; braincase more rounded, deeper, and more abruptly depressed posteriorly. Differs from *quercetі* in the same characters and also in having smaller audital bullæ.

Measurements.—Average of 6 topotypes (adult): Total length, 229 (219–236); tail vertebræ, 104 (97–111); hind foot, 30.8 (30–31). *Skull:* Average of 5 topotypes (adult): Greatest length, 33.5 (32.7–34); zygomatic breadth, 20.9 (20.6–21.1); mastoidal breadth, 17.2 (17.1–17.4); least interorbital breadth, 7.2 (6.9–7.3); least postorbital breadth, 8.6 (8.2–8.9); length of nasals, 9.4 (9.2–9.8); maxillary toothrow, 6.3 (6.1–6.4).

Type specimen.—No. 136400, U. S. Nat. Mus. (Biological Survey collection); ♂ ad., skin and skull; collected March 15, 1905, by J. H. Gaut.

Remarks.—The Texas flying squirrel closely resembles both *volans* and *quercetі* in color, but differs from them in skull characters. It is much paler than *saturatus*, which occupies the eastern Gulf States from Louisiana to Georgia. The material at hand is too scanty to show clearly the relationships and exact range of this form. Intergradation with *volans* is indicated by an intermediate specimen from Gainesville, Tex. (referred to *volans*), and doubtless intergradation takes place also with *saturatus* where their ranges meet.

Specimens examined.—Total number, 10, as follows:

Texas: Colmesniel, 1; Sour Lake, 6; Tarkington, 1; Texarkana, 1; Troup, 1.

GLAUCOMYS VOLANS GOLDMANI (NELSON).

MEXICAN FLYING SQUIRREL.

[Pl. II, fig. 6; Pl. IV, fig. 6.]

Sciuropterus volans goldmani Nelson, Proc. Biol. Soc. Washington, XVII, p. 148, Oct. 6, 1904.

Type locality.—Teopisca, Chiapas, Mexico (20 miles southeast).

Distribution.—Known only from type locality—probably the highlands of Chiapas and Guatemala.

Characters.—Closely similar in color to *saturatus*, but top and sides of nose whitish, sides of face marked with fuscous, and upper surface of flying membrane more brownish; soles naked; skull essentially like that of *volans*.

Color.—Spring pelage (April specimen, worn on nape and tail only): Upperparts dark sayal brown; sides of face smoke gray, strongly varied with fuscous; eye-ring fuscous; ears flesh color, shaded with fuscous; top and sides of nose creamy white; upper surface of flying membrane clove brown; hind feet fuscous, the toes faintly shaded with buff; front feet buffy white; tail, above, snuff brown; beneath, pinkish cinnamon or pale cinnamon buff; underparts creamy white, irregularly washed with pinkish cinnamon, most strongly along edges of membranes.

Skull.—Essentially the same as that of *volans*—slightly larger than that of *saturatus*.

Measurements.—Type and topotype: Total length, 237, 238; tail vertebræ, 112, 107; hind foot, 30, 31.5. *Skull:* Greatest length, 35.1, 34.9; zygomatic breadth, 21.3, 21.9; mastoidal breadth, 17.8, 17.5; least interorbital breadth, 8.7, 9.2; least postorbital breadth, 8.7, 9.2; length of nasals, 10.3, 9.9; maxillary toothrow, 6.4, 6.3.

Type specimen.—No. 132833, U. S. Nat. Mus. (Biological Survey collection); ♂ ad., skin and skull; collected April 8, 1904, by E. A. Goldman.

Remarks.—This race, although widely separated geographically from the United States forms of the group, bears so close a resemblance to *saturatus* that a subspecific designation seems best to express its relationship. From no point between southern Texas and Chiapas are specimens of the genus known, and Nelson and Goldman in their travels in Mexico heard of flying squirrels in only a few localities. The animals were reported to occur in the Pinal de Amoles range of mountains in eastern Queretaro, but whether these are referable to this race is unknown. Tomes, under the name *Pteromys volucella*, records a specimen from Duenas, Guatemala, which undoubtedly is referable to the present form.[1]

Specimens examined.—Two, from type locality.

Glaucomys sabrinus Group.

GLAUCOMYS SABRINUS (SHAW).

[Synonymy under subspecies.]

General characters.—Size medium to large (hind foot 34 mm. or more); hairs on underparts plumbeous at roots.

Cranial characters.—Skull medium to large (greatest length 36 mm. or more); rostrum usually rather long (except in *macrotis*); audital bullæ moderately or in some races considerably inflated.

Color.—Upperparts cinnamon, pinkish cinnamon, vinaceous-cinnamon, vinaceous-fawn, cinnamon-buff, avellaneous, drab, cinnamon-drab, wood brown, sayal brown, snuff brown, mikado brown, or pecan

[1] Tomes, Robert F., Proc. Zool. Soc. London, 1861, p. 281.

brown; sides (and in some races front) of face smoke gray or pale gray, often washed with buff, cinnamon, or fuscous; eye-ring fuscous; borders of flying membrane above, clove brown, fuscous, or blackish

FIG. 3.—Map showing the distribution of the subspecies of *Glaucomys sabrinus* (except *G. s. bullatus*, see fig. 4, p. 51), based on specimens examined.

brown; forefeet hair-brown, wood brown, drab, or mouse gray; hind feet hair-brown, fuscous, clove brown, wood brown, snuff brown, or mouse gray, the soles buffy white, yellowish white, creamy white,

drab, mouse gray, cinnamon-buff, colonial buff, olive-ochre, olive-buff, or oil yellow; tail above, cinnamon, hair-brown, wood brown, sayal brown, snuff brown, clove brown, fuscous, or fuscous-black, usually darkest at the tip; tail beneath, pinkish cinnamon, vinaceous-cinnamon, pinkish-, ochraceous-, cinnamon-, colonial-, cream-, or olive-buff, drab, drab-gray, wood brown, avellaneous, clove brown, or fuscous-black, frequently edged with hair-brown or fuscous; underparts white, creamy white, or buffy white, more or less washed or clouded with pinkish cinnamon, pinkish-, ochraceous-, cream-, cinnamon-, colonial-, or cartridge-buff, straw yellow, greenish yellow, Naples yellow, wood brown, or avellaneous.

Geographic distribution.—Wooded parts of Alaska, Canada, northeastern United States, and mountains of western United States, from the Yukon Valley, Cook Inlet, Upper Mackenzie River, Fort Anderson, Great Slave Lake, northern Manitoba, northern Quebec (Hamilton River), and Labrador (Makkovik), south to northern Massachusetts, southern New York (Catskill Mountains), Pennsylvania (Erie ?), central Michigan (Montcalm County), northern Wisconsin, central Minnesota (Elk River), South Dakota (Black Hills), Utah (Uinta[1] and Wasatch Mountains[2]), Idaho (Sawtooth Mountains), and southern California (Sierra Nevada, San Bernardino, and San Jacinto Mountains) (figs. 3 and 4).

GLAUCOMYS SABRINUS SABRINUS (Shaw).

Hudson Bay Flying Squirrel.

[Pl. II, fig. 11; Pl. IV, fig. 11; Pl. VI, fig. 6; Pl. VII, fig. 10.]

Sciurus hudsonius Gmelin, Syst. Nat., I, p. 153, 1788 (not *Sciurus vulgaris hudsonicus* Erxleben, 1777).

Sciurus sabrinus Shaw, Gen. Zool., II, p. 157, 1801.

? *Pteromys canadensis* Geoffroy, Cat. Mamm. Mus. Hist. Nat., Paris, p. 170, 1803. Type locality, North America [probably Quebec, Canada.[3]]

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[1] Allen (Monogr. North Amer. Rodentia, p. 664, 1877) records a specimen from Uinta Mountains which has since disappeared from the collection; this specimen was taken September 20, 1870, by H. D. Schmidt, near the head of Smiths Fork, Utah (see Prelim. Rept. U. S. Geol. Surv. Wyoming, etc., pp. 41–44, 461, 1871).

[2] F. E. Crandall, of Victor, Idaho, states that while living in Emery County, Utah, he often saw flying squirrels and knew of their being killed by loggers when felling trees. His report indicates that some form of the group ranges much farther south than has been supposed.

[3] The description under this name was based on a specimen (No. CCCLI) in the Paris Museum, but as I am informed by Dr. A. Menegaux in a recent letter, this specimen is not now in the museum. The description is inadequate, but the size of the animal is given as 150 mm. This measurement probably refers to the length of head and body, and if so agrees well with that of certain specimens of *sabrinus* from southern Ontario. It is too large for any member of the *volans* group. The specimen doubtless was sent from Canada (probably from the vicinity of Quebec), as suggested by the common name, "Le Polatouche du Canada," and the name *canadensis* may thus be considered a synonym of *sabrinus* of two years earlier date.

Pteromys sabrinus Richardson, Zool. Journal, III, p. 519, 1828; Fauna Boreali-Amer., I, p. 193, 1829; Audubon and Bachman, Quad. North Amer., III, p. 202, 1853, plate CXLIII.

Pteromys hudsonius Fischer, Synop. Mamm., p. 365, 1829; Baird, Mamm. North Amer.: Rept. Expl. and Surv. R. R. Pac., VIII, p. 288, 1857.

Sciuropterus volucella var. *hudsonius* Allen, Proc. Boston Soc. Nat. Hist., XVI, p. 289, 1874; Allen, Monogr. North Amer. Rodentia: Rept. U. S. Geol. Surv. Terr., XI, p. 655, 1877.

Sciuropterus volucella sabrinus Rhoads, Amer. Nat., XXVIII, p. 525, 1894.

Sciuropterus sabrinus Bangs, Proc. Biol. Soc. Washington, X, p. 162, 1896.

Type locality.—Mouth of Severn River, Ontario, Canada.

Distribution.—Interior of Canada, from Fort Simpson (possibly Fort Anderson), Mackenzie, and lower Churchill River, west side of Hudson Bay, south to northern Minnesota, extreme northwestern Wisconsin, southern Ontario (vicinity of Lake Nipissing), and southern Quebec (Lake Edward).

Characters.—Size medium (for the group); general tone of upperparts vinaceous-cinnamon; sides of face smoke gray; tail strongly shaded with fuscous; underparts whitish, shaded with drab; skull of medium size, rather long and narrow, with narrow braincase.

Color.—*Winter pelage:* Upperparts deep vinaceous-cinnamon, the sides faintly washed with light pinkish cinnamon, the underfur dark mouse gray; upper surface of flying membrane fuscous, the color extending over legs and becoming paler on feet; toes shaded with grayish white; front and sides of face smoke gray or pale smoke gray; eye-ring fuscous; underparts soiled whitish, faintly washed with pale yellowish and more or less strongly shaded with drab or hair-brown, especially along sides, the underfur deep neutral gray; tail, above, hair-brown or fuscous, often shaded near the base with vinaceous-cinnamon, the tip usually clear fuscous; beneath, drab, shaded with pale wood brown and bordered on sides and tip with hair-brown or fuscous; soles buffy white on inner side, drab on outer side. *Summer pelage:* Similar to the winter pelage.

Skull.—Size medium (larger than *macrotis*, smaller than *alpinus*); braincase rather narrow and elongate; zygomata not widely expanded, contracted anteriorly; dorsal outline nearly straight from nasals to postfrontal region; braincase moderately depressed; audital bullæ of medium size.

Measurements.—Adult male from Cochrane, Ontario: Total length, 315; tail vertebræ, 140; hind foot (dry), 40; ear from notch (dry), 18. Adult female from Lake Edward, Quebec: 315; 148; 43; 20.5. Average of 4 adults from Norway House, Manitoba: Hind foot (dry), 39.5 (38.5–41). *Skull:* Subadult male from Cochrane, Ontario: Greatest length, 40; zygomatic breadth, 24; mastoidal breadth, 18.1; least interorbital breadth, 7.3; least postorbital breadth, 8.9; length of nasals, 11.5; maxillary toothrow, 7.8. Two adults

from vicinity of Great Slave Lake, Mackenzie: Greatest length, 39.9, 40.2; zygomatic breadth, 24.5, 24.4; mastoidal breadth, 18.8, 19.2; least interorbital breadth, 8.3, 8.2; least postorbital breadth, 9.4, 9.2; length of nasals, 12, 12.8; maxillary toothrow, 7.8, 8.1.

Type specimen.—Not now known to exist.[1]

Remarks.—The Hudson Bay flying squirrel—the first form of the group to receive a name—is still imperfectly known, no specimens from the type locality being as yet available. A good series of skins from Norway House, Manitoba, doubtless represent the typical form, and these have been used in making comparisons, but there are no skulls in any collection from nearer the type locality than Great Slave Lake on one side and Cochrane, Ontario, on the other. Since these skulls, however, agree essentially in characters, they are assumed to be typical. Two winter specimens from Cochrane, Ontario, differ from Norway House specimens in being slightly paler and less vinaceous above, having the hind feet mouse gray and the tail dark hair-brown, with scarcely a trace of vinaceous; whether these specimens represent the typical race or an unrecognized form can not now be decided.

The present race has a very wide range and apparently intergrades with all the surrounding forms—with *makkovikensis* in eastern Quebec, with *macrotis* in northern Minnesota, northern Wisconsin, northern Michigan, and southern Ontario; with *canescens* in southern Manitoba, with *alpinus* in southern Mackenzie and Alberta, and probably with *bangsi* in southwestern Alberta and northwestern Montana. Specimens showing intergradation with *alpinus* have been examined from Fort Providence and Fort Simpson, Mackenzie; and from Cascade Rapid, Grand Rapids, Edmonton, and Red Deer, Alberta. The northern specimens differ from typical *sabrinus* in being paler and grayer;[2] those from Red Deer are nearly typical in color, but have skulls closely resembling those of *alpinus*. Specimens from Trout Creek, Ontario; Hinckley and Itasca County, Minn.; and Gordon, Wis., are intermediate between *sabrinus* and *macrotis*. A specimen from Godbout, Quebec, agrees with *sabrinus* in color, but has a skull equaling that of *makkovikensis* in size. Specimens from Rat Portage, Ontario, and Winnipeg, Manitoba, are paler than the typical form, thus showing approach to *canescens*.

A specimen in worn and faded pelage, without tail or skull, from Fort Liard, Mackenzie, is provisionally referred to this race. Better material from that region may show the form occurring there to be *alpinus*.

[1] The names *hudsonius* and *sabrinus* were based on Forster's account (Philos. Trans., LXII, p. 379, 1772) of a specimen sent to the Royal Society from the mouth of Severn River.

[2] Some of these intermediates bear a surprisingly close resemblance in color to *bangsi*.

Specimens examined.—Total number, 72, as follows:

Alberta: Calgary, 1; Cascade Rapid, Athabaska River, 1; Didsbury, 1; Edmonton, 4;[1] Grand Rapids, Athabaska River, 1; Gull Lake, 1;[2] Red Deer, 2.[2]

Mackenzie: Big Island, Great Slave Lake, 3; Fort Anderson, 1;[3] Fort Liard, 1;[4] Fort Providence, 5;[5] Fort Resolution, 1;[6] Fort Simpson, 2; Hay River, Great Slave Lake, 2.

Manitoba: "Hudson Bay," 1; Norway House, 9; Oxford House, 1; Red River Settlement, 3; Selkirk Settlement, 1; Winnipeg, 2.

Minnesota: Hinckley, 2; Itasca County, 8.[7]

Ontario: Cochrane, 2;[8, 9] Hannah Bay (near Moose Factory), 1;[2] Matawagamingue [=Ft. Mattagami], 5; Moose Factory, 1;[2] Rat Portage, 1; Trout Creek, 2.[8]

Quebec: Godbout, 2; Lake Edward, 1;[10] Tadousac, 1.[6]

Saskatchewan: Cumberland House, 1.

Wisconsin: Gordon, 1;[7] Nemakagan River, Burnett County, 1.[11]

GLAUCOMYS SABRINUS MAKKOVIKENSIS (Sornborger).

Labrador Flying Squirrel.

[Pl. II, fig. 12; Pl. IV, fig. 12.]

Sciuropterus sabrinus makkovikensis Sornborger, Ottawa Nat., XIV, p. 48, June 6, 1900.

Type locality.—Makkovik, Labrador.

Distribution.—Coast region of Labrador and eastern Quebec; exact limits unknown.

Characters.—Similar to *sabrinus*, but larger and darker, with darker face, tail, and feet.

Color.—*Adults:* Upperparts dark vinaceous-cinnamon (averaging a shade darker than in *sabrinus*); sides of face smoke gray; upper surface of flying membrane clove brown; feet clove brown to fuscous, the soles buffy white and toes washed with the same color; tail fuscous-black or clove brown, both above and below, moderately mixed (chiefly near the base) with pinkish cinnamon; underparts soiled whitish, faintly washed with light pinkish cinnamon or pinkish buff. *Young:* Upperparts wood brown, shaded with vinaceous-cinnamon; tail nearly uniform fuscous-black.

Skull.—Similar to that of *sabrinus*, but slightly larger.

Measurements.—Average of 5 specimens (adult and subadult) from Labrador: Total length, 309 (293–330); tail vertebræ, 138

[1] Collection Victoria Mem. Mus.
[2] Collection Mus. Comp. Zool.
[3] Fragments of skeleton; provisionally referred.
[4] Provisionally referred.
[5] Three in collection Victoria Mem. Mus.
[6] Collection Amer. Mus. Nat. Hist.
[7] Collection Dr. H. V. Ogden, Milwaukee, Wis.
[8] Collection Carnegie Museum.
[9] Collection W. E. Saunders, London, Ont.
[10] Collection Field. Mus. Nat. Hist.
[11] Collection Milwaukee Pub. Mus.

(128–146); hind foot, 41.8 (40–45). *Skull:* Average of 6 adults from Labrador: Greatest length, 40.7 (40.4–41.3); zygomatic breadth, 24.5 (23.5–25.2); mastoidal breadth, 18.9 (18.6–19.1); least interorbital breadth, 7.8 (7.3–8.2); least postorbital breadth, 10 (9.7–10.3); length of nasals, 11.4 (10.7–12.2); maxillary toothrow, 7.8 (7.3–8.1).

Type specimens.—Cotypes, Nos. 10476, 10477, Mus. Comp. Zool. (formerly Nos. 1540, 1541, collection J. D. Sornborger); skins and skulls, the skulls imperfect; collected in 1899 by Rev. W. W. Perritt.

Remarks.—The Labrador flying squirrel, like certain other species from this region, is larger and darker than the form from the interior of Canada. It is very much larger than *macrotis*, of New England. Intergradation with *sabrinus* apparently takes place in the vicinity of Godbout, Quebec. There is no material to show what form occupies the interior of eastern Quebec.

Specimens examined.—Total number, 15, as follows:

Labrador: Cartwright, 1; L'Anse au Loup, 1;[1] Makkovik, 9;[1] Paradise, 3.
Quebec: Northwest River, 1.

GLAUCOMYS SABRINUS MACROTIS (MEARNS).

MEARNS FLYING SQUIRREL.

[Pl. II, fig. 10; Pl. IV, fig. 10; Pl. VI, fig. 5.]

Sciuropterus volucella hudsonius Merriam, Trans. Linn. Soc. New York, II, p. 108, 1884 (not *Sciurus hudsonius* Gmelin).

Sciuropterus sabrinus macrotis Mearns, Proc. U. S. Nat. Mus., XXI, p. 353, Nov. 4, 1898.

Type locality.—Hunter Mountain (Catskills), Greene County, New York; altitude 3,300 feet.

Distribution.—Nova Scotia, New Brunswick, Maine, New Hampshire, Vermont, northern Massachusetts, Boreal portions of New York, northern Pennsylvania (?), southern Ontario, northern part of Michigan, and northeastern Wisconsin; west to Elk River, Minnesota.

Characters.—Similar to *sabrinus*, but smaller; ears averaging slightly longer; upperparts and hind feet paler and underparts whiter.

Color.—*Winter pelage* (adult): Upperparts cinnamon or pinkish cinnamon (rarely light pinkish cinnamon), shading on sides to pinkish buff; sides of face pale smoke gray, this color extending back on sides of neck beyond the ears; top of nose frequently tinged with gray; upper surface of membranes clove brown; fore feet drab, clouded with dull white; hind feet, above, light hair-brown or mouse gray; beneath, soiled whitish, shaded with drab or buff; tail, above, dull cinnamon, more or less mixed with hair-brown or fuscous, the general tone varying from hair-brown to pale snuff brown; beneath,

[1] Collection Mus. Comp. Zool.

pinkish cinnamon or light pinkish cinnamon; underparts white, irregularly shaded with light pinkish cinnamon. *Summer pelage:* Similar to the winter pelage, but upperparts usually slightly darker—pale orange-cinnamon. *Young* (October): Upperparts between wood brown and fawn color, otherwise as in adult.

Skull.—Similar to that of *sabrinus*, but decidedly smaller; braincase less elongate, more nearly spherical. Compared with *G. volans volans:* Slightly larger (greatest length 36 mm. or more in *macrotis;* 35.6 mm. or less in *volans*); fronto-parietal region more elevated; braincase deeper and less flattened.

Measurements.—Average of 16 adults from New York and New England:[1] Total length, 275.6 (263–290); tail vertebræ, 126.4 (115–135); hind foot, 36 (34–38); ear from notch (dry),[2] 18.8 (16–20). *Skull:* Average of 11 adults from same region: Greatest length, 37.3 (36–38.7); zygomatic breadth, 22.6 (21.9–23.5); mastoidal breadth, 17.6 (17.2–18); least interorbital breadth, 6.9 (6.2–7.3); least postorbital breadth, 9.2 (8.6–9.9); length of nasals, 10.7 (10–11.5); maxillary toothrow, 7 (6.4–7.7).

Type specimen.—No. 83152, U. S. Nat. Mus.; ♀ ad., skin and skull; collected August 31, 1896, by Edgar A. Mearns.

Remarks.—The Mearns flying squirrel is a strongly marked form having a rather extensive range in the Northeastern States and southern Canada, from Minnesota to Nova Scotia. It is not known from any point south of the Catskills in New York and the vicinity of Erie, Pa.,[3] but may be expected to occur in the mountainous parts of Pennsylvania and possibly farther south in the Alleghenies.

Intergradation with *sabrinus* is shown by specimens from southern Ontario (Gooderham) and northern Michigan (Porcupine Mountains and Vermilion). Two specimens from Elk River, Minn., show approach to *caneseens*, one of them being almost as pale as that form. The skulls are nearly typical of *macrotis*. Specimens from Maine have somewhat shorter ears than those from New York, Massachusetts, and New Hampshire.

The range of this form overlaps that of *G. volans volans* for a considerable distance in southern New England, New York, Michigan, Wisconsin, and Minnesota. Although some specimens approach *volans* rather closely in size and resemble it in the shape of skull and shortness of rostrum, they are always readily separable (except, perhaps, in the young) from the latter species by the plumbeous bases of the hairs on the belly. The upperparts, also, are decidedly more vinaceous and less drab than in *volans*.

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[1] Hunter Mountain and Peterboro, N. Y.; Wilmington, Mass.; Ossipee, N. H.; Greenville, Bucksport, and Moosehead Lake, Maine.

[2] Seven specimens from New York, Massachusetts, and New Hampshire.

[3] The specimens labeled as from Erie are without further data, but are said to have been in the collection of Geo. B. Sennett; they may not have been collected in the immediate vicinity of Erie. There are no other Pennsylvania records.

Specimens examined.—Total number, 78, as follows:

Maine: Bucksport, 3;[1] Greenville, 8;[1] Lincoln, 6;[2] Moosehead Lake, 1;[1] Steuben, 1; Third Mopang Lake, 2.[2]

Massachusetts: Lunenburg, 1; Wilmington, 3; Winchendon, 1.

Michigan: Le Roy, 1;[3] Montcalm County, 1;[3] Palmer, 1; Porcupine Mountains, 3;[3] Vermilion, 3.[3]

Minnesota: Elk River, 2.

New Brunswick: No specific locality, 1.

New Hampshire: Ossipee, 4.

New York: Adirondack Mountains, 1; Big Moose Lake, 3; Hunter Mountain, Greene County, 1; Locust Grove, 1; Peterboro, 1.

Nova Scotia: Annapolis, 3;[3, 4] Halifax, 3; Kings County, 5.[5]

Ontario: Gooderham, 3;[6] Maganetewan, 1;[2] New Edinburgh, 1;[5] Woodstock, 1.[7]

Pennsylvania: Erie [=mountains near?], 2.[8]

Vermont: Rutland, 2;[9] Sherburne, 1.[9]

Wisconsin: Clarks Lake, Door County, 1; Kelley Brook, 1;[10] Lakewood, 2; Langlade County, 1;[11] Mamie Lake, Vilas County, 2.

GLAUCOMYS SABRINUS CANESCENS Howell.

Pallid Flying Squirrel.

[Pl. II, fig. 7; Pl. IV, fig. 7; Pl. VI, fig. 11.]

Glaucomys sabrinus canescens Howell, Proc. Biol. Soc. Washington, XXVIII, p. 111, May 27, 1915.

Type locality.—Portage la Prairie, Manitoba.

Distribution.—Southern Manitoba; eastern North Dakota; Black Hills, S. Dak.; and Bear Lodge Mountains, Wyo.; exact limits unknown.

Characters.—Similar to *macrotis*, but much paler, with grayer head and larger skull. Compared with *sabrinus:* Size smaller; upperparts and feet paler; underparts whiter.

Color.—Winter pelage: Upperparts light pinkish cinnamon, shading to pale pinkish cinnamon on sides; front and sides of face (sometimes nearly the whole head) pale smoke gray; ears pale fuscous; eye-ring and upper side of flying membrane fuscous; feet hair-brown, the toes marked with grayish white; tail, above, dark cinnamon, shaded with hair-brown; beneath, light pinkish cinnamon, edged with hair-brown; underparts and soles creamy white.

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[1] Collection Mus. Comp. Zool.
[2] Collection Acad. Nat. Sci. Philadelphia.
[3] Collection Univ. Michigan.
[4] Collection E. R. Warren, Colorado Springs, Colo.
[5] Collection Victoria Mem. Mus.
[6] Collection Field Mus. Nat. Hist.
[7] Collection W. E. Saunders, London, Ont.
[8] Collection Amer. Mus. Nat. Hist.
[9] Collection G. L. Kirk, Rutland, Vt.
[10] Collection Milwaukee Pub. Mus.
[11] Collection Dr. H. V. Ogden, Milwaukee, Wis.

Skull.—Similar to that of *macrotis*, but slightly longer and relatively narrower, with longer nasals; decidedly smaller than that of *sabrinus*.

Measurements.—Average of 3 adults:[1] Total length, 297 (290–306); tail vertebræ, 138 (133–146); hind foot, 37.7 (37–38). *Skull:* Two topotypes (adult): Greatest length, 38.5, 38.8; zygomatic breadth, 22.8, 22.9; mastoidal breadth, 17.5, 17.6; least interorbital breadth, 9.2, 9.5; least postorbital breadth, 9.4, 9.2; length of nasals, 11.5, 11.2; maxillary toothrow, 7.7, 7.6.

Type specimen.—No. 7663, Field Mus. Nat. Hist.; ♀ subad., skin and skull; collected February 3, 1900, by G. F. Dippie.

Remarks.—This is the palest of the races of *sabrinus*, occupying chiefly the thinly timbered parts of southern Manitoba and eastern North Dakota. The limits of its range are not known, and may extend westward to Saskatchewan. Two specimens from the Bear Lodge Mountains, Wyo., are referred to this race, but a larger series may show characters to separate the form in that region. These two specimens show some approach to *bangsi* in skull characters and in a slightly more vinaceous coloring on the upperparts. One of them has a wash of pinkish cinnamon on the underparts. In a specimen from Portland, N. Dak., the upperparts are a deeper shade of pinkish cinnamon and the skull is larger, showing, apparently, intergradation with *sabrinus*. Two specimens in worn pelage from Pembina, N. Dak., are also considered intermediate between *canescens* and *sabrinus*.

Specimens examined.—Total number, 10, as follows:

Manitoba: Carberry, 1; Portage la Prairie, 2.[2]
Minnesota: Breckenridge, 1.
North Dakota: Grafton, 1; Pembina, 2; Portland, 1.
Wyoming: Bear Lodge Mountains (Middle Fork Hay Creek), 2.

GLAUCOMYS SABRINUS BANGSI (Rhoads).

BANGS FLYING SQUIRREL.

[Pl. II, fig. 3; Pl. IV, fig. 3; Pl. VI, fig. 10.]

Sciuropterus alpinus bangsi Rhoads, Proc. Acad. Nat. Sci. Philadelphia, June, 1897, p. 321.

Type locality.—Idaho County, Idaho.

Distribution.—Mountains of central Idaho, eastern Oregon, southwestern Montana, and western Wyoming, north to vicinity of Flathead Lake, Montana; southern limits unknown.

Characters.—Similar in size and color to *sabrinus*, but upperparts averaging more drab (less vinaceous or ochraceous) and underparts more clouded with pinkish cinnamon (never yellowish white, as in

[1] Two from type locality; one from Portland, N. Dak.
[2] Collection Field Mus. Nat. Hist.

sabrinus); feet grayer (less brownish). Compared with *alpinus:* Upperparts decidedly more vinaceous, tail paler and much less clouded with fuscous.

Color.—Winter pelage: Upperparts pale wood brown or avellaneous, shading in some specimens to vinaceous-cinnamon; feet pale hair-brown, shading to drab-gray, the toes often grayish white; tail above, wood brown, tinged with cinnamon and more or less shaded with hair-brown or fuscous; beneath, light pinkish cinnamon, shaded with dark hair-brown; underparts whitish, strongly washed with pinkish cinnamon or avellaneous. *Variation* (May specimen from Lake Como, Mont.): Upperparts pale orange-cinnamon; feet pale fuscous.

Skull.—Very similar to that of *sabrinus;* slightly smaller than that of *alpinus*, with smaller bullæ.

Measurements.—Average of 6 (adult and subadult) from Idaho and Montana:[1] Total length, 315 (304–327); tail vertebræ, 142 (137–148); hind foot, 39.5 (37–41). *Skull:* Average of 7 (adult and subadult) from same localities: Greatest length, 39.9 (38.2–41.2); zygomatic breadth, 24.3 (23.3–25); mastoidal breadth, 18.7 (18.3–19.1); least interorbital breadth, 7.5 (6.9–8); least postorbital breadth, 9 (8.4–9.7); length of nasals, 12.2 (11.1–12.5); maxillary toothrow, 8.1 (7.6–8.7).

Type specimen.—No. 6959, Mus. Comp. Zool. (formerly same number, collection E. A. and O. Bangs); ♂ subad., skin and skull; collected March 8, 1897, by Harbison and Bargamin, Raymond, Idaho.

Remarks.—This subspecies is the smallest of the Rocky Mountain forms of *sabrinus.* It agrees with the typical race in skull characters, but shows some approach in color to *alpinus*, differing from the latter, however, in color of tail and skull characters. Intergradation with *sabrinus* is indicated by a specimen from Paola, Mont. With *latipes*, whose range meets (and possibly overlaps) that of *bangsi*, there seems to be no intergradation. The specimen from Paola shows no approach to *latipes*, while one from Nyack, a few miles farther north, is clearly referable to the latter form. Specimens from western Wyoming (Pahaska, Kendall, Pacific Creek) are slightly larger than typical specimens, but do not differ appreciably in color. An August specimen from Anthony, Oreg., provisionally referred to this race, has the upperparts rich orange-cinnamon, much darker than any of the Idaho series, and quite different from another August specimen from Bourne, Oreg., which is in the normal wood-brown phase.

Specimens examined.—Total number, 31, as follows:

Idaho: Idaho County, 2;[2] Ketchum, 2;[2] Sawtooth Lake, 2.

[1] Idaho County (type and topotype), Ketchum, and Sawtooth Lake, Idaho; Florence, Mont.

[2] Collection Mus. Comp. Zool.

Montana: Florence, 6; Paola, 1; Rock Creek, near Lake Como, 1.
Oregon: Anthony, 9;[1] Bourne, 1.
Wyoming: Kendall (12 miles north, at 7,700 feet altitude), 2; Pacific Creek, 1; Pahaska, 2; Wind River Mountains, near Dubois, 2.

GLAUCOMYS SABRINUS ALPINUS (RICHARDSON).

RICHARDSON FLYING SQUIRREL.

[Pl. II, fig. 4; Pl. IV, fig. 4; Pl. VI, fig. 12.]

Pteromys alpinus Richardson, Zool. Journal, III, p. 519, 1828; Audubon and Bachman, Quad. North Amer., III, p. 206, 1854; Baird, Mamm. North Amer.: Rept. Expl. and Surv., R. R. Pac., VIII, p. 289, 1857.

Pteromys sabrinus var. *β alpinus* Richardson, Fauna Boreali-Amer., I, p. 195, 1829.

[*Sciuropterus volucella*] *alpinus* Trouessart, Bull. Soc. Angers, X, p. 67, 1880.

Sciuropterus alpinus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, p. 319, 1897.

Type locality.—Jasper House, Alberta.[2]

Distribution.—Rocky Mountain region of Alberta and British Columbia, from vicinity of Henry House north at least to Peace River and Babine Lake, British Columbia (limits of range unknown).

Characters.—Similar to *sabrinus*, but upperparts much grayer (less vinaceous), tail darker, and skull larger, with broader braincase.

Color.—*Winter pelage:* Upperparts light drab; sides of face pale smoke gray; eye-ring fuscous; ears edged with blackish brown; upper surface of flying membrane blackish brown; hind feet hair-brown; fore feet similar but slightly paler; soles and palms soiled whitish; tail wood brown, much mixed, both above and below, with fuscous or clove brown, strongest on sides and tip; underparts soiled whitish, sometimes irregularly marked (chiefly along median line) with light pinkish cinnamon.

Skull.—Similar to that of *sabrinus*, but larger, with broader braincase; postorbital constriction relatively narrow.

Measurements.—Two adults from Henry House, Alberta: Total length, 292, 343; tail vertebræ, 123, 155; hind foot, 44.5, 43; average of 3 adults from Stuart Lake, B. C.: 322; 149; 41.7. *Skull:* Average of 3 adults from Henry House and Jasper House, Alberta: Greatest length, 41.5 (41.2–42); zygomatic breadth, 25.4 (25.1–25.6); mastoidal breadth, 19.4; least interorbital breadth, 8.3 (8.2–8.8); least postorbital breadth, 9.2 (9.1–9.6); length of nasals, 12.5 (12.4–12.6); maxillary toothrow, 7.8 (7.5–8.1).

[1] Seven in collection Amer. Mus. Nat. Hist.; two in Mus. Vert. Zool., Univ. California.

[2] The habitat is given by Richardson in the original description as "Vallies in the Rocky Mountains." Later (Fauna Boreali-Amer., I, p. 195, 1829) he speaks of specimens from the head of the Elk [=Athabaska] River, and from the south branch of the Mackenzie [=Liard, specimens probably from Fort Nelson]. As Richardson speaks of Drummond as the discoverer of the species, the vicinity of Jasper House, on the headwaters of the Athabaska, near which place Drummond made extensive collections, may be considered the type locality.

Type specimen.—None known to exist.

Remarks.—This handsome race, recognized as distinct by Richardson nearly a century ago, has until recently been imperfectly known. Baird, in 1857, admitted the species but was in doubt as to its real characters. Allen, in his Monograph of the Sciuridæ (1877) placed it in synonymy. Rhoads, in 1897,[1] restored it to specific rank, evidently using New England specimens of *macrotis* in comparison and considering them typical of *sabrinus*. Additional material now available, both of typical *alpinus* and of *sabrinus* from various parts of its range, shows conclusively that the two forms are subspecifically related. As already shown under *sabrinus* (p. 33), specimens from western Mackenzie and northern Alberta are intermediate in color between *alpinus* and *sabrinus* and those from southern Alberta have skulls nearly typical of *alpinus* but agree with *sabrinus* in color. Of two specimens from Peace River Canyon, B. C., one is typical of *alpinus*, while the other closely matches *sabrinus* in color. The present form intergrades, also, with *zaphœus* and *columbiensis* in British Columbia, and possibly with *bangsi* in southern Alberta. Several specimens from Stuart Lake, B. C., are intermediate in color between *alpinus* and *columbiensis*, while one specimen is so dark as to suggest intergradation with *zaphœus*.

Specimens examined.—Total number, 23, as follows:

Alberta: Henry House, 3; Jasper House, 2; no specific locality, 1.[2]

British Columbia: Babine Lake, 8; Cariboo, 1;[2] Peace River Canyon (near Hudsons Hope), 2; Stuart Lake, 6.[3]

GLAUCOMYS SABRINUS YUKONENSIS (Osgood).

Yukon Flying Squirrel.

[Pl. II, fig. 8; Pl. IV, fig. 8.]

Sciuropterus yukonensis Osgood, North Amer. Fauna No. 19, p. 25, Oct. 6, 1900.

Type locality.—Camp Davidson, Yukon River, Yukon (near Alaska-Canada boundary).

Distribution.—Yukon River region, from vicinity of Mayo Lake, Yukon (head of Stewart River), to Tanana, Alaska; exact limits unknown.

Characters.—Similar to *sabrinus* in color, but larger, with longer tail, broader hind foot, and larger skull. Compared with *alpinus:* Upperparts more ochraceous (less drab); tail longer and more vinaceous.

Color.—Upperparts pinkish cinnamon to vinaceous-cinnamon; sides of face pale smoke gray, sometimes clouded with light pinkish

[1] Proc. Acad. Nat. Sci. Philadelphia., 1897, p. 319.

[2] Collection Field Mus. Nat. Hist.

[3] Two in collection Provincial Mus., Victoria, B. C.; one in Acad. Nat. Sci. Philadelphia.

cinnamon; eye-ring clove brown or fuscous-black; upper surface of flying membrane clove brown or fuscous; legs similar, partially overlaid with the color of the back; feet wood brown, hair-brown, or mouse gray; soles and palms cinnamon-buff or whitish, clouded with mouse gray; tail above, sayal brown, shaded with fuscous, becoming pure fuscous at the tip; beneath, vinaceous-cinnamon or light pinkish cinnamon, edged with fuscous or hair-brown; underparts soiled whitish, moderately washed with light pinkish cinnamon or avellaneous.

Skull.—Closely similar to that of *alpinus;* braincase slightly larger; nasals slightly shorter.

Measurements.—Type: Total length, 365; tail vertebræ, 180;[1] hind foot (dry), 41; ♀ adult from Tanana, Alaska: 324; 150; 42. *Skull:* Average of 3 adults from Alaska:[2] Greatest length, 41.3 (41–41.5); zygomatic breadth, 25.2 (25.1–25.3); mastoidal breadth, 19.6 (19.5–19.7); least interorbital breadth, 8.1 (7.8–8.3); least postorbital breadth, 9.5 (9.3–10.3); length of nasals, 11.9 (11.6–12.1); maxillary toothrow, 8.3 (7.9–8.7).

Type specimen.—No. $\frac{19909}{35320}$, U. S. Nat. Mus.; ♀ ad., skin and skull; collected December 8, 1890, by R. E. Carson.

Remarks.—This is one of the larger members of the group, about equaling *latipes* and *bullatus* in external measurements. The hind feet, although about the same length as those of *alpinus*, are considerably broader and heavier, and the tail averages longer. Although the present form resembles *sabrinus* in color, its skull is practically identical with that of *alpinus*. No specimens are available from the large area between the known ranges of *alpinus* and *yukonensis*, but in view of the close relationship of these two forms, as shown by the skull characters, it seems probable that they will be found to intergrade, and for that reason *yukonensis* is here treated as a subspecies of *sabrinus*. Osgood states[3] that flying squirrels have been taken in the Knik district, Cook Inlet, but until specimens can be secured from that region their subspecific identity must remain in doubt.

Specimens examined.—Total number, 10, as follows:

Alaska: Big Chena River (65 miles from mouth), 1;[4] Chicken, 1; Tanana, 3; Toklat River (head), 1.

Yukon: Camp Davidson (near Alaska-Canada boundary), 2; Fortymile, 1;[5] Mayo Lake, 1.[6]

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[1] In a topotype, the tail (measured from dry skin) is approximately 160.
[2] Camp Davidson, Tanana, and head of Toklat River.
[3] Osgood, W. H., North Amer. Fauna No. 21, p. 63, 1901.
[4] Skull only.
[5] Collection Mus. Vert. Zool., Univ. California.
[6] Collection Victoria Mem. Mus.

GLAUCOMYS SABRINUS ZAPHÆUS (Osgood).

Alaska Coast Flying Squirrel.

[Pl. III, fig. 6; Pl. V, fig. 6; Pl. VI, fig. 9.]

Sciuropterus alpinus zaphæus Osgood, Proc. Biol. Soc. Washington, XVIII, p. 133, Apr. 18, 1905.

Type locality.—Helm Bay, Cleveland Peninsula, Alaska.

Distribution.—Coast region of southeastern Alaska and northern British Columbia; limits of range unknown.

Characters.—Similar to *alpinus*, but upperparts browner (less grayish) and underparts darker. Compared with *oregonensis*: Upperparts paler; underparts grayer (without cinnamon or buff).

Color.—*Winter pelage:* Upperparts sayal brown; sides of face pale smoke gray, often clouded with fuscous-black, the blackish eye-ring often pronounced; upper surface of flying membrane fuscous; feet dark hair-brown or fuscous, the soles whitish tinged with hair-brown on outer margin; tail above, fuscous, tinged with sayal brown; beneath, dull vinaceous-cinnamon, much clouded with fuscous on sides and tip; underparts soiled whitish, strongly washed with avellaneous or wood brown, strongest along sides. *Summer pelage:* Upperparts yellowish wood brown; underparts washed with pinkish cinnamon.

Skull.—Similar to that of *alpinus*, but braincase narrower, bullæ slightly smaller, and upper toothrow slightly longer.

Measurements.—Average of 6 topotypes (adult): Total length, 307 (292–311); tail vertebræ, 144 (133–152); hind foot (dry skin), 40.7 (39–42); average of 3 topotypes (adult):[1] 306; 145; 40. *Skull:* Average of 6 topotypes (adult and subadult): Greatest length, 40.1 (39.3–41.5); zygomatic breadth, 24.7 (23.7–26.2); mastoidal breadth, 18.7 (18.2–19.1); least interorbital breadth, 7.8 (7.4–8.3); least postorbital breadth, 9 (8.7–9.8); length of nasals, 12.5 (12.2–12.9); maxillary toothrow, 7.8 (8–8.6).

Type specimen.—No. 136137, U. S. Nat. Mus. (Biological Survey collection); ♀ ad., skin and skull; collected January 21, 1905, by Cyrus Catt.

Remarks.—This subspecies is intermediate in color between *alpinus* and *oregonensis*, being nearer the latter in the color of the upperparts, but lacking the deep cinnamon-buff on the underparts. In skull characters it is close to *alpinus* and intergrades with it in the interior of British Columbia. The northern and southern limits of its range are unknown, but very probably it intergrades with *oregonensis* in southwestern British Columbia and possibly with *yukonensis* in Yukon.

[1] Measured in flesh by Frank Stephens.

Specimens examined.—Total number, 14, as follows:

Alaska: Bradfield Canal, 1;[1] Etolin Island, 1;[1] Helm Bay, Cleveland Peninsula, 10;[2] Tongass, 1.

British Columbia: Nass River, 1.

GLAUCOMYS SABRINUS OREGONENSIS (BACHMAN).

BACHMAN FLYING SQUIRREL.

[Pl. III, fig. 11; Pl. V, fig. 11; Pl. VI, fig. 8.]

Pteromys oregonensis Bachman, Journ. Acad. Nat. Sci. Philadelphia, VIII, p. 101, 1839; Audubon and Bachman, Quad. North Amer., I, p. 132, 1846.

[*Sciuropterus volucella*] *oregonentis* [sic] Trouessart, Bull. Soc. Angers, X, p. 67, 1880.

Sciuropterus alpinus oregonensis Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1897, p. 324.

Type locality.—"Pine woods of the Columbia near the sea"—probably near the present site of St. Helens, Oregon.

Distribution.—Coast region of Oregon, Washington, and southern British Columbia; northern and southern limits unknown.

Characters.—Similar to *zaphaus*, but colors more rufescent, both above and below (upperparts rich reddish brown, underparts cinnamon or buff); sides of face more buffy (less grayish); skull slightly smaller.

Color.—*Winter pelage:* Upperparts mikado brown or pecan brown; sides of face smoke gray or grayish white, often much mixed with buff or cinnamon; upper surface of flying membrane clove brown or fuscous; hind feet snuff brown or pale fuscous, the soles pinkish buff shaded with drab; fore feet hair-brown or drab; tail above, snuff brown, shaded on sides and tip with fuscous or clove brown; beneath, cinnamon-buff; underparts heavily washed with pinkish cinnamon or cinnamon-buff.

Skull.—Similar to that of *zaphaus*, but averaging smaller, with the zygomata less widely expanded. Closely similar to that of *fuliginosus*, but averaging slightly smaller.

Measurements.—Average of 4 adults from Oregon:[3] Total length, 300 (294–310); tail vertebræ, 127 (122–138); hind foot, 38.6 (38–40). *Skull:* Average of 8 adults from Oregon:[4] Greatest length, 39.9 (38.5–40.7); zygomatic breadth, 23.7 (23–24.9); mastoidal breadth, 18.3 (17.6–19); least interorbital breadth, 7.9 (7.3–8.8); least postorbital breadth, 8.6 (8.1–9); length of nasals, 12.2 (10.9–12.9); maxillary toothrow, 8.2 (7.9–8.7).

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[1] Collection Mus. Vert. Zool., Univ. California.

[2] Four in collection Mus. Vert. Zool., Univ. California.

[3] Portland, Yaquina Bay, and Gold Beach.

[4] Portland (3), Latourelle Falls, Yaquina Bay, Gold Beach, Salem, and lower Columbia River (type).

Type specimen.—No. 235, Acad. Nat. Sci. Philadelphia; adult, skin and skull; skin (dismounted and skull removed) in fair condition, possibly somewhat faded; skull nearly perfect, but portion of occiput cut away; collected in 1839 by J. K. Townsend.

Remarks.—The Bachman flying squirrel is easily recognized by its rich coloration, rufescent above and buffy below. It occupies the humid northwest coast belt, but does not range high in the mountains. Intergradation with *fuliginosus* is shown by a specimen from Marmot, Oreg. (west slope of Mount Hood), and with *columbiensis* by specimens from Sumas, Chilliwack, and Stave Lake, B. C. These latter specimens agree with *oregonensis* in the color of the upperparts, but are much paler beneath. A specimen from Sulphur Springs, Oreg., is considerably paler above than typical specimens. Specimens from Yaquina Bay and Gold Beach, Oreg., have smaller skulls than the type and other specimens from the Columbia River.

Specimens examined.—Total number, 41, as follows:

British Columbia: Agassiz, 1;[1] Chilliwack, 1; Harrison, 1;[2] Mission, 1;[3] Stave Lake, 1;[4] Sumas, 3.[4]

Oregon: Brownsville, 1;[5] Clackamas River, 1; "Columbia River," 3;[6] Elk Head, 1; Gold Beach, 1; Latourelle Falls (18 miles east of Portland), 1;[7] Marmot, 1; Portland, 4; Port Orford, 4; Salem, 1;[7] Sulphur Springs, Benton County (near Albany), 1; Yaquina Bay, 1; no specific locality, 2.

Washington: Camp Skagit, 1; Fort Bellingham, 1; "Lewis River," 1;[4] Olympic Mountains (north Fork Skokomish River), 1; Puget Sound, 6; no specific locality, 1.

GLAUCOMYS SABRINUS COLUMBIENSIS Howell.

OKANAGAN FLYING SQUIRREL.

[Pl. III, fig. 7; Pl. V, fig. 7; Pl. VI, fig. 7.]

Glaucomys sabrinus columbiensis Howell, Proc. Biol. Soc. Washington, XXVIII, p. 111, May 27, 1915.

Type locality.—Okanogan, British Columbia.

Distribution.—Interior valleys and foothills of southern British Columbia and northern Washington, from Shuswap Lake and Cranbrook, British Columbia, south to Lake Chelan, Washington.

Characters.—Decidedly paler than *oregonensis*, both above and below; similar to *klamathensis*, but upperparts more vinaceous and tail much darker; very similar to *sabrinus*, but soles of hind feet often yellow (as in *klamathensis*), and skull larger. Compared with

[1] Collection W. E. Saunders, London, Ont.
[2] Collection Provincial Mus., Victoria, B. C.
[3] Collection Victoria Mem. Mus.
[4] Collection Mus. Comp. Zool.
[5] Collection Leland Stanford, Jr., Univ.
[6] Collection Acad. Nat. Sci. Philadelphia.
[7] Collection Game Dept. Oregon.

fuliginosus: Upperparts more vinaceous (less brownish); underparts paler; tail more brownish.

Color.—Winter pelage: Upperparts between vinaceous-cinnamon and vinaceous-fawn; sides of face smoke gray, shaded with fuscous; front of face sometimes marked with grayish white; upper surface of flying membrane clove brown; feet hair-brown or pale fuscous, the soles deep colonial buff, or sometimes grayish white; tail above, snuff brown, shading to fuscous on sides and tip; beneath, pinkish cinnamon, more or less clouded (often strongly) with fuscous; underparts white, tinged with straw yellow or light pinkish cinnamon.

Skull.—Closely similar to that of *alpinus*, but averaging slightly narrower, with flatter, shallower braincase; similar to that of *oregonensis*, but slightly larger, with shorter toothrow; very similar to that of *fuliginosus*, but averaging relatively broader.

Measurements.—Two topotypes (subadult): Total length, 313; tail vertebræ, 143; hind foot, 42. *Skull:* Average of 7 (adult and subadult) from southern British Columbia.[1] Greatest length, 41.1 (40.3–41.6); zygomatic breadth, 24.5 (23.6–25.2); mastoidal breadth, 19.1 (18.8–19.5); least interorbital breadth, 7.8 (7.3–8.6); least postorbital breadth, 9.1 (8.4–9.7); length of nasals, 12.6 (12–13.3); maxillary toothrow, 7.8 (7.6–8.2).

Type specimen.—No. 94310, U. S. Nat. Mus. (Biological Survey collection); ♂ subad., skin and skull; collected May 9, 1898, by Allan Brooks.

Remarks.—This subspecies, like most of the races inhabiting the dry interior valleys of southern British Columbia, is considerably paler than the coast form (*oregonensis*). Intergradation with the latter is shown by a series of specimens from Sumas and Chilliwack, B. C., and with *fuliginosus* by a series from mouth of Salmon River, B. C. Two specimens in the latter series are referable to the present form, although having somewhat darker underparts. Other specimens, labeled as from the same locality but possibly taken at a higher altitude, agree essentially with *fuliginosus*, to which race they are referred. Intergradation with *alpinus* is shown by specimens from Stuart Lake, B. C. (referred to *alpinus*). One specimen from Cranbrook, B. C., is considerably grayer above than the typical form, thus suggesting intergradation with *latipes*, with which it agrees in all other respects. Another from the same place is typical.

Specimens examined.—Total number, 11, as follows:

British Columbia: Cranbrook, 2; Grand Prairie (22 miles northwest of Okanogan), 1;[2] Okanogan, 2; (Okanogan Falls (Shuttleworth Creek), 1;[2] Penticton, 1;[3] Salmon River (mouth), 2;[3] Vernon, 1.

Washington: Chelan Mountains, 1.[4]

[1] Okanogan, Vernon, Penticton, Cranbrook, and mouth of Salmon River.
[2] Collection Provincial Mus., Victoria, B. C.
[3] Collection Victoria Mem. Mus.
[4] Collection Amer. Mus. Nat. Hist.

GLAUCOMYS SABRINUS FULIGINOSUS (RHOADS).

CASCADE FLYING SQUIRREL.

[Pl. III, fig. 4; Pl. V, fig. 4; Pl. VII, fig. 7.]

Sciuropterus alpinus fuliginosus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, June, 1897, p. 321.

Type locality.—Cascade Mountains, near Martin Station, Kittitas County, Washington (altitude about 8,000 feet).

Distribution.—Cascade Range, from southern British Columbia south through Washington and Oregon to the Siskiyou Mountains, California.

Characters.—Similar to *columbiensis*, but upperparts more brownish (less vinaceous); underparts darker, and tail paler (less brownish). Compared with *oregonensis:* Colors much less rufescent, especially on upperparts and underside of tail.

Color.—Winter pelage: Upperparts pale sayal brown (between sayal brown and wood brown), the sides sometimes faintly washed with pinkish cinnamon; upper surface of flying membrane clove brown; sides of face smoke gray or pale smoke gray, sometimes washed with light buff or pale fuscous; eye-ring fuscous; ears hair-brown; hind feet dark hair-brown (approaching fuscous), the toes marked with buffy white, the soles buffy white or yellowish white, edged with hair-brown; tail above, dark hair-brown, shading to fuscous, sometimes sparingly mixed with dull cinnamon or pinkish cinnamon; beneath, pale ochraceous-buff or light ochraceous-buff, edged on sides with fuscous, the bases of hairs pale smoke gray; underparts pinkish cinnamon or light pinkish cinnamon, the throat often creamy white.

Skull.—Closely similar to that of *columbiensis*, but averaging relatively narrower; similar to that of *oregonensis*, but slightly larger.

Measurements.—Average of 3 topotypes (adult): Total length, 308 (304–317); tail vertebræ, 144 (140–153); hind foot, 40.7 (40–42). *Skull:* Average of 10 (adult and subadult) from Easton and Keechelus Lake, Wash.: Greatest length, 41.4 (40.2–42.5); zygomatic breadth, 24.1 (23.5–24.9); mastoidal breadth, 18.7 (17.9–19.3); least interorbital breadth, 8.3 (7.7–9); least postorbital breadth, 9.1 (8.4–9.6); length of nasals, 12.9 (12.3–13.3); maxillary toothrow, 8.4 (8.2–8.4).

Type specimen.—No. 8058, Acad. Nat. Sci. Philadelphia (formerly No. 1058, collection S. N. Rhoads); ♂ subad., skin and skull; collected in March, 1893, by Allan Rupert.

Remarks.—This subspecies, occupying the Cascade Range in Washington and Oregon, is markedly paler than the coast form (*oregonensis*). It intergrades with the latter on the western slopes of the range, with *klamathensis* on the eastern slopes in Oregon, with *colum-*

biensis in southern British Columbia, and with *flaviventris* in northwestern California.

Specimens from Vida and Belknap Springs, Oreg., have browner backs and paler bellies than the typical series, thus showing approach to *oregonensis*. A specimen from Crater Lake, Oreg., approaches *klamathensis* in having paler and more yellowish underparts. Specimens from the Siskiyou Mountains, Cal., are intermediate between *fuliginosus* and *flaviventris*, agreeing with the former in the color of the upperparts and feet and in skull characters, but having the underparts paler and more yellowish than in typical specimens.

Specimens examined.—Total number, 68, as follows:

British Columbia: Hope, 7;[1, 2] Salmon River (mouth), 6.[3]
California: Preston Peak, 1; Siskiyou Mountains, 5.
Oregon: Belknap Springs, 2; Crater Lake, 1; McKenzie Bridge, 2; Vida, 3.[4]
Washington: Bumping Lake, Yakima County, 1; Cowlitz River, 1; Easton, 18; Keechelus Lake, 14; Martin Station, 3; Potato Hill, 15 miles north of Goldendale, 1; Signal Peak, Yakima Indian Reservation, 3.

GLAUCOMYS SABRINUS LATIPES Howell.

BROAD-FOOTED FLYING SQUIRREL.

[Pl. III, fig. 8; Pl. V, fig. 8; Pl. VII, fig. 8.]

Glaucomys sabrinus latipes Howell, Proc. Biol. Soc. Washington, XXVIII, p.112, May 27, 1915.

Type locality.—Glacier, British Columbia.

Distribution.—Selkirk Range, and other ranges in southeastern British Columbia, higher mountains of northern Idaho and northwestern Montana; south to Mullan and Orofino, Idaho.

Characters.—Similar to *fuliginosus* but larger; upperparts averaging darker and grayer; feet larger and darker. Compared with *alpinus* and *bangsi:* Size larger; upperparts more brownish (less drab); underparts darker.

Color.—*Winter pelage:* Upperparts drab, more or less mixed with sayal brown; sides of face smoke gray; ears fuscous; upper surface of flying membrane dark clove brown; hind feet fuscous; fore feet dark hair-brown, the toes shaded with buffy white; tail above, fuscous shaded with sayal brown; beneath, pinkish buff or light ochraceous-buff, more or less mixed with fuscous; underparts light ochraceous-buff or cinnamon-buff. *Summer pelage:* Upperparts chiefly sayal brown with a drab tinge, otherwise as in winter.

Skull.—Similar in general to that of *fuliginosus*, but larger (about equaling that of *bullatus*): longer and relatively narrower than that of *alpinus*.

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[1] Collection Mus. Comp. Zool.
[2] Collection E. R. Warren, Colorado Springs, Colo.
[3] Collection Victoria Mem. Mus.
[4] Two in collection Game Dept. Oregon.

Measurements.—Average of 10 adults:[1] Total length, 342 (315–368); tail vertebræ, 153 (145–161); hind foot, 41.4 (38–44). *Skull:* Average of 7 adults:[1] Greatest length, 42.9 (41.6–44.2); zygomatic breadth, 24.5 (24–25.4); mastoidal breadth, 19.5 (19–20); least interorbital breadth, 8.3 (8–8.8); least postorbital breadth, 8.8 (8–9.1); length of nasals, 13.3 (12.5–14); maxillary toothrow, 8.3 (7.9–9).

Type specimen.—No. 68753, U. S. Nat. Mus. (Biological Survey collection), ♀ ad., skin and skull; collected August 13, 1894, by J. Alden Loring.

Remarks.—This subspecies is one of the largest of the American flying squirrels, nearly equaling *bullatus* in external measurements and size of skull. Although evidently closely related to *fuliginosus* of the Cascades, intermediate specimens are unknown, but are likely to be found when further collecting is done in British Columbia. The present form apparently does not intergrade either with *alpinus* of the northern Rockies or with *bangsi* of the Bitterroot and Sawtooth Ranges in Idaho and Montana. From the latter race, the range of which meets that of *latipes* in northern Montana, this form differs in much larger size and darker colors. The range of *latipes* is apparently confined to the mountains, since another form (*columbiensis*) occurs in the Okanogan Valley and at Cranbrook, B. C. One specimen from the latter locality nearly matches specimens of *latipes* in color of the upperparts, but in other characters agrees with *columbiensis*.

Specimens examined.—Total number, 23, as follows:

British Columbia: Glacier, 1; Schoonover Mountain, near Okanogan (4,000 feet altitude), 2;[2] Shuswap, 1.
Idaho: Coolin, 4; Mullan, 7; Orofino, 1; Priest Lake, 1.
Montana: Nyack 1; Stanton Lake, 5.

GLAUCOMYS SABRINUS OLYMPICUS (Elliot).

OLYMPIC FLYING SQUIRREL.

[Pl. III, fig. 10; Pl. V, fig. 16; Pl. VII, fig. 6.]

Sciuropterus alpinus olympicus Elliot, Field Columb. Mus., Publ. 30, Zool. Ser., I, p. 225, Feb. 1, 1899.

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

Distribution.—Olympic Peninsula, Washington, and south along the coast to southern Oregon; occurring in some localities with *oregonensis*.

[1] From Glacier, B. C.; Coolin, Idaho; and Stanton Lake and Nyack, Mont.
[2] Collection Provincial Mus., Victoria, B. C.

Characters.—Similar to *fuliginosus*, but upperparts, face, and feet much darker; colors much less rufescent than in *oregonensis*, both above and below; skull similar to that of *fuliginosus*, slightly larger than that of *oregonensis*.

Color.—*Worn summer pelage:* Upperparts wood brown; sides of face smoke gray shaded with cinnamon; eye-ring and upper surface of flying membrane fuscous-black; ears pale fuscous; feet fuscous, the soles shaded with buffy white; tail above, fuscous; beneath, dull light pinkish cinnamon, edged with fuscous; underparts whitish, heavily washed with pinkish cinnamon. *Winter pelage* (specimens from Ocean View, Oreg.):[1] Upperparts snuff brown; tail above, snuff brown heavily shaded with fuscous or fuscous-black; feet deep mouse gray; otherwise as in summer.

Skull.—Essentially the same as in *fuliginosus;* very similar to that of *oregonensis*, but averaging slightly larger.

Measurements.—Average of 4 topotypes (subadult): Total length, 335 (328–346); tail vertebræ, 162 (159–166); hind foot, 37.3 (35–39). *Skull:* Greatest length, 41 (40.3–41.6); zygomatic breadth, 23.9 (23.4–24.7); mastoidal breadth, 18.6 (18.4–19); least interorbital breadth, 8.2 (7.6–8.5); least postorbital breadth, 9.1 (8.8–9.4); length of nasals, 12.4 (11.2–13.2); maxillary toothrow, 8.4 (8.3–8.5).

Type specimen.—No. 5902, Field Mus. Nat. Hist.; ♂ subad., skin and skull; collected September 10, 1898, by D. G. Elliot.

Remarks.—The Olympic flying squirrel is apparently the darkest of the American forms. It is most nearly related to *oregonensis*, from which it differs in much less rufescent coloration. The material at hand is insufficient to show clearly whether the two races intergrade. The occurrence of typical specimens of both forms in the Olympic Mountains and at Gold Beach, Oreg., argues for their specific distinctness, but, on the other hand, a series from Ocean View, Oreg., strongly suggests intergradation, some of the specimens being clearly intermediate in color between *olympicus* and *oregonensis*. In view of the close cranial relationship which *olympicus* bears to both *oregonensis* and *fuliginosus* it seems best to unite it with them as a subspecies of *sabrinus*. To clear up the problem much additional material is needed—particularly a good series of winter specimens from the type region. At present the only available specimens in winter pelage are those from Ocean View, Oreg., which, as already explained, may be shading toward *oregonensis*.

Specimens examined.—Total number, 15, as follows:

Oregon: Gold Beach, 1;[2] Ocean View, 9.[3]
Washington: Olympic Mountains, 4;[2] Seattle, 1.[2]

[1] Possibly not typical—see Remarks.
[2] Collection Field Mus. Nat. Hist.
[3] Collection Game Dept. Oregon.

GLAUCOMYS SABRINUS BULLATUS Howell.

SAWTOOTH MOUNTAINS FLYING SQUIRREL.

[Pl. III, fig. 12; Pl. V, fig. 12; Pl. VII, fig. 4.]

Glaucomys bullatus Howell, Proc. Biol. Soc. Washington, XXVIII, p. 113, May 27, 1915.

Type locality.—Sawtooth [Alturas] Lake, Idaho.

Distribution.—Sawtooth Mountains, Idaho, north to Cranbrook, British Columbia, and west to the Blue Mountains, Oregon (fig. 4).

Characters.—Similar to *klamathensis*, but larger, with much larger bullæ; upperparts more pinkish, underparts tinged with avellaneous instead of yellow, tail darker above and more vinaceous below, and soles of hind feet smoke gray instead of olive-ochre. Similar in color to *bangsi*, but upperparts decidedly more pinkish (less vinaceous or drab); gray on face purer and more extensive; size much larger.

FIG. 4.—Map showing the distribution of *Glaucomys sabrinus bullatus*, based on specimens examined. This form occurs in some localities with others of the same species (see fig. 3, p. 30).

Color.—*Winter pelage:* Upperparts between pinkish cinnamon and cinnamon-buff, shaded in some specimens with wood brown, becoming paler on the face; sides of face and neck pale smoke gray, this color extending back to a point slightly behind the ears; ears dark hair-brown edged with fuscous and often partly clothed with smoke gray hairs; upper surface of flying membrane between hair-brown and fuscous; feet between mouse gray and hair-brown, the fore feet and toes of hind feet often marked with grayish white, the soles pale smoke gray; tail above, pinkish cinnamon much mixed with fuscous, becoming dark mouse gray at tip; beneath, dull light pinkish cinnamon; underparts creamy white, strongly shaded with avellaneous or light pinkish cinnamon, becoming pure avellaneous on sides. *Summer pelage:* Hind feet somewhat paler (about mouse gray) but otherwise as in winter.

Skull.—Size large (averaging largest of the races of *sabrinus*); braincase relatively narrow and very deep, abruptly depressed posteriorly; interorbital region depressed and fronto-parietal region markedly elevated; interorbital region broad, the interorbital notch obsolete or much reduced; audital bullæ very large; basioccipital relatively narrow; molar teeth massive.

Measurements.—Type: Total length, 340; tail vertebræ, 150; hind foot, 46. Average of 6 adults from Ketchum, Idaho: Total length, 336 (327–354); tail vertebræ, 142 (135–150); hind foot, 42.5 (39–45). *Skull:* Average of type and of 5 adults from Ketchum, Idaho: Greatest length, 43.3 (42.4–44.2); zygomatic breadth, 25 (24.4–25.5); mastoidal breadth, 19.3 (19–20); least interorbital breadth, 8.9 (8.1–9.6); least postorbital breadth, 9.4 (9–9.7); length of nasals, 13.6 (13.5–13.9); maxillary toothrow, 9.1 (8.8–9.3).

Type specimen.—No. $\frac{24271}{31675}$, U. S. Nat. Mus. (Biological Survey collection): ♀ ad., skin and skull; collected September 28, 1890, by Vernon Bailey and B. H. Dutcher.

Remarks.—This race is the largest and one of the handsomest of the American flying squirrels. It was originally believed to be a distinct species, since it occurs at the same localities with *bangsi* in Idaho and with *latipes* in British Columbia, and does not intergrade with them, but recently acquired material from eastern Oregon shows intergradation with *klamathensis*. An adult from Beech Creek, Oreg., agrees well with typical *bullatus* in color, and its skull is slightly larger than the largest of the Idaho series; the braincase, however, is relatively broader and flatter. Another adult from Cornucopia, Oreg., approaches *klamathensis* in having the belly and the soles tinged with colonial buff. A specimen from Cranbrook, British Columbia, differs from the Idaho series in having the underparts a slightly darker shade of cinnamon and the tail more extensively shaded with fuscous.

Specimens examined.—Total number, 14, as follows:

British Columbia: Cranbrook, 1.
Idaho: Ketchum, 6;[1] Sawtooth Lake, 2.
Oregon: Anthony, 1;[2] Beech Creek, 1; Cornucopia, 3.

GLAUCOMYS SABRINUS KLAMATHENSIS (MERRIAM).

KLAMATH FLYING SQUIRREL.

[Pl. III, fig. 3; Pl. V, fig. 3; Pl. VII, fig. 3.]

Sciuropterus alpinus klamathensis Merriam, Proc. Biol. Soc. Washington, XI, p. 225, July 15, 1897.

Type locality.—Fort Klamath, Oregon.

Distribution.—Central Oregon, chiefly east of the Cascades; northern and eastern limits unknown.

Characters.—Similar to *fuliginosus* but upperparts averaging slightly paler; gray on face purer and more extensive (less mixed with buff); underparts paler, usually washed with pale yellow; soles strongly tinted with yellow; audital bullæ larger. Similar to *bullatus*

[1] Collection Mus. Comp. Zool. [2] Collection Amer. Mus. Nat. Hist.

but bullæ smaller, colors paler, and underparts and soles shaded with yellowish.

Color.—Winter pelage: Upperparts cinnamon-drab or pale sayal brown shading in some specimens to light yellowish drab; sides of face smoke gray, often considerably washed with pinkish cinnamon; upper surface of flying membrane fuscous; ears drab or pale hair-brown; hind feet hair-brown, the soles olive-ochre or deep colonial buff; fore feet light brown mixed with buffy white; tail above, sayal brown or dull cinnamon, much mixed with hair-brown, the tip nearly pure hair-brown; beneath, pinkish buff, light pinkish cinnamon, or colonial buff, moderately shaded with hair-brown, chiefly on sides; underparts whitish, rather heavily washed with colonial buff or cream-buff, shading to light pinkish cinnamon along sides.

Skull.—Similar to that of *fuliginosus* but with larger bullæ; similar to that of *bullatus* but smaller, with smaller bullæ and flatter braincase.

Measurements.—Average of 9 topotypes (adult and subadult): Total length, 319 (300–336); tail vertebræ, 144 (135–154); hind foot, 40.4 (39.5–42). *Skull:* Average of 6 topotypes (adult and subadult): Greatest length, 40.9 (40.2–42.3); zygomatic breadth, 23.6 (23.2–25); mastoidal breadth, 18.9 (18.6–19.6); least interorbital breadth, 7.8 (7–9); least postorbital breadth, 9.2 (8.6–10); length of nasals, 12.7 (11.8–13.9); maxillary toothrow, 8.6 (8.1–9).

Type specimen.—No. 87310, U. S. Nat. Mus. (Biological Survey collection); ♀ ad., skin and skull; collected January 11, 1897, by B. L. Cunningham.

Remarks.—This race occupies the interior of Oregon, chiefly east of the Cascades, but extending into the eastern foothills of that range and occasionally as high as Crater Mountain (4 miles south of Crater Lake). It intergrades with *fuliginosus* in the Cascades and with *flaviventris* in northeastern California. A series of specimens from Davis Mountain, Crook County, Oreg., exhibit the characters of the subspecies in a more pronounced way than the series from the type locality. In color they are more drab above and have the underparts and feet more intensely yellowish; the skulls average somewhat larger. A specimen from Paulina Lake, Oreg., differs from typical specimens in having gray instead of yellow feet, and approaches *fuliginosus* also in the color of the back and underparts.

Specimens examined.—Total number, 27, as follows:

Oregon: Crater Mountain (4 miles south of Crater Lake), 1; Davis Mountain, Crook County, 7;[1] Fort Klamath, 17; Paulina Lake, 1; "Upper Klamath" [Lake], 1.[2]

[1] Collection Game Dept. Oregon. [2] Collection Field Mus. Nat. Hist.

GLAUCOMYS SABRINUS FLAVIVENTRIS Howell.

Yellow-Bellied Flying Squirrel.

[Pl. III, fig. 2; Pl. V, fig. 2; Pl. VII, fig. 2.]

Glaucomys sabrinus flaviventris Howell, Proc. Biol. Soc. Wash., XXVIII, p. 112, May 27, 1915.

Type locality.—Head of Bear Creek, Trinity County, California (altitude, 6,400 feet).

Distribution.—Northern California, from the Trinity Mountains in Siskiyou and Trinity Counties east to the Warner Mountains, Modoc County.

Characters.—Similar to *klamathensis* but smaller, with much smaller audital bullæ; underparts and feet more strongly suffused with yellow or buff; tail darker beneath.

Color.—Summer pelage: Upperparts pale sayal brown varying in some specimens to drab; sides of head smoke gray, often tinged with buff; ears hair-brown; upper surface of flying membrane fuscous; feet hair-brown, often tinged with pale greenish yellow, the soles oil yellow; tail above, dark buffy brown, shading to pale fuscous at tip; beneath, brownish cream-buff, bordered on sides with pale fuscous or hair-brown; underparts whitish, usually heavily washed with pale greenish yellow or Naples yellow, shading to wood brown along sides; a small white patch on throat, the hairs white to the roots.

Skull.—Similar to that of *klamathensis*, but decidely smaller, with much smaller bullæ; much smaller than that of *fuliginosus;* closely similar to that of *lascivus.*

Measurements.—Average of 5 topotypes (adult): Total length, 306 (286–322); tail vertebræ, 133 (122–140); hind foot, 40.4 (40–42). *Skull:* Greatest length, 39.5 (38.7–40.4); zygomatic breadth, 23.5 (23.2–24.2); mastoidal breadth, 17.9 (17.6–18.7); least interorbital breadth, 7.2 (6.3–8.3); least postorbital breadth, 8.9 (8.2–9.8); length of nasals, 12.3 (11.8–12.6); maxillary toothrow, 8.4 (7.7–8.8).

Type specimen.—No. 13319, Mus. Vert. Zool., Univ. California; ♂ ad., skin and skull; collected August 13, 1911, by Annie M. Alexander.

Remarks.—This race is apparently most nearly related to *lascivus* of the Sierra Nevada, from which it differs widely in color of underparts. It differs so much from *oregonensis*, both in color and cranial characters, that intergradation between them seems very improbable. Specimens from the Warner Mountains, Cal., are intermediate between this form and *klamathensis;* in color they resemble *flaviventris*, but one of the two individuals has a skull equaling that of *klamathensis*, though with smaller bullæ. A large series from Rush Creek, Siskiyou County, average slightly less yellowish beneath and have somewhat larger skulls than typical specimens, some of them equaling

skulls of *fuliginosus* in size. Intergradation with *lascivus* occurs in the region around Mount Lassen.

Specimens examined.—Total number, 27, as follows:

California:[1] Bear Creek, Trinity County (head, altitude, 6,400 feet), 5; Castle Lake, Siskiyou County, 2; Grizzly Creek, Trinity County (altitude, 6,000 feet), 1; Jackson Lake, Siskiyou County, 3; Rush Creek, Siskiyou County, 14; Warner Mountains, 2.

GLAUCOMYS SABRINUS LASCIVUS (BANGS).

SIERRA FLYING SQUIRREL.

[Pl. III, fig. 5; Pl. V, fig. 5; Pl. VII, fig. 1.]

Sciuropterus alpinus lascivus Bangs, Proc. New England Zool. Club, I, p. 69, July 31, 1899.

Type locality.—Tallac, Eldorado County, California.

Distribution.—Sierra Nevada Range and northward to eastern Shasta County, California.

Characters.—Similar to *flaviventris*, but slightly smaller, with smaller hind foot; underparts without yellow suffusion. Compared with *klamathensis:* Size smaller; color above more drab (less brownish); underparts and feet less yellowish. Similar in color to *stephensi*, but paler.

Color.—*Winter pelage:* Upperparts wood brown shading to drab; sides of face smoke gray, often shaded with pale fuscous; upper surface of flying membrane blackish brown; ears fuscous-black; hind feet hair-brown, the toes shaded with whitish or buff; fore feet mouse gray; tail above, fuscous-black mixed with wood brown or pale snuff brown; beneath, drab-gray shading to avellaneous; underparts grayish white faintly washed with avellaneous. *Summer pelage:* Upperparts more brownish, usually rich wood brown; underparts faintly washed with cartridge buff or light pinkish cinnamon; upper surface of membranes clove brown; hind feet pale hair-brown, the soles whitish drab or faintly tinged with olive-buff; under side of tail pinkish buff.

Skull.—Essentially like that of *flaviventris;* much smaller than that of *klamathensis* and of *fuliginosus.*

Measurements.—Average of 5 topotypes (adult and subadult): Total length, 303 (295–320); tail vertebræ, 133 (125–150); hind foot, 40.2 (39–43). Average of 11 from Cisco, Cal.: 292; 122; 37.5. *Skull:* Average of 4 topotypes (adult and subadult): Greatest length, 40.4 (39.5–41.5); zygomatic breadth, 23.5 (23–24.1); mastoidal breadth, 18.2 (17.7–18.8); least interorbital breadth, 7.4 (7.1–7.8); least postorbital breadth, 9.2 (9–9.5); length of nasals, 13 (12.7–13.2); maxillary toothrow, 8.1.

[1] All in collection Mus. Vert. Zool., Univ. California.

Type specimen.—No. 9186, Mus. Comp. Zool. (formerly in collection of E. A. and O. Bangs); ♀ subad., skin and skull; collected August 28, 1898, by W. W. Price and P. O. Simons.

Remarks.—The Sierra flying squirrel is closely related to *flaviventris* of northern California, but differs markedly from it in the color of the underparts, tail, and feet. Intergradation between the two forms is shown by specimens from Mount Lassen, Dana, Prattville, and Castle Lake, Siskiyou County, which approach *flaviventris* in having the soles yellowish and the underparts tinged with the same. One specimen from Echo, close to the type locality, also has yellow soles and a buffy tail, but no yellow on the belly. In a large series from Cisco, Cal., most of the specimens show indications of being stained on the underparts with soot. Intergradation with *californicus* is probable, but there is no material available from the southern Sierra to show it. This race is very similar in color to *alpinus* of the northern Rocky Mountains, but is of much smaller size and has a paler tail.

Specimens examined.—Total number, 34, as follows:

California: Blue Canyon, 3;[1] Cisco, 18;[1] Dana, 1; Echo, 1;[2] Fort Crook, 1; Fresno [=mountains near ?], 1 (skeleton); Kings River Canyon, 1; Mill Creek, south base Mount Lassen, 1; Mount Tallac, 4;[2, 3] Prattville (12 miles northeast), 1; Quincy, 1; Red Point, Placer County, 1.[4]

GLAUCOMYS SABRINUS CALIFORNICUS (Rhoads).

San Bernardino Flying Squirrel.

[Pl. III, fig. 9; Pl. V, fig. 9; Pl. VII, fig. 5.]

Sciuropterus alpinus californicus Rhoads, Proc. Acad. Nat. Sci., Philadelphia, p. 323, June, 1897.

Sciuropterus californicus Grinnell, Univ. California, Publ. Zool., V, pp. 138–139, 1908.

Type locality.—Squirrel Inn, San Bernardino Mountains, California (altitude, 5,200 feet).

Distribution.—San Bernardino and San Jacinto Mountains, California.

Characters.—Similar to *lascivus*, but upperparts paler and more grayish; face between eyes usually washed with gray; skull smaller.

Color.—Unworn pelage (April to August): Upperparts light drab, shaded in some specimens with yellowish wood brown; sides of face pale smoke gray; front of face often washed with gray; ears hair-brown; upper surface of flying membrane fuscous; feet hair-brown or mouse gray, the toes whitish or buffy white, the soles buffy white or olive-buff; tail above, hair-brown, sparingly mixed with

[1] Collection Mus. Vert. Zool., Univ. California.
[2] Collection Mus. Comp. Zool.
[3] Collection Acad. Nat. Sci. Philadelphia.
[4] Collection Leland Stanford, Jr., Univ.

sayal brown; beneath, pinkish buff or pale olive-buff, edged on sides with hair-brown; underparts soiled whitish, faintly shaded with cartridge buff.

Skull.—Similar to that of *lascivus*, but averaging smaller, with shorter nasals and smaller bullæ.

Measurements.—Average of 8 adults from San Bernardino Mountains, Cal.: Total length, 297 (280–312); tail vertebræ, 137 (127–149); hind foot, 37.6 (36–39). *Skull:* Average of 5 adults from same locality: Greatest length, 39 (37.3–40); zygomatic breadth, 22.8 (22.3–23.5); mastoidal breadth, 17.7 (17.2–18.1); least interorbital breadth, 7.8 (7.4–8.2); least postorbital breadth, 8.7 (7.9–9.6); length of nasals, 11.9 (11.3–12.4); maxillary toothrow, 8.1 (7.5–8.6).

Type specimen.—No. 10487, Acad. Nat. Sci. Philadelphia (formerly No. 3487, collection S. N. Rhoads); ♀ ad., skin and skull; collected June 5, 1896, by R. B. Herron.

Remarks.—This subspecies is the grayest of the races of *sabrinus*, being considerably paler than *alpinus*. It is closely related to *lascivus* of the Sierra, and probably intergrades with it, though no intermediate specimens have thus far been collected.

Specimens examined.—Total number, 9, as follows:

California: San Bernardino Mountains, 8;[1] San Jacinto Mountains, 1.[2]

GLAUCOMYS SABRINUS STEPHENSI (MERRIAM).

CALIFORNIA COAST FLYING SQUIRREL.

[Pl. III, fig. 1; Pl. V, fig. 1; Pl. VII, fig. 9.]

Sciuropterus oregonensis stephensi Merriam, Proc. Biol. Soc. Washington, XIII, p. 151, June 13, 1900.

Type locality.—Sherwood, Mendocino County, California.

Distribution.—Coast region of northern California; limits of range unknown.

Characters.—Similar to *lascivus*, but upperparts more reddish (less drab); soles whiter (never tinged with yellowish) and toes less distinctly marked with buffy or white; skull with very deep braincase. Compared with *oregonensis:* Upperparts and tail less reddish; underparts whiter. Compared with *fuliginosus:* Size much smaller; color above in fresh pelage somewhat grayer (less ochraceous) and underparts paler.

Color.—Fresh winter pelage: Upperparts wood brown; sides of face pale smoke gray; upper surface of flying membrane fuscous or

[1] Three in collection Acad. Nat. Sci. Philadelphia; three in Mus. Vert. Zool., Univ. California; one in Mus. Comp. Zool.

[2] Collection Mus. Vert. Zool., Univ. California.

fuscous-black; feet hair-brown, the soles buffy white; tail above, hair-brown, shaded with fuscous-black, darkest at tip; beneath, pale pinkish buff edged with hair-brown; underparts whitish, irregularly washed with light pinkish cinnamon. *Worn winter pelage* (May): Upperparts decidedly more brownish, about sayal brown; tail above, somewhat browner; beneath, light pinkish buff, edged with fuscous. *Summer pelage* (July): Similar to spring pelage but underside of tail darker (pinkish buff).

Skull.—Similar to that of *oregonensis* and of *lascivus*, but averaging slightly smaller, with relatively shorter nasals and slightly smaller bullæ; braincase deeper and more abruptly depressed.

Measurements.—Average of 3 adults from Laytonville, Cal.: Total length, 307 (300–310); tail vertebræ, 143 (133–149); hind foot, 39.3 (38–40) *Skull:* Average of 3 adults from Laytonville, Cal.: Greatest length, 40 (39.7–40.5); zygomatic breadth, 23.5 (23–24); mastodial breadth, 18.3 (18.3–18.4); least interorbital breadth, 7.9 (7.6–8.4); least postorbital breadth, 9.2 (8.6–9.9); length of nasals, 11.7 (11.1–12.6); maxillary toothrow, 7.9 (7.3–8).

Type specimen.—No. 99830, U. S. Nat. Mus. (Biological Survey collection); ♀ subad., skin and skull; collected May 10, 1894, by F. Stephens.

Remarks.—This race, as indicated by its skull, is closely related to *oregonensis;* in color it resembles *lascivus* rather closely, and doubtless intergrades with both it and *oregonensis.* The type (from Sherwood) and one nearly adult specimen from Laytonville have skulls in which the occipital region is very abruptly decurved, but in two other adults from the same locality this character is less pronounced. A specimen, without skull, from 8 miles southeast of Cecilville—within the known range of *flaviventris*—agrees essentially with the type of *stephensi*, and thus suggests that intergradation does not occur between these two races.

Specimens examined.—Total number, 6, as follows:

California: Cecilville (8 miles southeast), 1;[1] Eureka, 1;[2] Laytonville, 3;[3] Sherwood, 1.

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[1] Collection Mus. Vert. Zool., Univ. California.
[2] Collection Leland Stanford, Jr., Univ.
[3] Collection California Acad. Sci.

TABLES OF CRANIAL MEASUREMENTS.

TABLE I.—*Glaucomys volans.*

No.	Species and locality.	Sex.	Greatest length.	Zygomatic breadth.	Mastoidal breadth.	Interorbital breadth.	Postorbital breadth.	Length of nasals.	Maxillary toothrow.	Remarks.
	Glaucomys volans volans:		*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	
155510	Washington, D. C.	♀	34.1	20.9	17	7	9.1	9.6	6.2	Adult.
155517	Do.	♀	34.9	20.9	16.6	7.3	9.3	9.8	6.3	Subadult.
155518	Do.	♂	35.4	21.2	16.8	7	9.2	10.1	6.5	Adult.
155512	Do.	♂	34.6	20.4	16.5	6.2	8.6	9.2	6	Do.
47683	Lake George, N. Y.	♂	33.9	21.1	16.6	6.5	8.4	9.6	5.6	Do.
78010	Wilmington, Mass.	♂	35.7	22.1	17	7.5	8.9	9.9	6.6	Do.
194040	Elk River, Minn.	♀	33.6	20.5	16.5	6.9	9.1	9.1	6.5	Do.
194033	Do.	♀	35.5	21.5	16.7	7	9.4	9.9	6.4	Do.
	Glaucomys v. querceti:									
[1] 2451	Citronelle, Fla.	♀	35.3	20.9	17.5	6.6	8.2	9.4	6.3	Adult; type.
[1] 2453	Do.	♀	34.4	20.7	.....	6.9	8.6	9	6.4	Adult.
78969	Lake Harney, Fla.	♂	34.3	20.7	17.5	6.8	8.3	9.6	6.5	Subadult.
72572	Enterprise, Fla.	♂	34.5	19.5	16.8	7.2	8.7	9.6	6.4	Do.
	Glaucomys v. saturatus:									
178364	Dothan, Ala.	♀	33.8	20.2	17	6.8	9.1	9.7	6.4	Adult.
178366	Do.	♀	34.9	20.4	17.4	7.2	8.3	9.5	6.5	Adult; type.
178363	Do.	♂	34.4	20.5	17.3	7.3	9	10	6.7	Adult.
57032	Greensboro, Ala.	♂	34.3	20.2	16.8	7.3	8.4	9.7	6.2	Do.
	Glaucomys v. texensis:									
136790	Sour Lake, Tex.	♂	32.7	20.6	17.1	7	8.2	9.5	6.4	Subadult.
136400	Do.	♂	34	20.9	17.2	7.3	8.9	9.2	6.3	Old adult; type.
136401	Do.	♀	33.6	21	17.2	7.3	8.9	9.2	6.2	Adult.
136402	Do.	♀	33.6	20.9	17.4	6.9	8.5	9.2	6.1	Do.
	Glaucomys v. goldmani:									
132833	Teopisca, Chiapas.	♂	35.1	21.3	17.8	7.2	8.7	10.3	6.4	Adult; type.
132834	Do.	♀	34.9	21.9	17.5	7.2	9.2	9.9	6.3	Adult.

[1] Collection Mus. Comp. Zool.

TABLE II.—*Glaucomys sabrinus.*

No.	Species and locality.	Sex.	Greatest length.	Zygomatic breadth.	Mastoidal breadth.	Interorbital breadth.	Postorbital breadth.	Length of nasals.	Maxillary toothrow.	Remarks.
	Glaucomys sabrinus sabrinus:		*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	
[1] ——	Cochrane, Ontario.	♂	40	24	18.1	7.3	8.9	11.5	7.8	Subadult.
[2] 7596	Lake Edward, Quebec.	♀	39.4	24.2	18.5	8.1	9.7	11.4	7.3	Adult.
[3] 5432	Big Island, Mackenzie.	....	40.2	24.2	19.2	8.2	9.2	12.8	8.1	Subadult.
3756	Winnipeg, Manitoba.	♀	39.4	24.3	18	7.8	9.3	12	7.7	Do.
	Glaucomys s. makkovikensis.									
[3] 13451	Makkovik, Labrador.	....	40.8	24.7	.....	7.3	10	12.2	7.4	Adult.
[3] 13453	Do.	....	40.4	24.4	18.6	7.6	9.7	11.1	7.9	Do.
	Glaucomys s. macrotis:									
83152	Hunter Mountain, N. Y.	♀	37.5	22.4	17.5	7	9.3	10.6	7.1	Adult; type.
111075	Peterboro, N. Y.	♂	36.7	22.4	17.7	7.1	9.2	10.5	6.4	Adult.
71175	Ossipee, N. H.	♂	36	22.3	17.2	6.9	8.6	10.5	7.2	Do.
[3] 4960	Greenville, Me.	♀	38.7	23.5	17.9	6.8	8.9	10.1	6.7	Do.
	Glaucomys s. canescens:									
[2] 7662	Portage la Prairie, Manitoba.	♂	38.5	22.8	17.5	7.7	9.2	11.5	7.7	Do.
[3] 7663	Do.	♀	38.8	22.9	17.6	7.6	9.5	11.2	7.6	Adult; type.

[1] Collection Carnegie Mus.; not numbered.
[2] Collection Field Mus. Nat. Hist.
[3] Collection Mus. Comp. Zool.

TABLE II.—*Glaucomys sabrinus*—Continued.

No.	Species and locality.	Sex.	Greatest length.	Zygomatic breadth.	Mastoidal breadth.	Interorbital breadth.	Postorbital breadth.	Length of nasals.	Maxillary toothrow.	Remarks.
			Mm.	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm*	*Mm.*	
	Glaucomys s. bangsi:									
[1] 6959	Idaho Co., Idaho	♂	38.8	23.7	18.6	7.4	8.4	11.5	8.7	Subadult; type.
31674	Sawtooth Lake, Idaho	♂	40.9	21.8	18.7	7.8	9	11.8	8.7	Adult.
169169	Florence, Mont	♀	41.2	24.7	19.1	7.8	9	12.4	8	Do.
	Glaucomys s. alpinus:									
88646	Jasper House, Alberta	♂	41.4	25.4	19.4	8	9	12.4	8.1	Do.
174398	Henry House, Alberta	♀	41.2	25.1	19.4	8.2	9.1	12.6	7.5	Do.
174397	Do	♀	42	25.6	19.4	8.8	9.6	12.4	7.9	Subadult.
	Glaucomys s. yukonensis:									
35320	Camp Davidson, Alaska	♀	41.5	25.3	19.5	7.8	10.3	12	7.9	Adult; type.
180338	Tanana, Alaska	♀	41	25.1	19.7	8.3	8.9	11.6	8.4	Adult.
	Glaucomys s. zaphaxus:									
136137	Helm Bay, Alaska	♀	41.5	26.2	19.1	8.3	9	12.9	8	Adult; type.
136138	Do	♂	40.1	24.2	18.2	7.4	8.8	12.3	8.3	Subadult.
[2] 8790	Bradfield Canal, Alaska	♀	41.2	24.7	18.9	8.4	9.2	12.6	7.8	Very old.
	Glaucomys s. oregonensis:									
[3] 253	Columbia River, Oreg		40.5+	24.8	19	8.5	8.9	12.4	8.1	Adult; type.
[4] 146	Salem, Oreg	♂	40.7	24.9	18.6	8.1	8.7	12.9	8.7	Adult.
141952	Portland, Oreg	♂	40.5	23.7	19	8.8	9	12.5	8	Do.
69416	Gold Beach, Oreg	♀	38.5	23	18.2	7.6	8.1	10.9	7.9	Old adult.
	Glaucomys s. columbiensis:									
94310	Okanogan, B. C	♂	40.5	21.4	18.9	7.7	9.2	12	7.7	Subadult; type.
[5] 1026	Penticton, B. C	♀	41.2	25.2	19.1	7.7	8.4	12.9	7.7	Old adult.
206543	Cranbrook, B. C	♀	41.6	24.6	19.5	8.6	9	12.6	8	Do.
	Glaucomys s. fuliginosus:									
[3] 8058	Martin Station, Wash	♂	39.5	23.7	.....	8.4	9.3	12.6	8.6	Subadult; type.
93282	Keechelus Lake, Wash	♀	42.5	24.3	19.1	9	9.6	13	8.8	Subadult.
93144	Do	.....	41.9	24.4	18.8	8.6	8.8	13	8.2	Adult.
	Glaucomys s. latipes:									
68573	Glacier, B. C	♀	44.2	25.1	20	8.3	9	14	8.8	Adult; type.
159393	Coolin, Idaho	♀	43.7	24.2	19.5	8	9	13.6	9	Adult.
159394	Do	♂	41.6	24	19	8	8.8	12.5	8	Do.
	Glaucomys s. olympicus:									
[6] 5902	Olympic Mountains, Wash	♂	41.5	23.7	18.4	8.2	8.8	13.2	8.5	Subadult; type.
[6] 5905	Do	♂	41.6	21.7	19	8.4	8.9	12.5	8.3	Subadult.
[6] 5904	Do	♂	40.5	23.7	18.5	7.6	9.2	12.5	8.3	Do.
	Glaucomys s. bullatus:									
31675	Sawtooth Lake, Idaho	♀	44	25	19	8.7	9.6	13.9	9.2	Adult; type.
[1] 8199	Ketchum, Idaho	♂	44.2	25.5	19.4	9.6	9.2	13.5	9.3	Adult.
[1] 8495	Do	♂	42.6	24.4	19	8.1	9	13.9	9.2	Do.
	Glaucomys s. klamathensis:									
87310	Fort Klamath, Oreg	♀	40.6	24	18.8	9	8.7	12.6	8.1	Old adult; type.
193991	Do	♂	40.2	23.4	19	7.8	10	12.7	8.4	Old adult.
87305	Do	.....	42.3	25	19.6	8.3	9.4	13.9	8.7	Adult.
	Glaucomys s. flaviventris:									
[2] 13319	Bear Creek, Trinity Co., Cal.	♂	40	23.4	17.9	7.9	9.3	12.3	8.1	Adult; type.
[2] 13321	Do	♀	40.4	24.2	18.7	8.3	9.8	11.8	8.7	Adult.
[2] 13318	Do	♀	38.7	23.3	17.6	7.2	8.7	12.6	7.7	Do.
	Glaucomys s. lascivus:									
[1] 9186	Mount Tallac, Cal	♀	39.5	23	17.7	7.8	9.5	12.8	8.1	Subadult; type.
[1] 9187	Do	♀	41.5	23.3	18.8	7.2	9.2	13.2	8.2	Subadult.
[3] 11458	Do	♀	40.4	24.1	18.4	7.6	9	12.7	.....	Adult.
	Glaucomys s. californicus:									
[3] 10487	San Bernardino Mountains, Cal.	♀	39.3	23.5	17.6	8.2	9.2	11.7	8.1	Old adult; type.
[3] 10486	Do	♀	37.3	22.3	18.1	7.4	7.9	11.3	7.5	Old adult.
[1] 8646	Do	♀	40	22.9	18	7.4	8.4	12.1	7.7	Do.
	Glaucomys s. stephensi:									
99830	Sherwood, Cal	♀	38.4	22.5	17.4	7.4	9.5	11.7	7.5	Subadult type.

[1] Collection Mus. Comp. Zool.
[2] Collection Mus. Vert. Zool., Univ. California.
[3] Collection Acad. Nat. Sci., Philadelphia.
[4] Collection Game Dept. Oregon.
[5] Collection Victoria Mem. Mus.
[6] Collection Field Mus. Nat. Hist.

EXPLANATION OF PLATES.

[All natural size.]

PLATE II.

Fig. 1. *Glaucomys volans saturatus*, ♂ ad., Dothan, Ala. (No. 178363, U. S. Nat. Mus., Biological Survey collection).

Fig. 2. *Glaucomys volans volans*, ♀ ad., Cleveland Park, D. C. (No. 155517, U. S. Nat. Mus.).

Fig. 3. *Glaucomys sabrinus bangsi*, ad., Florence, Mont. (No. 168243, U. S. Nat. Mus., Biological Survey collection).

Fig. 4. *Glaucomys sabrinus alpinus*, ♀ ad., Henry House, Alberta (No. 174398, U. S. Nat. Mus.).

Fig. 5. *Glaucomys volans texensis*, ♀ ad., Sour Lake, Tex. (No. 136402, U. S. Nat. Mus., Biological Survey collection).

Fig. 6. *Glaucomys volans goldmani*, ♀ ad., Teopisca, Chiapas (No. 132834, U. S. Nat. Mus., Biological Survey collection).

Fig. 7. *Glaucomys sabrinus canescens*, ♀ ad. (type), Portage la Prairie, Manitoba (No. 7663, Field Mus. Nat. Hist.).

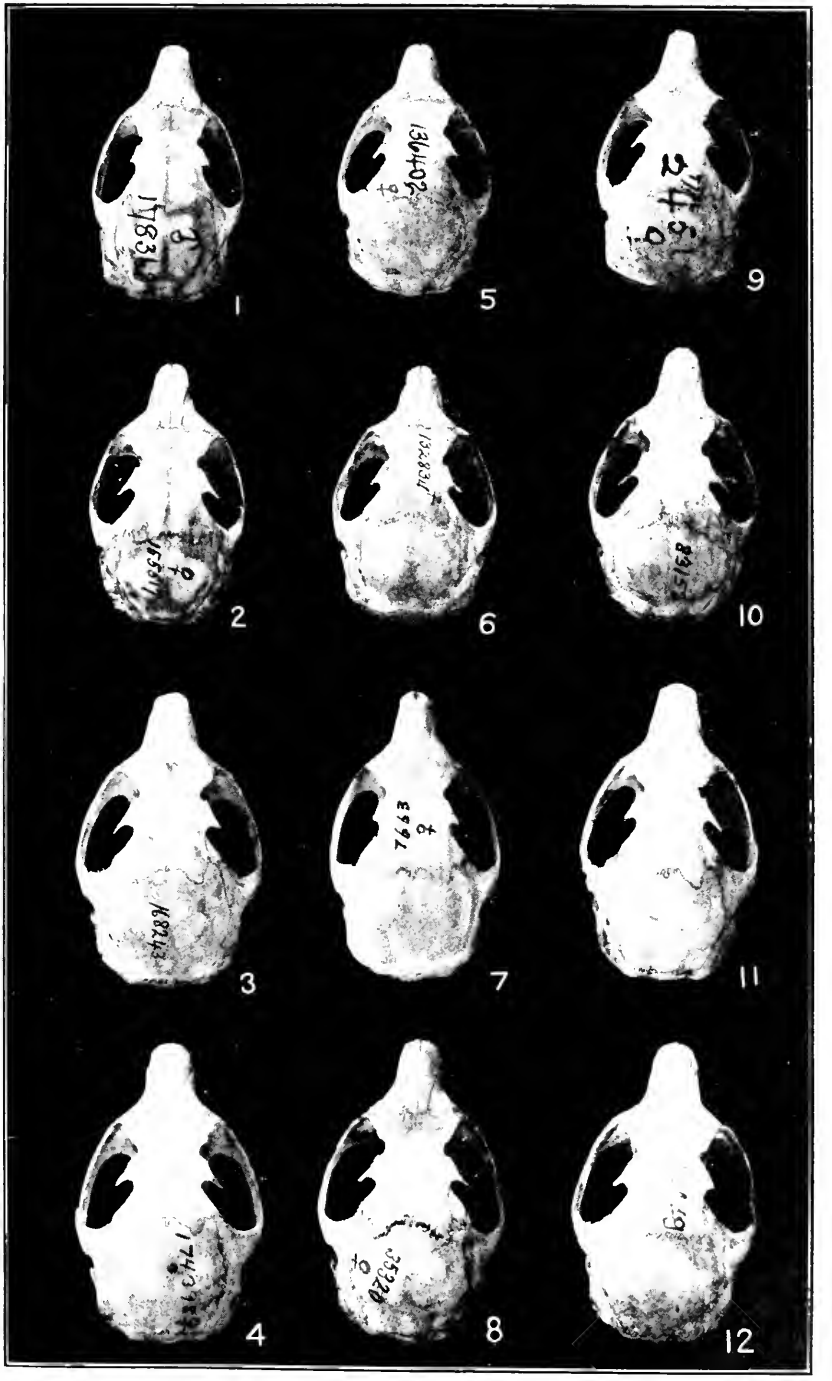
Fig. 8. *Glaucomys sabrinus yukonensis*, ♀ ad. (type), Camp Davidson, Alaska (No. 35320, U. S. Nat. Mus.).

Fig. 9. *Glaucomys volans querceti*, ♀ ad. (type), Citronelle, Fla. (No. 2451, Mus. Comp. Zool.).

Fig. 10. *Glaucomys sabrinus macrotis*, ♀ ad. (type), Catskill Mountains, N. Y. (No. 83152, U. S. Nat. Mus.).

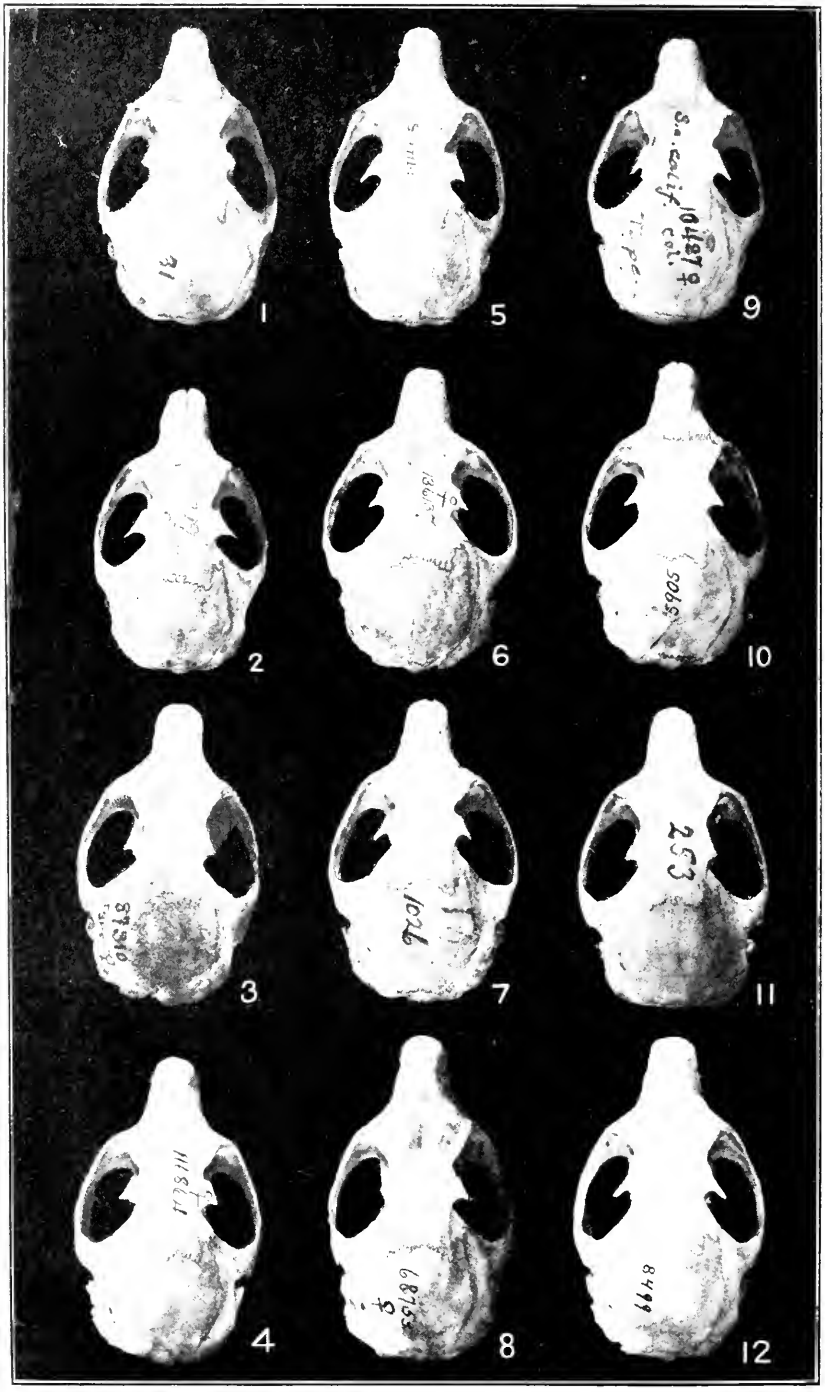
Fig. 11. *Glaucomys sabrinus sabrinus*, ♂ subad., Cochrane, Ontario (Carnegie Mus., not numbered).

Fig. 12. *Glaucomys sabrinus makkovikensis*, ad., Makkovik, Labrador (No. 13449, Mus. Comp. Zool.).



SKULLS OF GLAUCOMYS VOLANS AND G. SABRINUS.

1. G. v. saturatus.
2. G. v. volans.
3. G. s. bangsi.
4. G. s. alpinus.
5. G. v. texensis.
6. G. v. goldmani.
7. G. s. canescens.
8. G. s. yukonensis.
9. G. v. querceti.
10. G. s. macrotis.
11. G. s. sabrinus.
12. G. s. makkovikensis.



SKULLS OF GLAUCOMYS SABRINUS.

1. G. s. stephensi.
2. G. s. flaviventris.
3. G. s. klamathensis.
4. G. s. fuliginosus.
5. G. s. lascivus.
6. G. s. zaphaeus.
7. G. s. columbiensis.
8. G. s. latipes.
9. G. s. californicus.
10. G. s. olympicus.
11. G. s. oregonensis.
12. G. s. bullatus.

Plate III.

Fig. 1. *Glaucomys sabrinus stephensi*, ♂ ad., Laytonville, Cal. (No. 331, Cal. Acad. Sci.)

Fig. 2. *Glaucomys sabrinus flaviventris*, ♂ ad. (type), Bear Creek, Trinity County, Cal. (No. 13319, Mus. Vert. Zool.).

Fig. 3. *Glaucomys sabrinus klamathensis*, ♀ ad. (type), Fort Klamath, Oreg. (No. 87310, U. S. Nat. Mus., Biological Survey collection).

Fig. 4. *Glaucomys sabrinus fuliginosus*, ♀ ad., Easton, Wash. (No. 116864, U. S. Nat. Mus., Biological Survey collection).

Fig. 5. *Glaucomys sabrinus lascivus*, ♀ ad., Cisco, Cal. (No. 19495, Mus. Vert. Zool.).

Fig. 6. *Glaucomys sabrinus zaphœus*, ♀ ad. (type), Helm Bay, Alaska (No. 136137, U. S. Nat. Mus., Biological Survey collection).

Fig. 7. *Glaucomys sabrinus columbiensis*, ♀ ad., Penticton, B. C. (No. 1026, Victoria Mem. Mus.).

Fig. 8. *Glaucomys sabrinus latipes*, ♀ ad. (type), Glacier, B. C. (No. 68573, U. S. Nat. Mus., Biological Survey collection).

Fig. 9. *Glaucomys sabrinus californicus*, ♀ ad. (type), San Bernardino Mountains, Cal. (No. 10487, Acad. Nat. Sci. Philadelphia).

Fig. 10. *Glaucomys sabrinus olympicus*, ♂ subad., Olympic Mountains, Wash. (No. 5905, Field Mus. Nat. Hist.).

Fig. 11. *Glaucomys sabrinus oregonensis*, ad. (type), Columbia River, Oreg. (No. 253, Acad. Nat. Sci. Philadelphia).

Fig. 12. *Glaucomys sabrinus bullatus*, ♂ ad., Ketchum, Idaho (No. 8499, Mus. Comp. Zool.).

Plate IV.

Fig. 1. *Glaucomys volans saturatus*, ♂ ad., Dothan, Ala. (No. 178363, U. S. Nat. Mus., Biological Survey collection).

Fig. 2. *Glaucomys volans volans*, ♀ ad., Cleveland Park, D. C. (No. 155517, U. S. Nat. Mus.).

Fig. 3. *Glaucomys sabrinus bangsi*, ad., Florence, Mont. (No. 168243, U. S. Nat. Mus., Biological Survey collection).

Fig. 4. *Glaucomys sabrinus alpinus*, ♀ ad., Henry House, Alberta (No. 174398, U. S. Nat. Mus.).

Fig. 5. *Glaucomys volans texensis*, ♀ ad., Sour Lake, Tex. (No. 136402, U. S. Nat. Mus., Biological Survey collection).

Fig. 6. *Glaucomys volans goldmani*, ♀ ad., Teopisca, Chiapas (No. 132834, U. S. Nat. Mus., Biological Survey collection).

Fig. 7. *Glaucomys sabrinus canescens*, ♀ ad. (type), Portage la Prairie, Manitoba (No. 7663, Field Mus. Nat. Hist.).

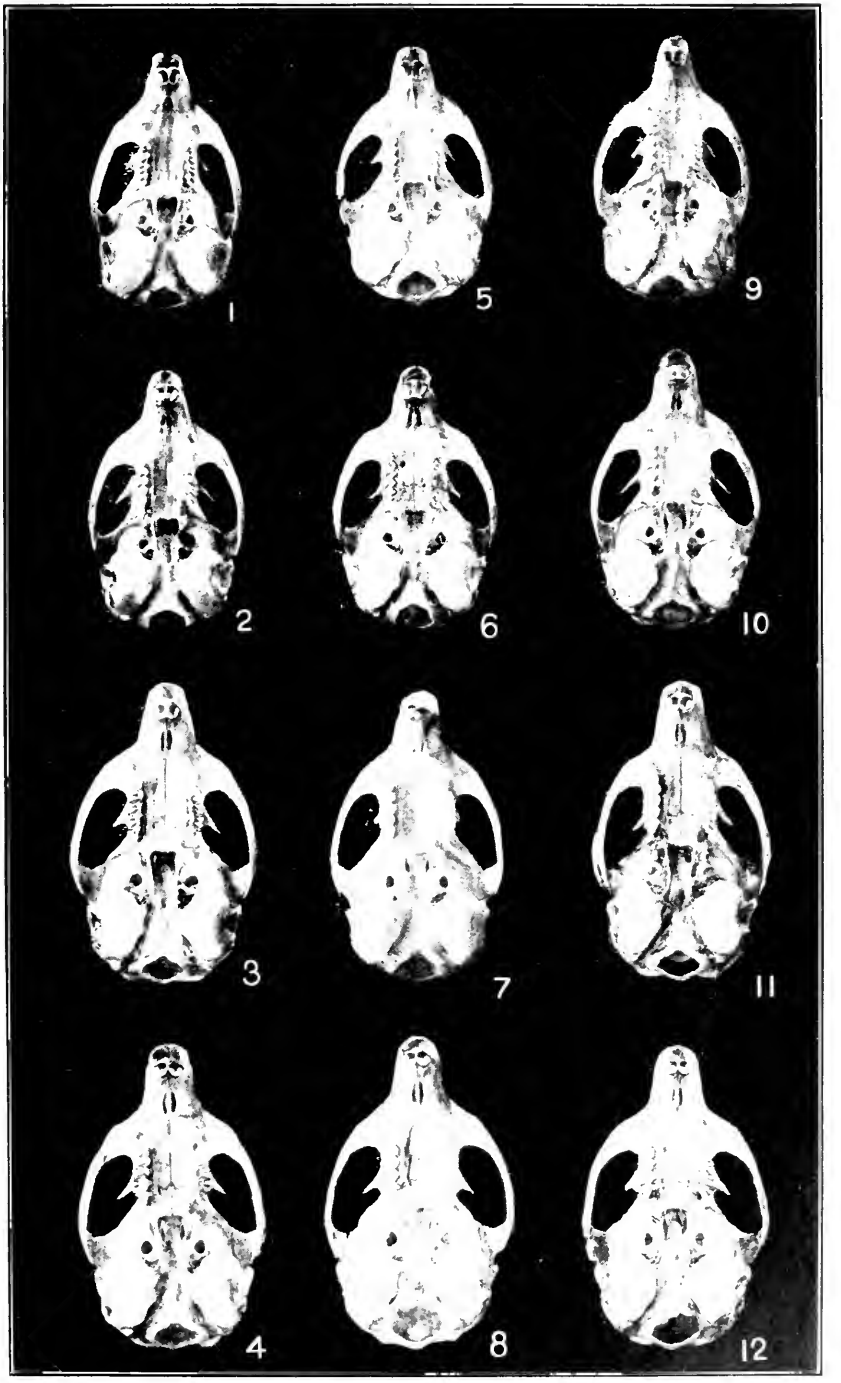
Fig. 8. *Glaucomys sabrinus yukonensis*, ♀ ad. (type), Camp Davidson, Alaska (No. 35320, U. S. Nat. Mus.).

Fig. 9. *Glaucomys volans querceti*, ♀ ad. (type), Citronelle, Fla. (No. 2451, Mus. Comp. Zool.).

Fig. 10. *Glaucomys sabrinus macrotis*, ♀ ad. (type), Catskill Mountains, N. Y. (No. 83152, U. S. Nat. Mus.).

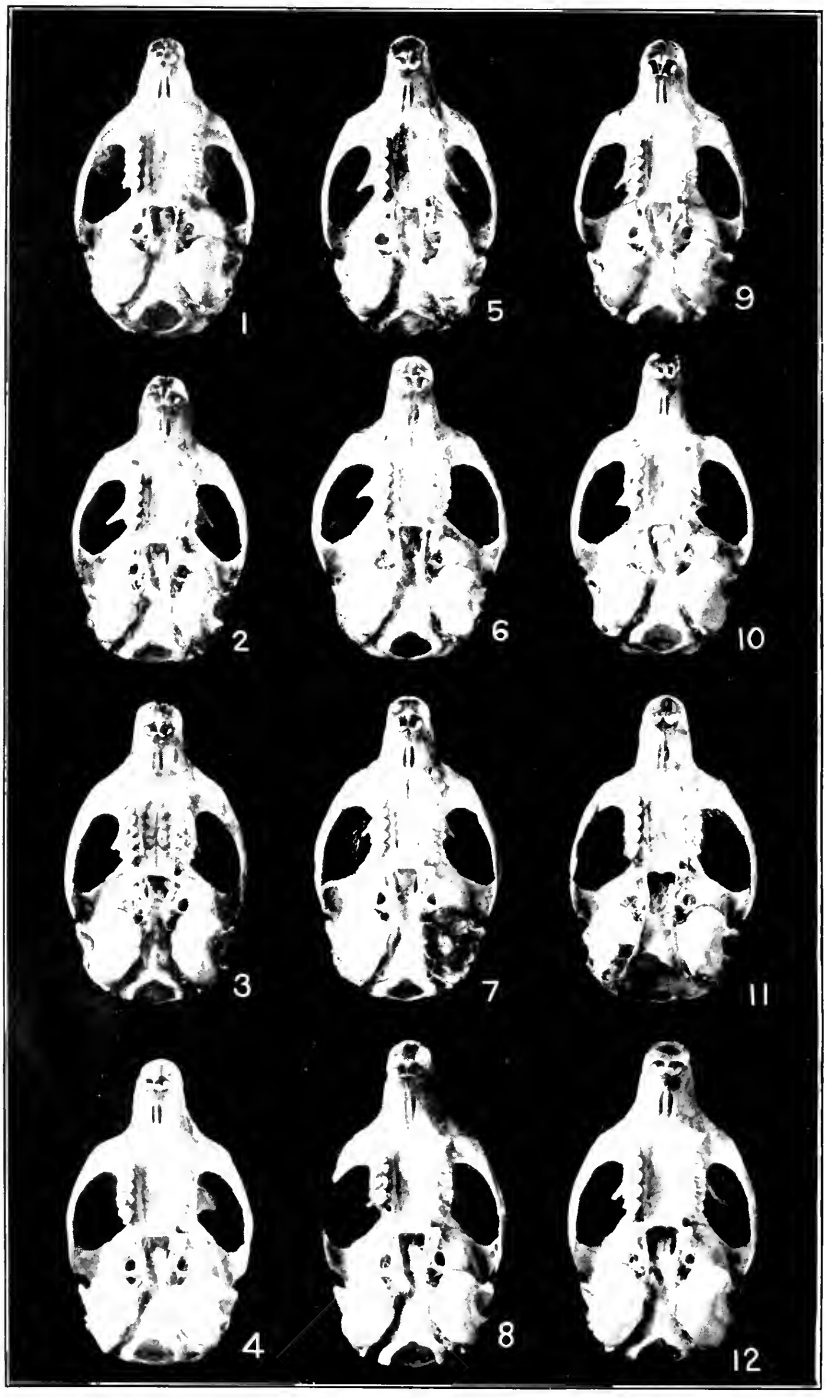
Fig. 11. *Glaucomys sabrinus sabrinus*, ♂ subad., Cochrane, Ontario (Carnegie Mus., not numbered).

Fig. 12. *Glaucomys sabrinus makkovikensis*, ad., Makkovik, Labrador (No. 13449, Mus. Comp. Zool.).



SKULLS OF GLAUCOMYS VOLANS AND G. SABRINUS.

1. G. v. saturatus.
2. G. v. volans.
3. G. s. bangsi.
4. G. s. alpinus.
5. G. v. texensis.
6. G. v. goldmani.
7. G. s. canescens.
8. G. s. yukonensis.
9. G. v. querceti.
10. G. s. macrotis.
11. G. s. sabrinus.
12. G. s. makkovikensis.



SKULLS OF GLAUCOMYS SABRINUS.

1. G. s. stephensi.
2. G. s. flaviventris.
3. G. s. klamathensis.
4. G. s. fuliginosus.
5. G. s. lascivus.
6. G. s. zaphaeus.
7. G. s. columbiensis.
8. G. s. latipes.
9. G. s. californicus.
10. G. s. olympicus.
11. G. s. oregonensis.
12. G. s. bullatus.

PLATE V.

Fig. 1. *Glaucomys sabrinus stephensi*, ♂ ad., Laytonville, Cal., (No. 331, Cal. Acad. Sci.).

Fig. 2. *Glaucomys sabrinus flaviventris*, ♂ ad. (type), Bear Creek, Trinity County, Cal. (No. 13319, Mus. Vert. Zool.).

Fig. 3. *Glaucomys sabrinus klamathensis*, ♀ ad. (type), Fort Klamath, Oreg. (No. 87310, U. S. Nat. Mus., Biological Survey collection).

Fig. 4. *Glaucomys sabrinus fuliginosus*, ♀ ad., Easton, Wash. (No. 116864, U. S. Nat. Mus., Biological Survey collection).

Fig. 5. *Glaucomys sabrinus lascivus*, ♀ ad., Cisco, Cal. (No. 19495, Mus. Vert. Zool.).

Fig. 6. *Glaucomys sabrinus zaphœus*, ♀ ad. (type), Helm Bay, Alaska (No. 136137, U. S. Nat. Mus., Biological Survey collection).

Fig. 7. *Glaucomys sabrinus columbiensis*, ♀ ad., Penticton, B. C. (No. 1026, Victoria Mem. Mus.).

Fig. 8. *Glaucomys sabrinus latipes*, ♀ ad. (type), Glacier, B. C. (No. 68573, U. S. Nat. Mus., Biological Survey collection).

Fig. 9. *Glaucomys sabrinus californicus*, ♀ ad. (type), San Bernardino Mountains, Cal. (No. 10487, Acad. Nat. Sci. Philadelphia).

Fig. 10. *Glaucomys sabrinus olympicus*, ♂ subad., Olympic Mountains, Wash. (No. 5905, Field Mus. Nat. Hist.).

Fig. 11. *Glaucomys sabrinus oregonensis*, ad. (type), Columbia River, Oreg. (No. 253, Acad. Nat. Sci. Philadelphia).

Fig. 12. *Glaucomys sabrinus bullatus*, ♂ ad., Ketchum, Idaho (No. 8499, Mus. Comp. Zool.).

PLATE VI.

Fig. 1. *Glaucomys volans volans*, ♀ ad., Cleveland Park, D. C. (No. 155517, U. S. Nat. Mus.).

Fig. 2. *Glaucomys volans querceti*, ♀ ad. (type), Citronelle, Fla. (No. 2451, Mus. Comp. Zool.).

Fig. 3. *Glaucomys volans saturatus*, ♂ ad., Dothan, Ala. (No. 178363, U. S. Nat. Mus., Biological Survey collection).

Fig. 4. *Glaucomys volans texensis*, ♀ ad., Sour Lake, Tex. (No. 136402, U. S. Nat. Mus., Biological Survey collection).

Fig. 5. *Glaucomys sabrinus macrotis*, ♀ ad. (type), Catskill Mountains, N. Y. (No. 83152, U. S. Nat. Mus.).

Fig. 6. *Glaucomys sabrinus sabrinus*, ♂ subad., Cochrane, Ontario (Carnegie Museum, not numbered).

Fig. 7. *Glaucomys sabrinus columbiensis*, ♀ ad., Penticton, B. C. (No. 1026, Victoria Mem. Mus.).

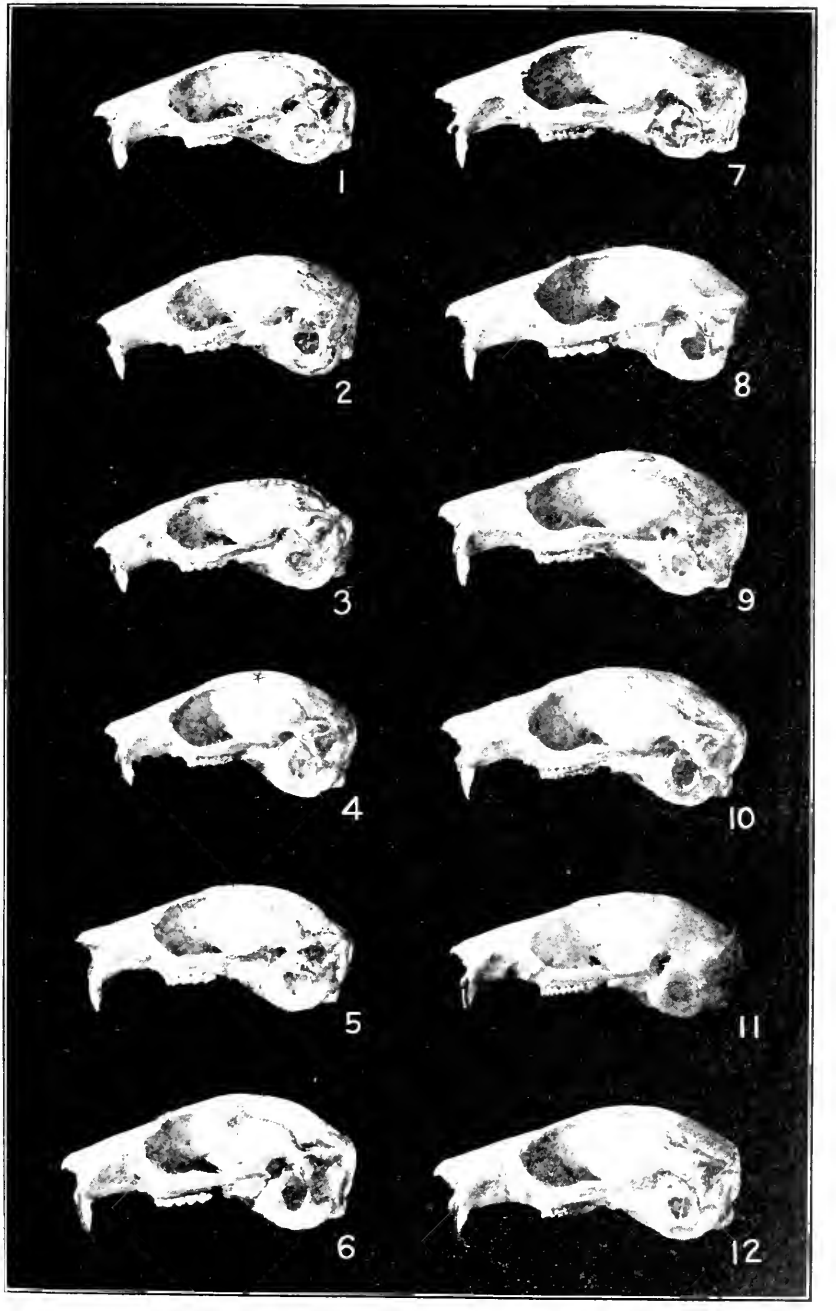
Fig. 8. *Glaucomys sabrinus oregonensis*, adult (type), Columbia River, Oreg. (No. 253, Acad. Nat. Sci. Philadelphia).

Fig. 9. *Glaucomys sabrinus zaphaus*, ♀ ad. (type), Helm Bay, Alaska (No. 136137, U. S. Nat. Mus., Biological Survey collection).

Fig. 10. *Glaucomys sabrinus bangsi*, ad., Florence, Mont. (No 168243, U. S. Nat. Mus., Biological Survey collection).

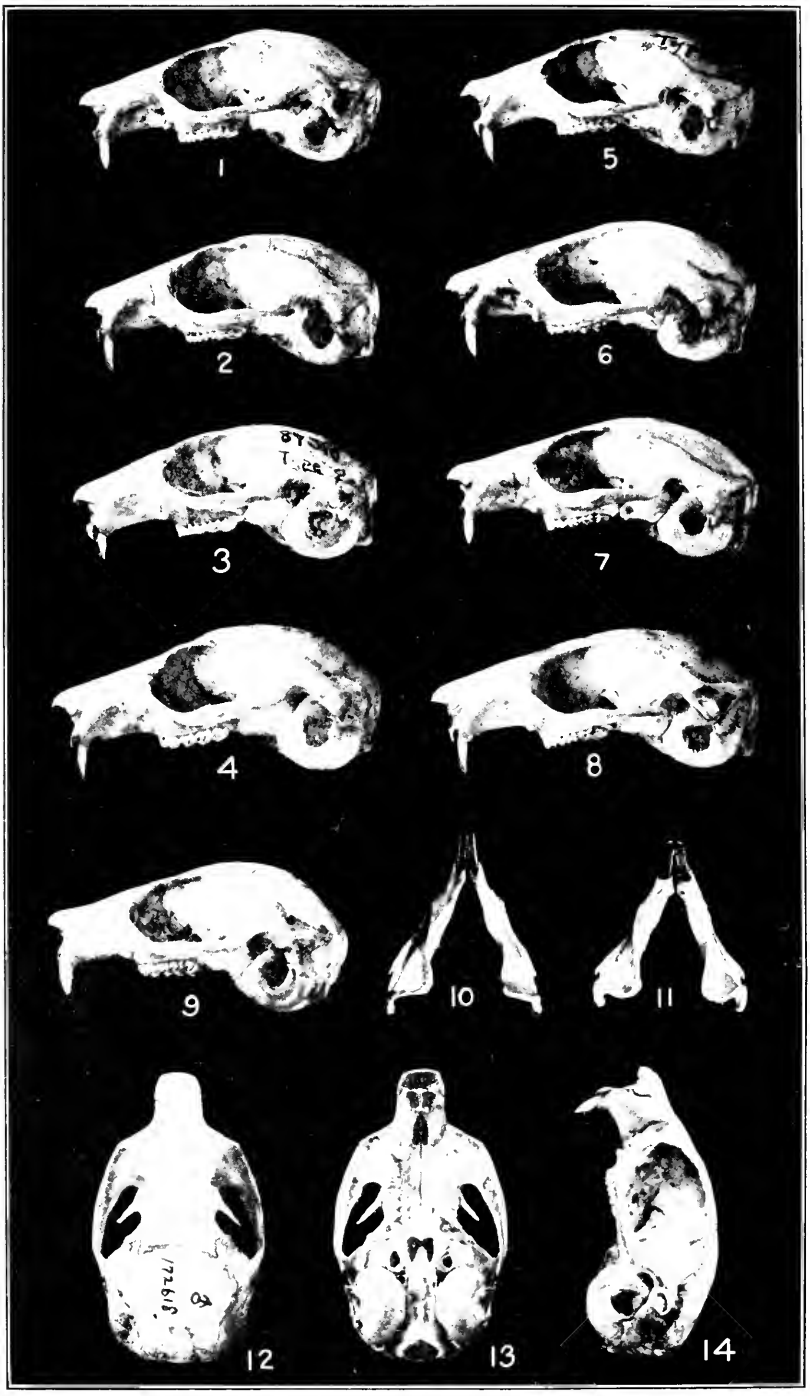
Fig. 11. *Glaucomys sabrinus canescens*, ♀ ad. (type), Portage la Prairie, Manitoba (No. 7663, Field Mus. Nat. Hist.).

Fig. 12. *Glaucomys sabrinus alpinus*, ♀ ad., Henry House, Alberta (No. 174398, U. S. Nat. Mus.).



SKULLS OF GLAUCOMYS VOLANS AND G. SABRINUS.

1. G. v. volans.
2. G. v. querceti.
3. G. v. saturatus.
4. G. v. texensis.
5. G. s. macrotis.
6. G. s. sabrinus.
7. G. s. columbiensis.
8. G. s. oregonensis.
9. G. s. zaphaeus.
10. G. s. bangsi.
11. G. s. canescens.
12. G. s. alpinus.



SKULLS OF GLAUCOMYS SABRINUS AND PTEROMYS BÜCHNERI.

1. G. s. lascivus.
2. G. s. flaviventris.
3. G. s. klamathensis.
4. G. s. bullatus.
5. G. s. californicus.
6. G. s. olympicus.
7. G. s. fuliginosus.
8. G. s. latipes.
9. G. s. stephensi.
10. G. s. sabrinus.
11, 12, 13, 14. P. büchneri.

PLATE VII.

Fig. 1. *Glaucomys sabrinus lascivus*, ♀ ad., Cisco, Cal. (No. 19495, Mus. Vert. Zool.).

Fig. 2. *Glaucomys sabrinus flaviventris*, ♂ ad. (type), Bear Creek, Trinity County, Cal. (No. 13319, Mus. Vert. Zool.).

Fig. 3. *Glaucomys sabrinus klamathensis*, ♀ ad. (type), Fort Klamath, Oreg. (No. 87310, U. S. Nat. Mus., Biological Survey collection).

Fig. 4. *Glaucomys sabrinus bullatus*, ♂ ad., Ketchum, Idaho (No. 8499, Mus. Comp. Zool.).

Fig. 5. *Glaucomys sabrinus californicus*, ♀ ad. (type), San Bernardino Mountains, Cal. (No. 10487, Acad. Nat. Sci. Philadelphia).

Fig. 6. *Glaucomys sabrinus olympicus*, ♂ subad., Olympic Mountains, Wash. (No. 5905, Field Mus. Nat. Hist.).

Fig. 7. *Glaucomys sabrinus fuliginosus*, ♂ ad., Easton, Wash. (No. 116864, U. S. Nat. Mus., Biological Survey collection).

Fig. 8. *Glaucomys sabrinus latipes*, ♀ ad. (type), Glacier, B. C. (No. 68573, U. S. Nat. Mus., Biological Survey collection).

Fig. 9. *Glaucomys sabrinus stephensi*, ♂ ad., Laytonville, Cal. (No. 331, Cal. Acad. Sci.).

Fig. 10. *Glaucomys sabrinus sabrinus*, ♂ subad., Cochrane, Ontario (Carnegie Mus., not numbered).

Figs. 11, 12, 13, 14. *Pteromys büchneri*, ♂ ad., Shansi Mountains, China (No. 172618, U. S. Nat. Mus.).

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[Synonyms in *italics*.]

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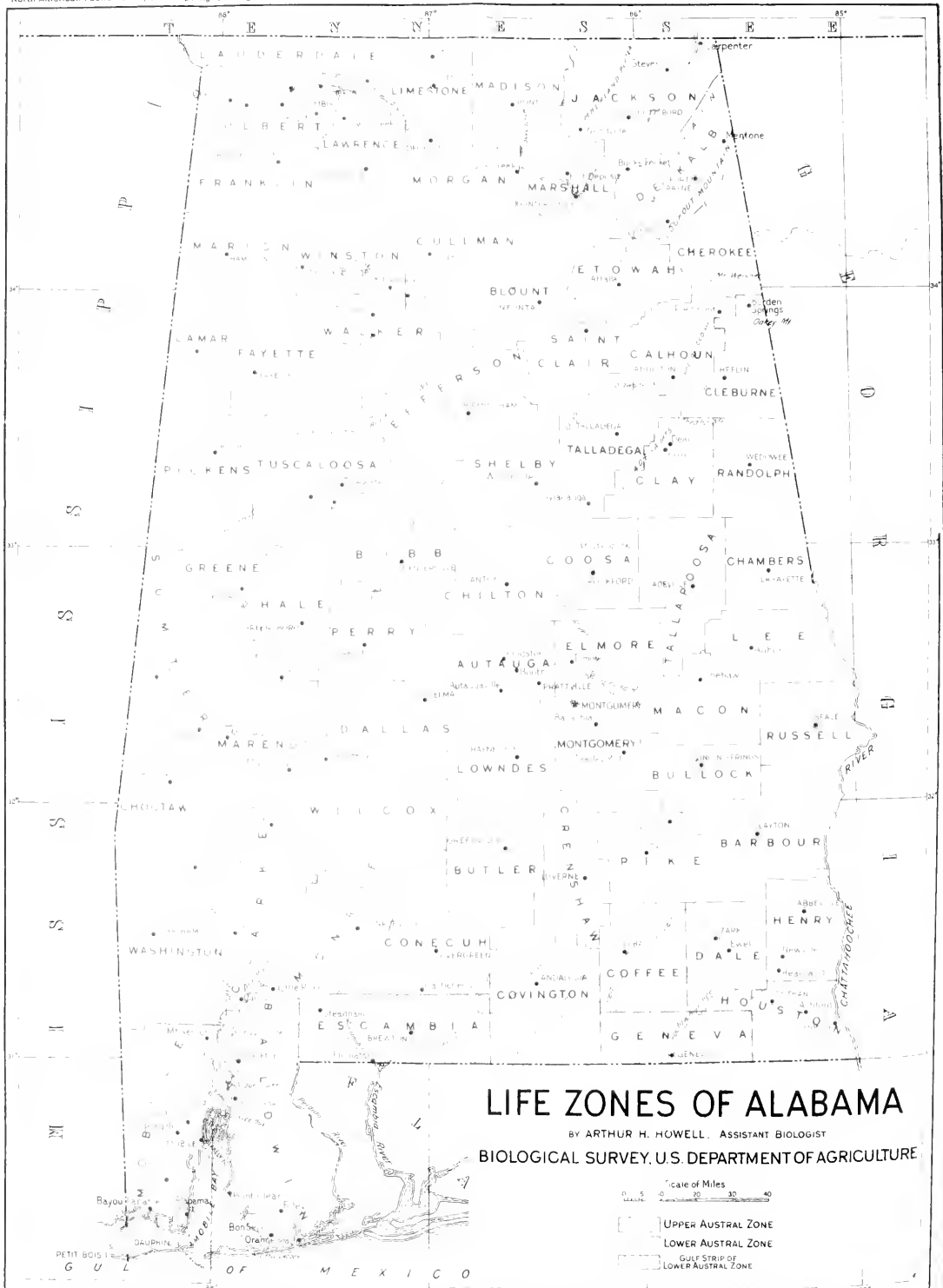


LIFE ZONES OF ALABAMA

BY ARTHUR H. HOWELL, ASSISTANT BIOLOGIST

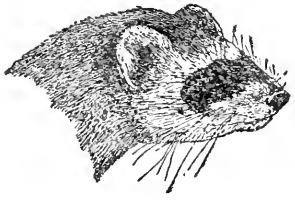
BIOLOGICAL SURVEY, U.S. DEPARTMENT OF AGRICULTURE

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
E. W. NELSON, *Chief*

NORTH AMERICAN FAUNA

No. 45

[Actual date of publication, October 28, 1921]



A BIOLOGICAL SURVEY OF ALABAMA

I. PHYSIOGRAPHY AND LIFE ZONES
II. THE MAMMALS

BY

ARTHUR H. HOWELL

ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1921

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., January 18, 1921.

SIR: I have the honor to transmit herewith, recommending that it be published as No. 45 in the series of the North American Fauna, a report on the biological survey of Alabama, by Arthur H. Howell, assistant biologist of this bureau. This treats of the life zones and the mammals of the State. A further report on the birds has been prepared for separate publication. Both are based on natural history explorations conducted during recent years by the bureau. The first part of the present report defines the physiographic features of the State and characterizes the two transcontinental life zones represented; it is accompanied by a map showing the boundaries of each zone. The second part consists of notes on the distribution, abundance, and habits of the native mammals of the State, of which there are 65 forms now known, 10 having been added as a result of the Survey investigations, 3 of them new to science. This report will be of material assistance to farmers, students, and others interested in the habits and economic relations of our native wild animals.

Respectfully,

E. W. NELSON,
Chief of Bureau.

HON. E. T. MEREDITH,
Secretary of Agriculture.

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ILLUSTRATIONS.

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TEXT FIGURES.

A BIOLOGICAL SURVEY OF ALABAMA.

By Arthur H. Howell.

INTRODUCTION.

In the work of mapping the life zones of North America and the distribution of mammals and birds—a project upon which the Biological Survey has been engaged for many years—the Southeastern States have until very recent years received little attention. The more conspicuous birds and mammals found in that region were known in a general way, but exact knowledge of their distribution was lacking and, as a result, the boundaries of the life zones could be drawn only tentatively.

To secure definite information regarding the distribution, abundance, and economic relations of the birds and mammals and at the same time to study the distribution of the plant life of this region, a biological survey of Alabama was carried on during a period of several years. From these investigations, and with the aid of Mohr's detailed report on the plant life,[1] it has been possible to define the ranges of the mammals and birds and the boundaries of the natural life zones within the State. The report on the bird life has been prepared and tentative arrangements made for its publication; the reports on life zones and on the mammals are presented herewith.

The field collecting on which the present report is chiefly based was carried on by the writer, with the assistance of James S. Gutsell, Ernest G. Holt, James L. Peters, and Luther J. Goldman during parts of the years 1908 and 1911–1916. Collections had previously been made by C. S. Brimley in 1890, and by Russell J. Thompson in 1892. The writer's work covered every month in the year and practically all parts of the State. Valuable assistance was rendered also by numerous residents of the State, who were instrumental in

[1] Mohr, Charles, Plant life of Alabama: Contr. U. S. Nat. Herb., vol. 6, 1901.

securing needed specimens and information. Among those who rendered especially valuable aid were Lewis S. Golsan, of Prattville; Edward S. Graves, of Bentonsport, Iowa (formerly residing on Sand Mountain, near Carpenter, Ala.); Peter A. Brannon, of Montgomery; and H. P. Loding, of Mobile.

PART I. PHYSIOGRAPHY AND LIFE ZONES OF ALABAMA.

PHYSIOGRAPHIC FEATURES OF THE STATE.

Alabama presents a wide diversity of physiographic conditions, ranging from the low sandy islands and pine-covered flats of the coast region through the fertile valleys and rolling hills of the central parts, to the rugged and rock-crowned ranges of the northeast, reaching in Clay County an altitude of 2,400 feet above sea level. The principal natural divisions of the State are the following:[2] Mountain Region, Tennessee Valley, Warrior Basin and Tableland, Central Prairie Belt, Coast Pine Belt, and Coast Plain or Gulf Strip.

Mountain Region.

The Mountain Region comprises the southernmost spurs of the Appalachian system and covers approximately the northeastern portion of the State from northern Coosa County northward. The principal ranges are the Talladega Mountains, in Talladega and Clay Counties (Cheaha Peak, altitude 2,407 feet); Choccolocco Mountain, in Calhoun County (2,074 feet); Oakey Mountain, in Cleburne County (1,945 feet); Mount Weisner, in Cherokee County (1,900 feet); Lookout Mountain (1,847 feet, near Mentone); Sand Mountain (1,785 feet, near Carpenter) (the last two being parallel ridges extending from the vicinity of Gadsden and Attalla northeastward through Dekalb County), and the Cumberland Plateau, in Jackson and Marshall Counties.

On most of the mountains the soil is thin and rocky, supporting a rather open, stunted growth of pine, red cedar, oak, chestnut, hickory, and other trees, and it is on the upper slopes of these ridges that the Upper Austral Zone reaches its southern limit.

Tennessee Valley.

The Tennessee River flows through a broad, rolling valley, from 12 to 15 miles wide, crossing the State from the northeastern to the northwestern corner. Now largely cleared of timber and under cultivation, this valley is one of the most important agricultural sections of the State.

[2] Adapted in part from Mohr's map of the floral areas of Alabama, in "Plant Life of Alabama" (1901), where will be found a more detailed discussion of the physiographic conditions.

Warrior Basin and Tableland.

The Warrior Tableland comprises the elevated plateau in the north central part of the State, covering part or all of Winston, Cullman, Marshall, Blount, Etowah, Walker, Jefferson, Tuscaloosa, Shelby, and Bibb Counties. It is a region of low hills, interspersed with narrow valleys, many of the streams flowing through deep gorges bordered with high cliffs. A large proportion of this area is heavily forested, the prevailing trees being chestnut oak (*Quercus prinus*), Spanish oak (*Quercus digitata*), pines (*Pinus echinata*, *Pinus taeda*, *Pinus virginiana*, and *Pinus palustris*), hickories, chestnut, and sour gum (*Nyssa sylvatica*). On the moist slopes of the ravines a dense growth of shrubs is usually found, including laurel (*Kalmia*), azaleas, huckleberries, and the handsome oak-leaved hydrangea (*Hydrangea quercifolia*).

Central Prairie Belt.

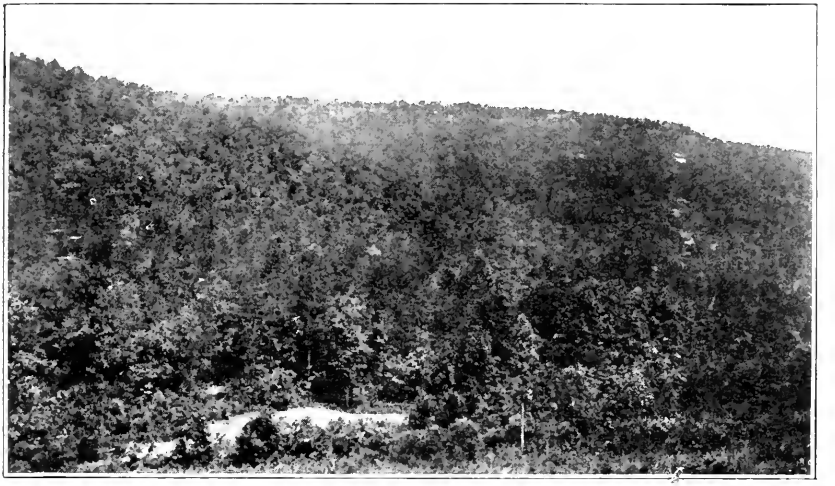
The Prairie Region of Alabama comprises a belt from 35 to 45 miles wide crossing the State from Sumter County to Russell County, and including also part or all of Pickens, Greene, Hale, Perry, Dallas, Autauga, Lowndes, Montgomery, Macon, and Bullock Counties. It consists of a rolling plain, bordered on the north and south by pine-covered hills. Although it contains extensive tracts of prairie, it is by no means exclusively of this character, but includes many small areas of forested land, extensive wooded swamps, and numerous canebrakes.

Many varieties of trees are found in this region, among the more prominent of which are the post oak (*Quercus minor*), Texas white oak (*Quercus durandi*), water oak (*Quercus nigra*), overcup oak (*Quercus lyrata*), pecan, hickories, elms, hawthorns, red cedar, and several species of pine (*Pinus taeda*, *Pinus echinata*, *Pinus palustris*, and *Pinus glabra*).

Coast Pine Belt.

The Coast Pine Belt extends across the State from Choctaw to southern Barbour and Henry Counties, merging on the north into the Prairie Belt and on the south into the Coast Plain. Of its floral characters, Mohr says: "Broadly stated, it consists in the increased frequency of types which are at home in the Louisianian Area, and in distinction from regions farther north, of a tree growth in which, though otherwise similar, the long-leaf pine in its highest development predominates. * * * Fully one-half of the area of this region is under cover of the long-leaf pine * * *."[3] Other characteristic trees and shrubs are the shortleaf pine (*Pinus echinata*), southern spruce pine (*Pinus glabra*), basswood (*Tilia heterophylla*), magnolia

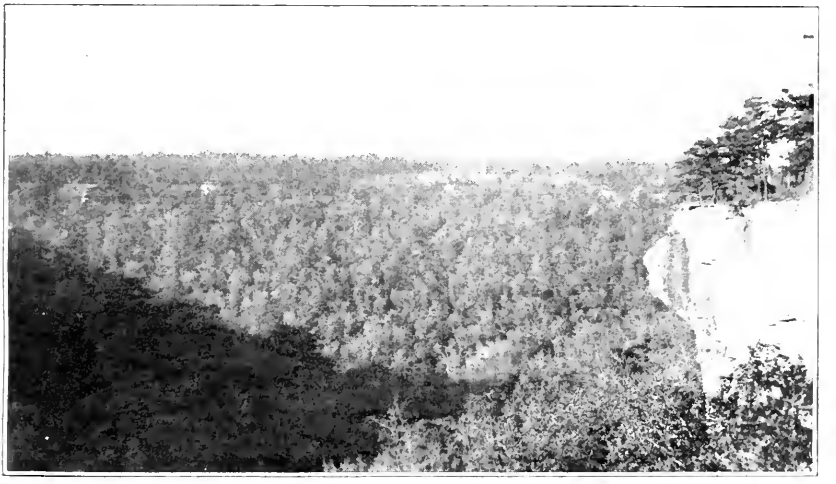
[3] Mohr, Charles, Plant life of Alabama, pp. 106, 110, 1901.



B15103

FIG. 1.—EASTERN SLOPES OF SAND MOUNTAIN, FROM TRENTON VALLEY.

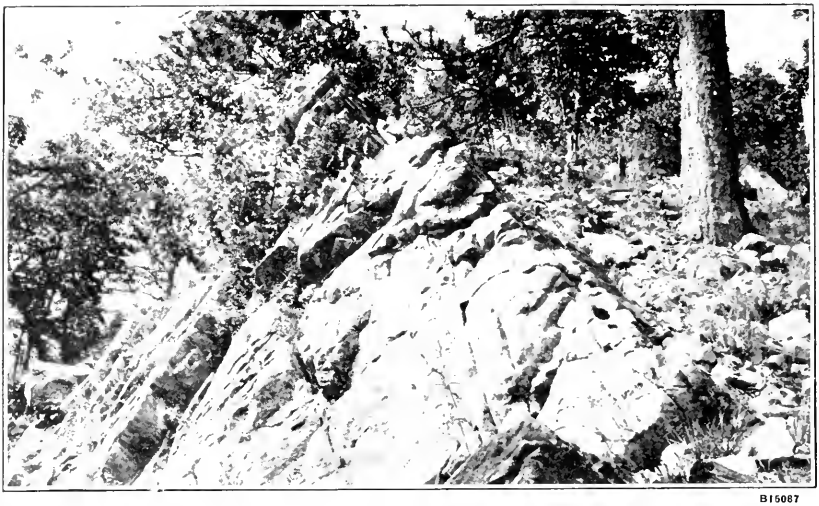
Rocky escarpment, heavily timbered, except on steepest slopes.



B17307

FIG. 2.—GULCH OF LONG ISLAND CREEK, SAND MOUNTAIN.

Hardwood timber in the bottom of the gulch; shortleaf pines (*Pinus virginiana*) on top of plateau.



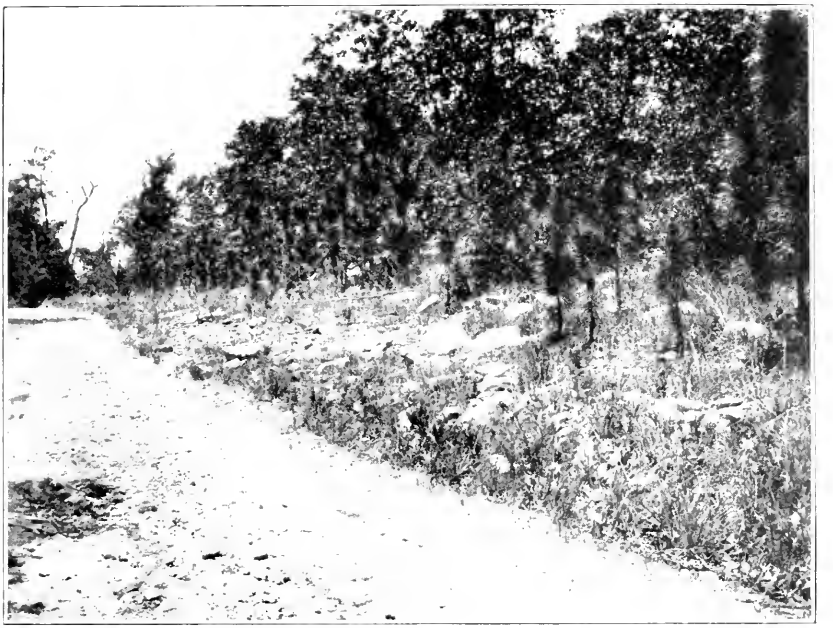
B15087

FIG. 1.—ROCK RIDGE NEAR SUMMIT OF CHOCCOLOCCO MOUNTAIN.

Longleaf pine (*Pinus palustris*) growing on summit.

B17310

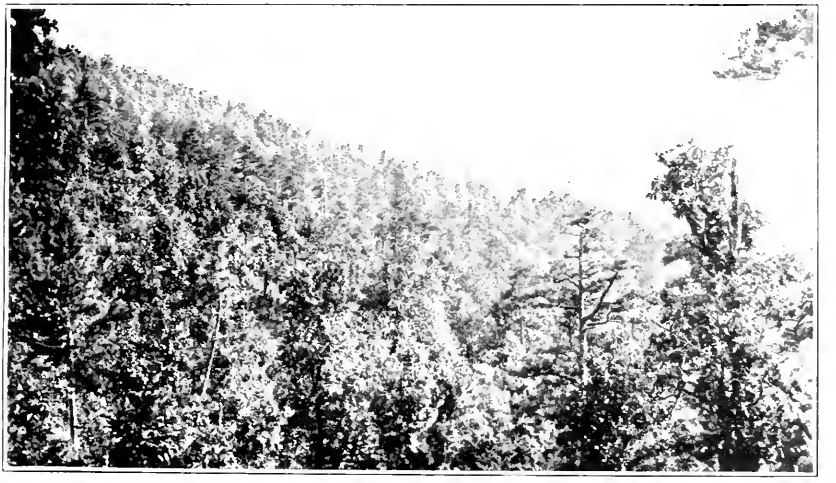
FIG. 2.—CHOCCOLOCCO VALLEY, NEAR PIEDMONT. DUGGER MOUNTAIN IN DISTANCE.



B13527

FIG. 1.—ROCKY SLOPES NEAR BASE OF TALLADEGA MOUNTAINS.

Young growth of longleaf pine (*Pinus palustris*).



B15088

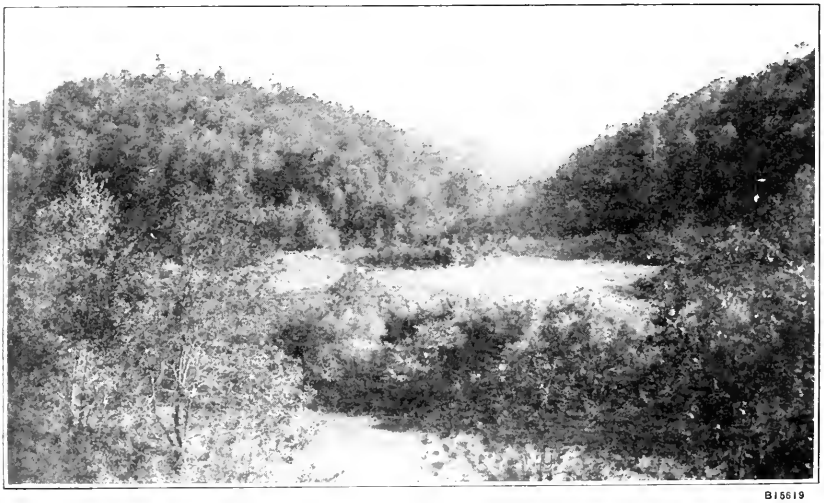
FIG. 2.—UPPER SLOPES OF CHOCCOLOCCO MOUNTAIN.

Timber chiefly oaks and longleaf pine.

B14051

FIG. 1.—TENNESSEE RIVER NEAR BLOOMFIELD.

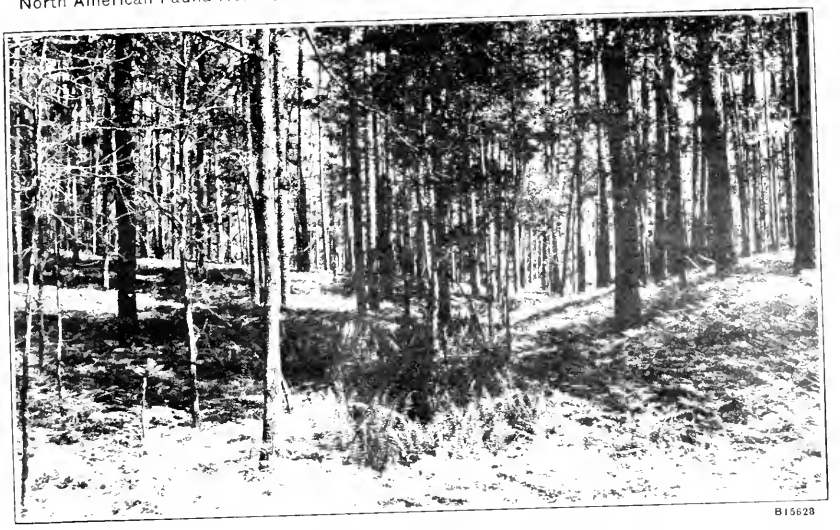
Rock bluff covered with dense growth of mixed timber.



B15619

FIG. 2.—SIPSEY FORK AT MOUTH OF BEAR BRANCH.

Wooded hills, with narrow valley bottoms under cultivation.



B15628

FIG. 1.—PINE FOREST NEAR JASPER.

Chiefly longleaf pine (*Pinus palustris*) with a carpet of ferns (*Pteridium aquilinum* and *Osmunda cinnamomea*).

B13509

FIG. 2.—TURPENTINE "ORCHARD" NEAR MOBILE.

Pure stand of longleaf pine.

B15633

FIG. 1.—CATOMA SWAMP, NEAR TEASLEY MILL.

Spruce pine, beech, oaks, hickories, etc.

B15649

FIG. 2.—RIVER-BOTTOM SWAMP NEAR SEALE.

Undergrowth of palmetto (*Sabal minus*) in hardwood forest.

(*Magnolia foetida*), red bay (*Persea borbonia*), beech, water oak (*Quercus nigra*), laurel oak (*Quercus laurifolia*), storax bush (*Styrax grandiflora*), sweet illicium (*Illicium floridanum*), white and red flowered buckeyes, and the Carolina allspice (*Calycanthus floridus*).

Coast Plain or Gulf Strip.

The Coast Plain, as used here, includes the Lower Coast Pine Belt, the Coast Plain, and the Littoral Belt of Mohr's "Map of the Floral Areas of Alabama." It comprises the sand-dune and salt-marsh areas of the coast and outer islands, the coastal pine flats, the extensive river swamps around the head of Mobile Bay, and the rolling sandy uplands of the southern tier of counties.

In the hill country, which attains an altitude of 250 or 300 feet above sea level, the longleaf pine (*Pinus palustris*) is the prevailing tree, with some loblolly pine (*Pinus taeda*), interspersed with a rather sparse and stunted growth of turkey oak (*Quercus catesbaei*), blue jack (*Quercus brevifolia*), huckleberry bushes, and the heatherlike shrub *Ceratiola ericoides*. In the depressions between the hills and about the heads of the numerous streams rising in this area are found many small swamps, in which is a dense growth of white bay (*Magnolia virginiana*), water oak (*Quercus nigra*), laurel oak (*Quercus laurifolia*), southern black gum (*Nyssa biflora*), swamp maple, white cedar (*Chamaecyparis thyoides*), pond cypress (*Taxodium ascendens*), and scattering pines.

On the flats along the coast is found an open forest of pines, chiefly the swamp pine (*Pinus elliottii*). In the hammocks—slightly elevated tracts rising from the swampy flats—occurs a profusion of large timber trees, including the magnolia (*Magnolia foetida*), beech, holly (*Ilex opaca*), water oak (*Quercus nigra*), laurel oak (*Quercus laurifolia*), and the magnificent live oak (*Quercus virginiana*), a tree characteristic of the coastal region. About the borders of the hammocks and in the small swamps is found a dense growth of shrubs, including the titi (*Cliftonia monophylla*) and the leatherwood (*Cyrilla racemiflora*).

Extensive river swamps cover the delta formed by the Mobile and Tensaw Rivers, much of the land being subject to long-continued overflows. Here grow magnificent forests of cypress (*Taxodium distichum*), tupelo gum (*Nyssa aquatica*), black gum (*Nyssa biflora*), red maple (*Acer drummondii*), water hickory (*Hicoria aquatica*), water oak (*Quercus nigra*), overcup oak (*Quercus lyrata*), water ash (*Fraxinus caroliniana*), green ash (*Fraxinus lanceolata*), swamp cottonwood (*Populus heterophylla*), and other trees, all heavily festooned with the long Spanish "moss" and hung with tangles of grape vine and other climbing plants.

On the shores of the coastal bays and on the outer islands are extensive salt marshes, largely occupied by the black rush (*Juncus roemerianus*) and inhabited by great numbers of the Louisiana clapper rail (*Rallus crepitans saturatus*).

On Dauphin Island is a considerable forest of pines and hardwoods. Petit Bois Island supports only a small tract of pines, but parts of the island are covered with dense thickets of yaupon (*Ilex vomitoria*). The lower parts of both Dauphin and Petit Bois Islands are given over to rolling sand dunes, and the shores are bordered with extensive mud flats.

LIFE ZONES OF ALABAMA.

Only two of the seven transcontinental life zones of North America are represented in Alabama—the humid divisions of the Upper Austral and Lower Austral Zones, known, respectively, as the Carolinian and Austroriparian (or Louisianian), and corresponding in the West to the arid divisions, the Upper Sonoran and the Lower Sonoran, respectively. The Lower Austral Zone covers the greater part of the State and is subdivided into two fairly well-marked regions.

Upper Austral Zone.

The humid, or Carolinian, division of the Upper Austral Zone occurs in rather dilute form on the higher mountains in the northeastern part of Alabama, reaching its southern limit in the Talladega Mountains of Clay County. This zone is chiefly confined to the upper slopes, above 1,500 feet altitude, and is therefore of little agricultural importance in the State. Its most important crops are hay, corn, oats, wheat, tobacco, cowpeas, white potatoes, sweet potatoes, apples, pears, peaches, and plums. A large number of plants and a smaller number of birds and mammals occurring in this zone serve to mark approximately its southern boundary. The most important species in Alabama are the following:

Characteristic Breeding Birds—Upper Austral Zone.

Ruffed grouse (*Bonasa umbellus umbellus*).
Sparrow hawk (*Cerchneis sparveria sparveria*).[4]
Whip-poor-will (*Setochalchis vocifera vocifera*).
Phoebe (*Sayornis phoebe*).[4]
Scarlet tanager (*Piranga olivacea*).[4]
Worm-eating warbler (*Helmitheros vermivorus*).
Ovenbird (*Seiurus aurocapillus aurocapillus*).
Southern robin (*Planesticus migratorius achrusterus*).

Characteristic Mammals—Upper Austral Zone.

New York weasel (*Mustela noveboracensis*).
Allegheny cliff rat (*Neotoma pennsylvanica*).
Southern woodchuck, or ground-hog (*Marmota monax monax*).[5]

[4] Breeds rarely in the Lower Austral Zone.
[5] Occurs also in mountainous parts of the Lower Austral Zone.

CHARACTERISTIC PLANTS—UPPER AUSTRAL ZONE.[6]

Trees and shrubs.

Hemlock (*Tsuga canadensis*).
Butternut (*Juglans cinerea*).
Cherry birch (*Betula lenta*).
Scarlet oak (*Quercus coccinea*).
Chestnut oak (*Quercus primus*).
Hairy syringa (*Philadelphus hirsutus*).
Mountain black cherry (*Prunus serotina neomontana*).
Clammy locust (*Robinia viscosa*).
Rose acacia (*Robinia hispida*).
Mountain privet (*Ilex monticola*).
Bitter-sweet (*Celastrus scandens*).
Fetid buckeye (*Aesculus glabra*).
Blue grape (*Vitis bicolor*).
Sweet-scented azalea (*Azalea arborescens*).
Mountain blueberry (*Vaccinium pallidum*).
Blue ash (*Fraxinus quadrangulata*).
Withe-rod (*Viburnum cassinoides*).
Bush honeysuckle (*Diervilla rivularis*).

Herbaceous plants.

Moccasin flower (*Cypripedium acaule*).
Showy orchid (*Orchis spectabilis*).
Virginian spring beauty (*Claytonia virginica*).
Round-leaved campion (*Silene rotundifolia*).
Smooth meadow-rue (*Thalictrum dioicum*).
Sweet wood-violet (*Viola leconteana*).
Pale violet (*Viola striata*).
Long-spurred violet (*Viola rostrata*).
Colored willow-herb (*Epilobium coloratum*).
Spikenard (*Aralia racemosa*).
Canada lovage (*Ligusticum canadense*).
Sweet cicely (*Osmorrhiza claytoni*).
Spotted wintergreen (*Chimaphila maculata*).
Four-leaf loosestrife (*Lysimachia quadrifolia*).
Mountain steironema (*Steironema tonsum*).
Four-leaved milkweed (*Asclepias quadrifolia*).
Creeping purple phlox (*Phlox reptans*).
Virginia lungwort (*Mertensia virginica*).
Bradbury horsemint (*Monarda bradburiana*).
Gerardia (*Agalinis asperula*).
Narrow-leaved houstonia (*Houstonia tenuifolia*).
Upland boneset (*Eupatorium sessilifolium*).
White goldenrod (*Solidago bicolor*).
Broad-leaved goldenrod (*Solidago flexicaulis*).
Hispid goldenrod (*Solidago hispida*).
Slender aster (*Aster gracilis*).
Sky-blue aster (*Aster azureus*).
Canada leaf-cup (*Polymnia canadensis*).
Mountain cone-flower (*Rudbeckia monticola*).

Lower Austral Zone.

The Austroriparian (Louisianian) Division of the Lower Austral Zone occupies all the lowlands of Alabama and the lower slopes of the mountains below 1,500 feet altitude, thus including practically all the agricultural lands in the State. The principal crops in this zone are cotton, corn, oats, sorghum, peanuts, sweet potatoes, water-

[6] Partial list.

melons, cantaloupes, strawberries, peaches, figs, and pecans. Lumber and turpentine also are important products.

A subdivision of the Lower Austral Zone, known as the Semitropical or Gulf Strip, is recognized as occupying the southern tier of counties from about the latitude of Castleberry southward, its northern boundary practically coinciding with that of Mohr's "Lower Coast Pine Belt." In this belt many varieties of subtropical fruits flourish which will not live farther north.

The Lower Austral Zone in Alabama is characterized by the presence of a large number of southern animals and plants, among which the following are the most important:

CHARACTERISTIC BREEDING BIRDS—LOWER AUSTRAL ZONE.

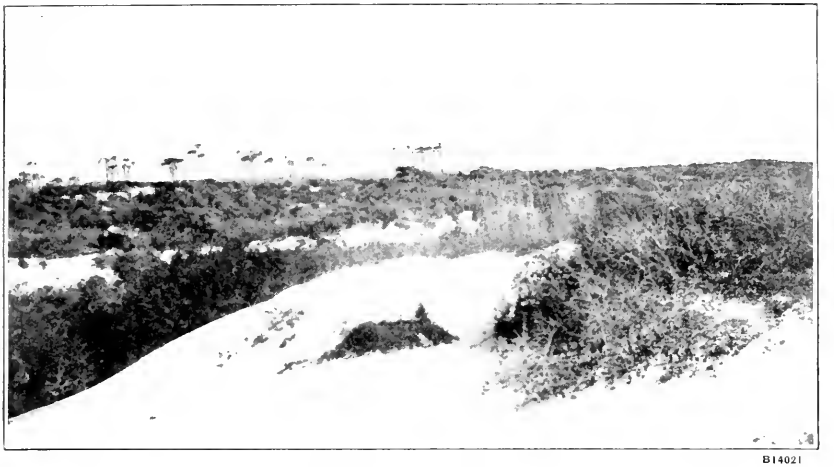
(*a*) SPECIES RANGING NEARLY THROUGHOUT THE LOWER AUSTRAL ZONE AND LIMITED NORTHWARD BY IT.

Black vulture (*Coragyps urubu urubu*).
Florida red-shouldered hawk (*Buteo lineatus alleni*).
Florida barred owl (*Strix varia alleni*).
Florida screech owl (*Otus asio asio*).
Southern hairy woodpecker (*Dryobates villosus audubonii*).
Downy woodpecker (*Dryobates pubescens pubescens*).
Red-cockaded woodpecker (*Phrenopicus borealis*).
Flicker (*Colaptes auratus auratus*).
Chuck-will's-widow (*Antrostomus carolinensis*).
Florida blue jay (*Cyanocitta cristata cristata*).[7]
Southern meadowlark (*Sturnella magna argutula*).
Bachman sparrow (*Peucaea aestivalis bachmani*).[8]
Alabama towhee (*Pipilo erythrophthalmus canaster*).
Blue grosbeak (*Guiraca caerulea caerulea*).[8]
Swainson warbler (*Limnothlypis swainsonii*).
Bachman warbler (*Vermivora bachmanii*).
Yellow-throated warbler (*Dendroica dominica dominica*).[8]
Florida white-breasted nuthatch (*Sitta carolinensis carolinensis*).[9]
Brown-headed nuthatch (*Sitta pusilla*).

(*b*) SPECIES RANGING NORTH TO ABOUT THE MIDDLE OF THE STATE (AUTAUGA AND HALE COUNTIES).

Ground dove (*Chaemepelia passerina passerina*).
Little sparrow hawk (*Cerchneis sparveria paula*).
Florida nighthawk (*Chordeiles minor chapmani*).[10]
Florida red-wing (*Agelaius phoeniceus phoeniceus*).
Loggerhead shrike (*Lanius ludovicianus ludovicianus*).
Florida yellow-throat (*Geothlypis trichas ignota*).

[7] Formerly known as *Cyanocitta cristata florincola*.
[8] Occurs also in the Upper Austral Zone.
[9] Formerly known as *Sitta carolinensis atkinsi*.
[10] Possibly throughout the zone.



B14021

FIG. 1.—SAND DUNES, ORANGE BEACH.

Thickets of yaupon (*Ilex vomitoria*) and dwarf live-oak (*Quercus virginiana maritima*); home of the white-fronted beach mouse (*Peromyscus polionotus albifrons*).

B13512

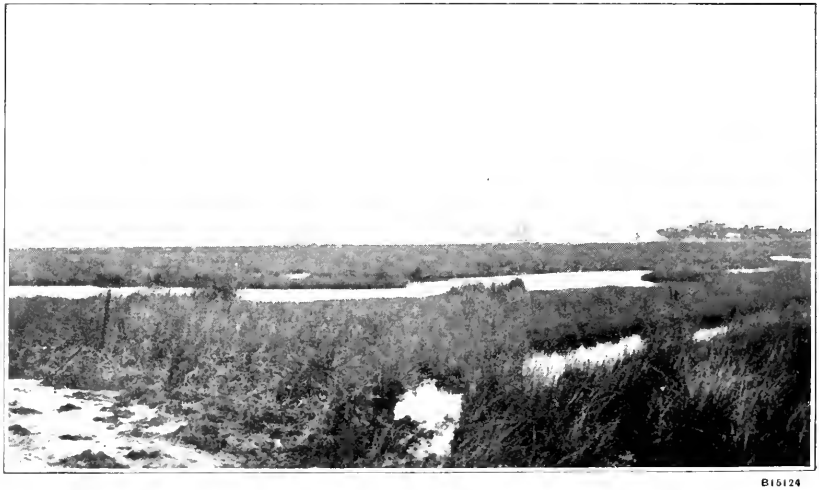
FIG. 2.—SWAMP ON DAUPHIN ISLAND, OVERFLOWED BY SAND.

Black rush (*Juncus roemerianus*) in foreground; swamp pine (*Pinus elliottii*) in background.

B15644

FIG. 1.—STIGGINS LAKE, TENSAW RIVER DELTA.

Shores bordered with cypress (*Taxodium distichum*) and various hardwood trees.



B15124

FIG. 2.—MARSH ON BAY SIDE OF DAUPHIN ISLAND.

Dense growth of black rush (*Juncus roemerianus*).

(c) Species Confined to the Semitropical, or Gulf, Strip.

Louisiana clapper rail (*Rallus crepitans saturatus*).
Purple gallinule (*Ionornis martinicus*).
Florida grackle (*Quiscalus quiscula quiscula*).
Boat-tailed grackle (*Megaquiscalus major major*).
Howell seaside sparrow (*Passerherbulus maritimus howelli*).[11]
Marian marsh wren (*Telmatodytes palustris marianae*).

Characteristic Mammals—Lower Austral Zone.

(a) Species Ranging Nearly Throughout the Lower Austral Zone and Limited Northward by It.

Carolina short-tailed shrew (*Blarina brevicauda carolinensis*).
Evening bat (*Nycticeius humeralis*).[12]
Alabama weasel (*Mustela peninsulae olivacea*).
Old-field mouse (*Peromyscus polionotus polionotus*).
Cotton mouse (*Peromyscus gossypinus* subspp.).
Southern golden mouse (*Peromyscus nuttalli aureolus*).
Swamp rice rat (*Oryzomys palustris palustris*).[12]
Cotton rat (*Sigmodon hispidus hispidus*).
Florida wood rat (*Neotoma floridana floridana*).
Alabama pocket gopher (*Geomys tuza mobilensis*).[13]
Swamp rabbit (*Sylvilagus aquaticus aquaticus*).

(b) Species Confined to the Semitropical, or Gulf, Strip.

Mahogany bat (*Nycteris seminola*).
LeConte free-tailed bat (*Nyctinomus cynocephalus*).[14]
White-fronted beach mouse (*Peromyscus polionotus albifrons*).
Louisiana muskrat (*Fiber rivalicius*).
Bayou gray squirrel (*Sciurus carolinensis fuliginosus*).
Coast swamp rabbit (*Sylvilagus aquaticus littoralis*).
Marsh rabbit (*Sylvilagus palustris palustris*).

Characteristic Plants—Lower Austral Zone.[15]

(a) Species Ranging Nearly Throughout the Lower Austral Zone and Limited Northward by It.

Trees and shrubs.

Loblolly pine (*Pinus taeda*).
Longleaf pine (*Pinus palustris*).
Spruce pine (*Pinus glabra*).
Swamp cypress (*Taxodium distichum*).
Saw palmetto (*Serenoa serrulata*).
Pecan (*Hicoria pecan*).
Nutmeg hickory (*Hicoria myristicaeformis*).
Water hickory (*Hicoria aquatica*).
Southern wax myrtle (*Myrica cerifera*).
Overcup oak (*Quercus lyrata*).
Texas white oak (*Quercus durandi*).
Turkey oak (*Quercus catesbaei*).
Swamp Spanish oak (*Quercus pagodaefolia*).

[11] Cf. Griscom, Ludlow, and J. T. Nichols, Abstr. Proc. Linnaean Soc. New York, no. 32, p. 22, Nov. 3, 1920.
[12] Occurs locally in the Upper Austral Zone.
[13] Ranges north to Tuscaloosa County only.
[14] Ranges north to Greensboro.
[15] Partial list.

Water oak (*Quercus nigra*).
Laurel oak (*Quercus laurifolia*).
Upland willow oak (*Quercus brevifolia*).
Winged elm (*Ulmus alata*).
Planer tree (*Planera aquatica*).
Southern hackberry (*Celtis mississippiensis*).
Magnolia (*Magnolia foetida*).
Sweet-shrub; calycanthus (*Calycanthus floridus*).
Red bay (*Persea borbonia*).
Swamp red bay (*Persea pubescens*).
Prairie plum (*Prunus umbellata*).
Southern prickly-ash (*Zanthoxylum clava-herculis*).
Sebastiana (*Sebastiana ligustrina*).
Leatherwood (*Cyrilla racemiflora*).
Tall inkberry (*Ilex lucida*).
Pale-bark maple (*Acer leucoderme*).
Florida maple (*Acer floridanum*).
Drummond red maple (*Acer drummondii*).
Southern basswood (*Tilia australis*).
Virginia stewartia (*Stewartia malacodendron*).
Southern St. Peterswort (*Aseyrum hypericoides*).
Southern black gum (*Nyssa biflora*).
Tupelo gum (*Nyssa aquatica*).
Fetterbush (*Picris nitida*).
Evergreen blueberry (*Vaccinium myrsinites*).
Elliott blueberry (*Vaccinium elliottii*).
Fuscous blueberry (*Vaccinium fuscatum*).
Southern buckthorn (*Bumelia lycioides*).
Southern silver-bell tree (*Halesia diptera*).
Powdery storax (*Styrax pulverulenta*).
Large-flowered storax (*Styrax grandifolia*).
Water ash (*Fraxinus caroliniana*).
Devil-wood (*Osmanthus americana*).
Yellow jessamine (*Gelsemium sempervirens*).
Catalpa (*Catalpa catalpa*).
Opossum haw (*Viburnum nitidum*).

Herbaceous plants.

Cane (*Arundinaria macrosperma*).
Downy eriogonum (*Eriogonum tomentosum*).
Red-flowered pitcher-plant (*Sarracenia rubra*).
Short-leaved sundew (*Drosera brevifolia*).
Sensitive pea (*Chamaecrista multipinnata*).
Lanceolate false-indigo (*Baptisia lanceolata*).
Round-leaved rattlebox (*Crotalaria rotundifolia*).
Spreading lupine (*Lupinus diffusus*).
Hairy lupine (*Lupinus villosus*).
Pine-barren prairie-clover (*Kuhnistera pinnata*).
Wild indigo (*Indigofera caroliniana*).
Hispid goat's-rue (*Cracca hispidula*).
Narrow-leaved tick-trefoil (*Meibomia tenuifolia*).
Large-flowered milkwort (*Polygala grandiflora*).
Queen's-delight (*Stillingia sylvatica*).
Rough rose-mallow (*Hibiscus aculeatus*).
Carolina violet (*Viola carolina*).
Lance-leaved meadow-beauty (*Rhexia lanceolata*).
Deer grass (*Rhexia glabella*).
Hoary ludwigia (*Ludwigia pilosa*).
Miterwort (*Cynoctonum mitreola*).
Rabbit's-milkweed (*Asclepias humistrata*).
Carolina morning-glory (*Ipomaea caroliniana*).
Low breweria (*Breweria humistrata*).
Florida phlox (*Phlox floridana*).
Spanish "cypress" (*Gilia rubra*).
Carolina vervain (*Verbena carolinensis*).
Swamp basil (*Hyptis rugosa*).
Carolina thyme (*Clinipodium carolinianum*).
Azure salvia (*Salvia azurea*).
Fascicled gerardia (*Agalinis fasciculata*).
Southern bluehearts (*Buchnera elongata*).
Fimbriated ruellia (*Ruellia humilis*).
Southern bluets (*Houstonia pusilla*).

Narrow wild lettuce (*Lactuca graminifolia*)
Narrow-leaved vernonia (*Vernonia angustifolia*).
Blazing-star (*Lacinaria elegans*).
Vanilla plant (*Trilisa odoratissima*).
Hoary-leaved golden aster (*Chrysopsis trichophylla*).
Hoary golden aster (*Chrysopsis pilosa*).
Narrow-leaved goldenrod (*Solidago angustifolia*).
Short-leaved goldenrod (*Solidago brachyphylla*).
Mouse-ears (*Sericocarpus bifoliatus*).
Wandlike aster (*Aster purpuratus*).
Seaside aster (*Aster exilis*).
Southern daisy fleabane (*Erigeron quercifolius*).
Rosinweed (*Silphium asteriscus*).
Oxeye (*Heliopsis minor*).
False sunflower (*Tetragonotheca helianthoides*).
Short-leaved helenium (*Helenium brevifolium*).

(*b*) Species of the Subtropical Division, or Gulf Strip, of the Lower Austral Zone.

Trees and shrubs.

Swamp pine (*Pinus elliottii*).
Sand pine (*Pinus clausa*).
Pond cypress (*Taxodium ascendens*).
Coast red cedar (*Juniperus barbadensis*).
Bartram wax-myrtle (*Myrica inodora*).
Dwarf live-oak (*Quercus virginiana maritima*).
Twin live-oak (*Quercus geminata*).
Seaside scrub-oak (*Quercus myrtifolia*).
Narrow-leaved papaw (*Asimina angustifolia*).
Deer plum (*Chrysobalanus oblongifolius*).
Ceratiola (*Ceratiola ericoides*).
Titi (*Cliftonia monophylla*).
Low andromeda (*Pieris phillyreaefolia*).
Hoary huckleberry (*Gaylussacia frondosa tomentosa*).
Scarlet balm (*Clinopodium coccineum*).
Seaside balm (*Conradina canescens*).
Carolina boxthorn (*Lycium carolinianum*).

Herbaceous plants.

Elliott yellow-eyed grass (*Xyris elliottii*).
Creeping orchis (*Habenaria repens*).
Small yellow pondlily (*Nymphaea chartacea*).
Sea rocket (*Cakile chapmani*).
Parrot-beak (*Sarracenia psittacina*).
Drummond trumpet-leaf (*Sarracenia drummondi*).
Capillary sundew (*Drosera capillaris*).
Pursh rattlebox (*Crotalaria purshii*).
Slender prairie-clover (*Kuhnistera gracilis*).
Goat's-rue (*Cracca smallii*).
Prostrate goat's-rue (*Cracca chrysophylla*).
Acute-leaved vetch (*Vicia acutifolia*).
Florida milk-pea (*Galactia floridana*).
Erect milk-pea (*Galactia erecta*).
Pine-barren pitcheria (*Pitcheria galactioides*).
Chapman milkwort (*Polygala chapmani*).
Dwarf St. Peter's-wort (*Ascyrum pumilum*).
Opaque St. John's-wort (*Hypericum opacum*).
Seaside rock-rose (*Helianthemum arenicola*).
Divaricate pinweed (*Lechea divaricata*).
Crowfoot cactus (*Opuntia pes-corvi*).
Swamp meadow-beauty (*Rhexia stricta*).
Narrow-leaved gaura (*Gaura angustifolia*).
Large-leaved sabbatia (*Sabbatia macrophylla*).

Gentian sabbatia (*Lapithea gentianoides*).
Michaux milkweed (*Asclepias michauxii*).
Goat's-foot morning-glory (*Ipomoea pes-caprae*).
Seaside morning-glory (*Ipomoea littoralis*).
Fog-fruit (*Lippia nodiflora*).
Large-flowered pennyroyal (*Dicerandra linearifolia*).
Narrow-leaved ground-cherry (*Physalis angustifolia*).
Florida toad-flax (*Linaria floridana*).
Rough hedge-hyssop (*Sophronanthe hispida*).
Leafless gerardia (*Agalinis aphylla*).
Night-blooming ruellia (*Ruellia noctiflora*).
Round-leaved houstonia (*Houstonia procumbens*).
Short-leaved lobelia (*Lobelia brevifolia*).
Azure-flowered stokesia (*Stokesia laevis*).
Slender blazing-star (*Lacinaria gracilis*).
Large-flowered golden aster (*Chrysopsis oligantha*).
Few-flowered goldenrod (*Chrysoma pauciflosculosa*).
Small-leaved aster (*Aster adnatus*).
Rayless sunflower (*Helianthus radula*).
Lance-leaved Indian plantain (*Mesadenia lanceolata*).
Smooth thistle (*Cirsium nuttalli*).
LeConte thistle (*Cirsium lecontei*).

PART II. REPORT ON THE MAMMALS OF ALABAMA.

HISTORY OF ALABAMA MAMMALOGY.

Alabama was visited in the early years of its settlement by numbers of travelers and a few naturalists, some of whom have published accounts of their journeys, but the references in their works to mammals are for the most part brief and incidental.

Apparently the first naturalist to visit the State was William Bartram, who, in the summer and fall of 1776 (or possibly 1777, the date not being clear from his narrative). in the course of extended travels in the Southern States passed through Alabama from the old Muscogee town of Uche, on the "Chata Uche" River, to Tallassee, on the Tallapoosa River, thence southward along the general course of the Alabama River to "Taensa" and Mobile. His narrative,[1] although replete with interesting descriptions of the flora, contains only a few brief references to the larger mammals, such as wolves, bears, "tygers" (cougars), and deer. In 1820 Adam Hodgson made an extended journey through the Southern States, crossing Alabama twice—first from Ouchee Bridge, in Russell County, to Blakely and Mobile, and later from Franklin County eastward to Madison County, via Tuscumbia, Muscle Shoals, Athens, and Huntsville. In his narrative he refers casually to "panthers" (cougars), gray foxes, and bears.[2] In 1830 James Stuart journeyed across Alabama from Fort Mitchell to Montgomery, thence to Mobile. Apparently, the only mammals which attracted his attention were deer, which he mentions incidentally.[3] Two years later, in 1832, C. D. Arfwedson covered practically the same route and likewise in his narrative mentions only deer.[4] In 1856 Charles Lanman published an account of his "Adventures," in which are included four chapters on Alabama, with a few casual references to mammals.[5]

Audubon and Bachman, in their monumental work on the North American quadrupeds[6]—the first and in some respects the best ever published on the subject—have given us many excellent biogra-

[1] Bartram, William, Travels, pp. 520, London, 1792.

[2] Hodgson, Adam, Letters from North America, vol. 1, pp. 117–154, 262–273, London, 1824.

[3] Stuart, James, Three years in North America, vol. 2, pp. 164–226, Edinburgh, 1833.

[4] Arfwedson, C. D., The United States and Canada, vol. 2, pp. 1–47, London, 1834.

[5] Lanman, Charles, Adventures in the wilds of the United States and British American Provinces, vol. 2, pp. 146–188, 1856.

[6] Audubon, J. J., and John Bachman, Quad. North Amer., 3 vols., New York, 1846–1854.

phies of southern mammals, largely based on Bachman's careful observations in South Carolina, but containing numerous incidental references to Alabama mammals. In Baird's great work on North American mammals[7] only a few Alabama specimens are listed. Gosse, in his "Letters,"[8] referred briefly to a number of mammals and gave interesting accounts of deer hunting and of a nocturnal "possum" hunt.

Later references to Alabama mammals are found chiefly in monographs and technical revisions, and as a rule do not treat at all of habits or distribution. In 1909, however, the present writer published a paper containing brief notes on the distribution of southern mammals based on a field trip made during the summer and fall of 1908. This paper—apparently the first local list from the State—contains records of 20 species occurring in Alabama.[9] In 1916 John H. Wallace, jr., published in his Fifth Annual Report of the Department of Game and Fish of the State of Alabama a list of the mammals of Alabama, comprising 50 species. The paper is evidently based on a nominal list furnished by the Biological Survey; the annotations are descriptive and biographical and contain no information as to distribution.

The present report, resulting from the field investigations carried on by the Biological Survey from 1908 to 1916, comprises an annotated list of 65 forms, 10 not heretofore recorded from the State and 3 new to science.[10]

ANNOTATED LIST OF MAMMALS.

Order MARSUPIALIA.

Family DIDELPHIIDAE: Opossums.

Didelphis virginiana virginiana Kerr.

VIRGINIA OPOSSUM.

Didelphis virginiana Kerr, Animal Kingdom, p. 193, 1792.

Opossums are common and generally distributed throughout Alabama, dwelling chiefly in timbered regions, either in swampy bottom lands or the drier upland woods and in ravines among the hills. Two specimens from Ardell and one from Leighton are typical *virginiana*, as was also a captive specimen examined at Piedmont, but there are no specimens available to show where this race merges into *pigra* of the coast region. The species is reported from Sand

[7] Baird, S. F., Mamm. North Amer.: Rept. Expl. Surv. R. R. Pac., vol. 8, 1857.

[8] Gosse, P. H., Letters from Alabama, pp. 306, London, 1859.

[9] Howell, A. H., Notes on the distribution of certain mammals in the southeastern United States: Proc. Biol. Soc. Washington, vol. 22, pp. 55–68, 1909.

[10] The new forms are *Scalopus aquaticus howelli* Jackson, *Mustela peninsulae olivacea* Howell, and *Glaucomys volans saturatus* Howell.

Mountain, Woodville, Elkmont, Fort Payne, Mount Weogufka, Natural Bridge, Greensboro, Wilsonville, Talladega Mountains, Auburn, Tidewater (Tuscaloosa County), and other places.

The 'possum is a stupid, clumsy creature, with scarcely enough sense to keep out of reach of a cur dog; it often blunders into any sort of a trap. Young individuals are frequently taken in spring-wire rat traps set for small mammals, and the adults in small steel traps. Opossum hunting is a favorite sport in the South, and thousands of the animals are captured every season by local hunters without seriously reducing their numbers. This is due, doubtless, to the great fecundity of the species. It is reported to breed three or more times in a season, usually (according to Bachman) in March, May, and July, and to produce from 6 to 13 young in a litter.

The animals are chiefly nocturnal, remaining during the daytime in their retreats in hollow logs or in old nests of the gray squirrel or the Florida wood rat. At Leighton, in July, 1911, while hunting for wood rats along the osage-orange hedges, the writer poked a full-grown opossum out of a large rat nest 10 feet up among the thorny branches of the hedge trees.

Audubon and Bachman describe the feeding habits of the opossum as follows:

> It enters the cornfields (maize), crawls up the stalks, and sometimes breaks them down in the manner of the raccoon, to feed on the young and tender grains; it picks up chestnuts, acorns, chinquapins and beechnuts, and munches them in the manner of the bear. We have, on dissection, ascertained that it had devoured blackberries, whortleberries, and wild cherries, and its resort to the persimmon tree is proverbial. It is also insectivorous, and is seen scratching up the leaves in search of worms and the larvæ of insects, of which it is very fond. In early spring it lays the vegetable kingdom under contribution for its support, and we have observed it digging up the roots of the small atamasco lily (*Zephyrina atamasco*), and the young and tender shoots of the China brier (*Smilax rotundifolia*), as they shoot out of the ground like asparagus. It is moreover decidedly carnivorous, eating young birds that it may detect on the ground, sucking the eggs in all the partridge, towhee-bunting and other nests it can find in its persevering search. It destroys mice and other rodentia, and devours whole broods of young rabbits, scratching about the nest and scattering the hair and other materials of which it was composed. We have observed it squatting in the grass and brier thickets in Carolina, which are the common resort of the very abundant cotton rat (*Sigmodon hispidum*), and from patches of skin and other mutilated remains we satisfied ourselves that the opossum was one among many other species designed by Providence to keep in check the too rapid increase of these troublesome rats. We must admit that it sometimes makes a sly visit to the poultry house, killing a few of the hens and playing havoc among the eggs. The annoyances of the farmer however from this mischievous propensity, are not as great as those sustained from some of the other species, and can not for a moment be compared with the destruction caused by the weasel, the mink, or the skunk.[11]

[11] Audubon and Bachman, Quad. North Amer., vol. 2, pp. 112–113, 1851.

Didelphis virginiana pigra Bangs.

FLORIDA OPOSSUM.

Didelphis virginiana pigra Bangs, Proc. Boston Soc. Nat. Hist., vol. 28, p. 172, 1898.

The Florida opossum, characterized by darker colors, with less white on the toes, occupies the southern part of the State. Two specimens from Castleberry and one from Bon Secour are referable to this subspecies, but the northern limits of its range are at present uncertain. Allen refers four skulls from Sylacauga to this form. Reports of the occurrence of opossums at Scale, Hayneville, Catoma Creek (Montgomery County), Myrtlewood, Thomasville, Carlton, Mobile, and Alabama Port should probably be assigned to the present form.

Order INSECTIVORA.

Family TALPIDAE: Moles.

Scalopus aquaticus howelli Jackson.

HOWELL MOLE.

Scalopus aquaticus howelli Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, 1914.

The Howell mole, which is a form of the common mole, ranges over practically the whole State and inhabits a great variety of situations. Sandy or loamy soil is preferred by the mole, and its wanderings take it into meadows, gardens, cultivated fields, river bottoms, mountain slopes, and both coniferous and hardwood forests. The tunnels are usually near the surface and appear as a network of tortuous ridges or sometimes as a single ridge running approximately straight for some distance. During periods of drought moles burrow deeper and at times almost desert the surface ridges. They practically never leave their burrows and when forcibly brought to the surface at once seek safety by burrowing again into the soil. Although possessing rudimentary eyes, moles probably are unable to distinguish objects by sight, but they may be able to perceive light from darkness.

The mole is considered a pest by most farmers and is accused of destroying newly planted corn and injuring potatoes and other field crops, as well as garden bulbs. Its diet, however, is composed largely of insects and earthworms, and much of the damage attributed to it is really done by pine mice, which follow its tunnels and attack the plants or seeds near which they lead. It is true, nevertheless, that moles do cause both annoyance and damage by uprooting lawns and by tunneling among the roots of plants, thereby aiding the incursions of injurious rodents.

The form of the common mole inhabiting Alabama is intermediate in size between the eastern mole (*Scalopus aquaticus aquaticus*) and the Florida mole (*Scalopus a. australis*), but it is usually paler than either, with a flat skull and a long, narrow rostrum. Specimens have been taken at Huntsville, Sand Mountain (near Carpenter), Auburn, Ardell, Autaugaville, Greensboro, Cottondale, Eutaw, and Castleberry. Evidence of the presence of moles has been noted at Elkmont, Natural Bridge, Talladega Mountains, Seale, Dothan, Carlton, Mobile, Bayou Labatre, Orange Beach, and many other places.

Family SORICIDAE: Shrews.

Blarina brevicauda carolinensis (Bachman).

CAROLINA SHORT-TAILED SHREW.

Sorex carolinensis Bachman, Journ. Acad. Nat. Sci. Philadelphia, vol. 7, pt. 2, p. 366, 1837.

The Carolina short-tailed shrew is the largest of the three species of shrews found in the State; it occurs in all sections, but less abundantly in the south. In Bear Swamp, near Autaugaville, a number of specimens were trapped by the writer around rotten logs in the swamp, and at York a number were secured at rotten logs in weedy fields. In Bucks Pocket, on Sand Mountain, two were caught in the same spot beside a log in a wooded ravine. L. J. Goldman found the animals plentiful in pine woods at Ardell, and at Greensboro, Jackson, and Seale individuals have been taken in fields of broom sedge. Single specimens have been taken also by J. L. Peters, at Alabama Port, and by H. P. Loding, at Spring Hill.

In the shrews the senses of hearing, smell, and touch are acute, while that of sight is practically useless, serving apparently only to distinguish light from darkness. The little creatures are exceedingly fierce and voracious, easily capturing and killing animals larger than themselves.

The present species, like most of its tribe, is almost wholly nocturnal. It lives chiefly in hollow logs and stumps and in underground burrows, usually in moist or peaty soil. It also makes shallow runways under the surface vegetation and uses the burrows and runways of other animals.

Studies of the northern race of this species (*Blarina brevicauda brevicauda*), by A. Franklin Shull, showed that its food consists mainly of meadow voles (*Microtus*), mice, insects, earthworms, and land snails. The snails were hoarded in little piles near the entrances to the burrows, and also moved back and forth into the galleries. The burrows were found to be 25 to 30 millimeters in diameter, entering the ground at a steep angle, and extending from 15 to 40 centime-

ters (6 to 15¾ inches). The nests were "usually made of grass, sedge, and leaves of nettle, goldenrod, or ash, arranged in the form of a hollow ball, the shell of which was 1 to 3 cm. thick."[12]

Bachman mentions having found two nests of this species composed of root fibers and withered blades of grasses about a foot beneath the surface. One nest contained five, the other six young. On another occasion in one of the tunnels of the mole he found "a small cavity containing a hoard of coleopterous insects, principally composed of a rare species (*Scarabaeus tityus*), fully the size of the animal itself; some of them were nearly consumed, and the rest mutilated, although still living."[13]

Cryptotis parva (Say).

LEAST SHREW.

Sorex parvus Say, Long's Exped. Rocky Mountains, vol. 1, p. 163, 1823.

The least shrew is the smallest of the short-tailed shrews, and but little larger than the Bachman shrew (*Sorex longirostris*). Although few specimens have been taken, it is apparently generally distributed over most of the State and in some localities is not uncommon. In the Merriam collection is one taken at Mobile in 1890 by the late Dr. Charles Mohr. E. G. Holt secured seven specimens, December 14, 1911, from beneath an overturned stack of old alfalfa hay in an open field at Barachias. H. P. Loding captured two around manure piles in his garden in the suburbs of Mobile. Three skulls of this species were found in the stomachs of two barred owls (*Strix varia alleni*) killed at Autaugaville in December, 1911. Specimens have been trapped on Sand Mountain (near Carpenter), on Cane Creek, Marshall County (near Oleander), and at Woodville and Alabama Port.

Relatively little is known about the habits of this little shrew. It is believed to be partly diurnal, and is an inhabitant of dry, grassy fields, rather than the woods or marshes preferred by most other shrews. It is frequently taken in runways of cotton rats (*Sigmodon*) and may also make small runways of its own. A nest found under a log at Victoria, Texas, by J. D. Mitchell was built of coarse, broad-leaved grass and lined inside with fine grass, the outside neatly and strongly woven.

Sorex longirostris Bachman.

BACHMAN SHREW.

Sorex longirostris Bachman, Journ. Acad. Nat. Sci. Philadelphia, vol. 7, pt. 2, p. 370, 1837.

The Bachman shrew, a tiny long-tailed species, even smaller in bulk than the least shrew (*Cryptotis parva*), is the smallest mammal

[12] Shull, A. Franklin, Amer. Nat., vol. 41, pp. 495–522, 1907.
[13] Audubon and Bachman, Op. cit., vol. 2, p. 177.

found in Alabama, and likewise the rarest. It is known only from a single specimen taken from the stomach of a barred owl killed by Lewis S. Golsan on the borders of Bear Swamp, Autauga County, December 1, 1911. The writer, in company with Mr. Golsan, trapped carefully for several days in and around Bear Swamp, where the owl responsible for the single Alabama specimen was killed, but no shrews of this genus were secured.

Originally described from the lower Santee River, South Carolina, the species has since been taken in North Carolina, Virginia, Maryland, Indiana, Illinois, and Georgia. Although ranging over a wide area, it is apparently uncommon or else difficult to trap, since comparatively few specimens have been taken.

Little is known of the habits of this shrew, but apparently they are similar to those of the other long-tailed shrews, which are found chiefly in moist woodland, living in or beneath rotten logs or stumps or in crevices of rocks. One of the original specimens, described by Bachman, was found by laborers while digging a ditch through grounds nearly overflowed with water. Another was taken from the throat of a hooded merganser, presumably killed in a swamp or rice marsh.[14] In southern Illinois, Edmund Heller secured a number of specimens in low, swampy woods; but Brimley, at Raleigh, North Carolina, states that the species is "found on comparatively high ground, not in swamps nor on the edges of them * * *."[15]

Order CHIROPTERA.

Family VESPERTILIONIDAE: Typical Bats.

Myotis grisescens Howell.

GRAY BAT.

Myotis grisescens Howell, Proc. Biol. Soc. Washington, vol. 22, p. 46, 1909.

The gray bat, a medium-sized species, is abundant at several localities along the Tennessee River, but has not been taken elsewhere in Alabama. It was first discovered in Nickajack Cave, Tennessee, which is in the north face of Sand Mountain, about half a mile north of the Alabama-Georgia-Tennessee boundary, where in August, 1908, the writer collected the series from which the species was described.[16] Colonies have since been found near Fort Deposit, on the Tennessee River, and at Rogersville.

The gray bat lives in caves, both winter and summer, usually in large colonies. In Nickajack Cave large clusters hung from the

[14] Audubon and Bachman, Op. cit., vol. 3, p. 250.
[15] Brimley, C. S., Amer. Nat., vol. 31, p. 448, 1897.
[16] Howell, A. H., Op. cit., pp. 45–47.

high ceiling of a large chamber about 300 yards from the entrance, and smaller numbers were found in crevices in the ceiling close to the entrance. In the cave near Fort Deposit the bats occupied a small, low chamber, reached by following a narrow, winding passage for about half a mile. They hung from the ceiling in one compact mass, 3 or 4 feet square and several bats deep. On the evening of June 18 the bats were observed coming out of this cave about 7 o'clock; they swarmed out in large numbers, feeding in the mouth of the cave and among the trees on the river bank. Of the 18 specimens collected in this cave, all were males; while in Saltpetre Cave, near Rogersville, of 62 specimens collected by Holt, 46 were females. Holt, writing of his visit to the Rogersville Cave, says:

> The bats were not hanging in clusters, but thousands of them lined the ceiling in a solid sheet, hanging separately head downward. A couple of shots were sufficient to cause pandemonium, and immediately I found myself in almost total darkness (my assistant having retreated around a corner with the lantern), surrounded by a swirling mass of squeaking bats. They were everywhere, the flying thousands filling the air, and in their panic rushing against me and sticking all over my head and body; I had to keep kicking to prevent them crawling up my breeches legs. On my way out the scattered bats seemed to fill the whole cave. Their droppings covered the floor in places to the depth of several feet.

At Limekiln, on the Tennessee River north of Leighton, we observed a number of bats, believed to be of this species, coming out of a small cave on the river bluff, from which issues also a cold spring.

[Myotis lucifugus lucifugus (LeConte).

Little Brown Bat.

V[espertilio] *lucifugus* LeConte, McMurtrie's Cuvier, Animal Kingdom, vol. 1, p. 431, 1831.

The little brown bat has an extensive range from northern Canada south to Florida, but apparently is absent or very scarce in Alabama. Miller records a skin from Greensboro in the Merriam collection,[17] but the specimen can not be located, nor is there any record of it in Dr. Merriam's catalogue. There is considerable doubt, therefore, as to the occurrence of this species in the State.]

Lasionycteris noctivagans (LeConte).

Silver-haired Bat.

V[espertilio] *noctivagans* LeConte, McMurtrie's Cuvier, Animal Kingdom, vol. 1, p. 431, 1831.

The silver-haired bat is a northern-breeding species, and occurs in Alabama only as a migrant or possibly a winter resident. It is known at present only from five specimens taken by the writer, as follows: Squaw Shoals, April 11, 1912 (2); Autaugaville, April 17, 1912 (2);

[17] Miller, G. S., North Amer. Fauna No. 13, p. 62, 1897.

and Sand Mountain, near Carpenter, October 29, 1916 (1). At Squaw Shoals a specimen was seen which had been taken from a hollow tree by J. T. Winchester, in the fall of 1911.

These are the most southerly records for the species. It breeds in the northern United States and south to North Carolina and possibly northern Georgia[18] and migrates in autumn to the Southern States and even to Bermuda. The silver-haired bat is a tree-dwelling species. Vernon Bailey states that in Minnesota it roosts under bark on old trees, and C. S. Brimley, in North Carolina, has on several occasions taken specimens in winter in hollow trees. Its flight is rather slower and less erratic than that of the red bat.

Pipistrellus subflavus subflavus (F. Cuvier).

SOUTHEASTERN PIPISTRELLE.

V[espertilio] subflavus F. Cuvier, Nouv. Ann. Mus. Hist. Nat., Paris, vol. 1, p. 17, 1832.

The southern pipistrelle is the smallest and one of the commonest of the bats in the South. It ranges to Florida and southern Louisiana, but apparently is scarce or absent in southern Alabama. Specimens have been collected at Leighton, Elkmont, Stevenson, Huntsville, Fort Payne, Bucks Pocket (near Grove Oak), and Greensboro. A number of small bats seen at Abbeville were thought to be of this species.

This little bat may usually be distinguished by its small size and its erratic, butterfly-like flight. It frequents caves in winter and to a less extent in summer. Hahn says of it, as observed in Indiana:

Pipistrellus subflavus is solitary in habit. Occasionally two are found side by side, though I have never seen them clinging to each other except in mating. However they do not avoid the vicinity of others of their own kind or other species. This species seems to prefer the side walls of the higher passages. I have never seen it suspended from the roof except where there was a crevice or prominent ledge.[19]

In Bucks Pocket, on Sand Mountain, a semitorpid individual was found November 5, 1916, clinging to the side of a large rock in a cool ravine. Hahn mentions seeing one under a ledge of rock near Mitchell, Indiana, in February.[20]

Eptesicus fuscus fuscus (Beauvois).

LARGE BROWN BAT.

Vespertila [sic] *fuscus* Beauvois, Cat. Peale's Mus., Philadelphia, p. 14, 1796.

The large brown bat is moderately common in the northern part of the State, but has thus far never been taken in the southern part. It

[18] Specimens are known from Bertie County, North Carolina, July 1, 1891, and December 26, 1892 (Brimley, Amer. Nat., vol. 31, p. 239, 1897); Highland, North Carolina, April 18, 1886 (Merriam collection); Toccoa, Georgia, May 26, 1916 (Biological Survey collection).

[19] Hahn, W. L., Biological Bulletin (Indiana Univ.), vol. 15, No. 3, p. 145, 1908.

[20] Op. cit., p. 144.

has been taken during the breeding season at Leighton, Sand Mountain (near Carpenter), Erin, and Greensboro; two specimens taken at Autaugaville, January 17 and February 26, 1912, may have been migrants.

This species frequents caves to some extent in winter, but in summer is most often found concealed about buildings, either in the attic, in some dark corner under the eaves, or behind a shutter. In a schoolhouse at Leighton on July 3, 1913, Holt found eight individuals hanging to the wall of the open vestibule, just beneath the ceiling. They were seen there about 9 p. m., but were not to be found during the day. Dr. Fisher states that in southern New York this species is the last to make its appearance in the evening and that its favorite hunting grounds are fields well surrounded by trees.[21]

Nycteris borealis borealis (Müller).

Red Bat.

Vespertilio borealis Müller, Natursyst, Suppl., p. 21, 1776.

The red bat is one of the commonest bats, ranging practically all over the State, except in the coast region, where its place is largely taken by the mahogany bat (*Nycteris seminola*). Specimens have been collected at Leighton, Sand Mountain (near Carpenter), Guntersville, Attalla, Logan, Mount Weogufka, Squaw Shoals, Greensboro, Hayneville, Autaugaville, Barachias, Point Clear, Ashford, Castleberry, and Abbeville. In the coast region it is of rare occurrence and the few specimens taken there (Point Clear, Apr. 21, 29, 1892; Ashford, Nov. 27, 1916) may have been migrants.

The red bat, though sometimes found in caves in winter, is in summer a dweller in trees or garrets. On one occasion at Lake Grove, New York, in summer, the writer came upon a number of these bats closely bunched together hanging to a low branch of a small hickory tree. This is one of the first bats to appear in the evening, being seen usually half an hour or more before dark and sometimes also during the middle of the day. On Sand Mountain, April 16, 1914, one was seen about noon feeding in bright sunlight; it flew leisurely up and down over a creek for a period of 20 minutes or more. Holt reports seeing one drinking, swallow-fashion, over the Tennessee River.

This bat is known to perform extended migrations and has even been observed migrating during the daytime.[22]

Nycteris seminola (Rhoads).

Mahogany Bat.

Atalapha borealis seminola Rhoads, Proc. Acad. Nat. Sci. Philadelphia, p. 32, 1895.

The mahogany bat is a dark-colored species occurring commonly in the coast region, where it takes the place of the red bat of the more

[21] Fisher, A. K., Forest and Stream, vol. 16, p. 490, 1881.

[22] Miller, G. S., Science (N. S.), vol. 5, pp. 541–543, April 2, 1897; Mearns, E. A., Bull. Amer. Mus. Nat. Hist., vol. 10, p. 345, 1898.

northern counties. Specimens have been taken at Point Clear, April 25, 1892; Orange Beach, January 24, 28, 1912; and Mobile, May 10, 1911, August 1, 1913, and February 27, 1916. It ranges sporadically also as far north as Autaugaville and even Fort Payne, where specimens were taken April 17, 1912, and June 30, 1911, respectively. These show no evidence of intergradation with *borealis*, and the material at present available indicates that this form is a distinct species. Apparently it does not differ materially in habits from its near relative, the red bat. Like the latter species, it is an early flier, often seen abroad shortly after sundown. At Orange Beach, the last week in January, one was seen flying a few minutes after 5 p. m. During the winter season it apparently feeds only on mild days. In South Carolina the writer found this bat resting in long bunches of Spanish moss.

Nycteris cinerea (Beauvois).

HOARY BAT.

Vespertilio cinereus Beauvois, Cat. Peale's Mus., Philadelphia, p. 15, 1796.

The large and handsome hoary bat occurs in the State only as a rare migrant; only two specimens have thus far been taken—one by Russell J. Thompson, at Point Clear, Mobile Bay, April 19, 1892, the other by Lewis S. Golsan, at Autaugaville, January 15, 1912. Its summer home is chiefly within the Canadian Zone, from northern New York and Wisconsin northward, but during the winter season it migrates southward for long distances, having been taken in central Mexico, southern Lower California, and the Bermuda Islands. Little is known of its habits, but, like its smaller relative, the red bat, it is undoubtedly a tree-dweller. Merriam writes of its habits as observed in the Adirondack region of New York:

> The Hoary Bat can be recognized, even in the dusk of evening, by its great size, its long and pointed wings, and the swiftness and irregularity of its flight. It does not start out so early as our other bats, and is consequently much more difficult to shoot. The borders of woods, water courses, and roadways through the forest are among its favorite resorts, and its nightly range is vastly greater than that of any of its associates. While the other species are extremely local, moving to and fro over a very restricted area, this traverses a comparatively large extent of territory in its evening excursions, which fact is probably attributable to its superior power of flight.[22]

Nycticeius humeralis (Rafinesque).

EVENING BAT.

Vespertilio humeralis Rafinesque, Amer. Monthly Mag., vol. 3, p. 445, 1818.

The evening bat is abundant and generally distributed throughout the State. Specimens have been taken at Leighton, Guntersville,

[22] Merriam, C. Hart, Mamm. Adirondack region: Trans. Linnaean Soc. New York, vol. 2, p. 78, 1884.

Ardell, Squaw Shoals, Erin, Mount Weogufka, Auburn, Greensboro, Hayneville, Seale, Abbeville, Bon Secour, Point Clear, and Castleberry. In flight it appears of small or medium size and of a very dark color. Like the red bat, it begins to hunt considerably before dark; at Guntersville, in the middle of June, the first ones were seen flying about 7 o'clock in the evening. Compared with that of other species, its flight is rather slow and steady, often close to the earth, though sometimes at a moderate height. In winter this bat probably hibernates in the same manner as other species. A specimen was taken at Bon Secour on October 19, 1908; and at Autaugaville the writer saw several flying on November 20 and 21, 1916.

Corynorhinus macrotis (LeConte).

LeConte Big-eared Bat.

Plec[otus] macrotis LeConte, McMurtrie's Cuvier, Animal Kingdom, vol. 1, p. 431, 1831.

The LeConte big-eared bat is apparently of rather local distribution and nowhere very common in the State. Only a few specimens have thus far been captured—one each from Huntsville, Town Creek, and Greensboro, and two from Autaugaville. The Huntsville specimen was obtained in a small outhouse on Monte Sano (altitude 1,600 feet), having been stupefied by the smoke of a fire built in the house, so that it dropped from the ceiling, to which it was clinging. F. W. McCormack described some very long-eared bats which he caught some years ago in the garret of an old mill on Town Creek; later a specimen was obtained (July 4, 1913) from this mill by E. G. Holt. Miller lists a skin in the Merriam collection from Greensboro, but the specimen can not now be located, nor is there any other record of it.[23] L. S. Golsan obtained two specimens at Autaugaville, August 22 and September 3, 1912. Hahn states that in Indiana this species has been found only in dimly lighted parts of caves near the entrances, where it was clinging to the side walls, its long ears folded down along the neck.[24]

Family MOLOSSIDAE: Free-tailed Bats.

Nyctinomus cynocephalus (LeConte).

LeConte Free-tailed Bat.

Nyct[icea] cynocephala LeConte, McMurtrie's Cuvier, Animal Kingdom, vol. 1, p. 432, 1831.

The LeConte free-tailed bat probably occurs more or less commonly over at least the southern part of Alabama, but thus far it has been taken only at Greensboro and Orange Beach. It is primarily

[23] Miller, G. S., North Amer. Fauna No. 13, p. 52, 1897.
[24] Hahn, W. L., Biological Bull. (Indiana Univ.), vol. 15, no. 3, p. 145, 1908.

a house bat, often infesting the attics of dwellings in such numbers as to become a decided nuisance. It hides also in the crevices of wooden bridges. Vernon Bailey states that the species possesses a rank, musky odor, so strong as to be noticeable from the outside of an infested house. The late Dr. W. C. Avery caught about 400 specimens by setting nets on the outside of an old building at Greensboro; 30 specimens, secured July 31 and August 1, 1890, are preserved in the Biological Survey collection. At Orange Beach, January 24 and 28, 1912, two specimens shot by local hunters were secured. The writer has shot many bats in various parts of the South, but as yet has never taken this species.

Order CARNIVORA.

Family URSIDAE: Bears.

Ursus floridanus Merriam.

FLORIDA BLACK BEAR.

Ursus floridanus Merriam, Proc. Biol. Soc. Washington, vol. 10, p. 81, 1896.

Bears doubtless ranged over all of Alabama in early times, but at present are exterminated everywhere except in the swamps of the southern counties. In the big swamps bordering the Tensaw and Mobile Rivers they are still common and a number are killed there every fall. A. J. McIntyre, of Carlton, is reported to have killed in recent years over 100 bears and to have caught 10 cubs. In April, 1911, he killed an old male, estimated to weigh 500 pounds, which for 25 years had been known to settlers in that region as "Old Nubfoot," being recognized by his peculiar track. This bear had become very bold in raiding hog pens and was charged with the destruction of a considerable number of calves and hogs. Bears are occasionally found in the swamps of southern Mobile County, and are reported fairly numerous near Bayou Labatre, where they do considerable damage to stock. In November, 1915, T. J. Pendarvis killed a large male, near Irvington, estimated to weigh 400 pounds. The animal was baited in the swamp through which he had been passing and was shot by moonlight from a place of concealment near the bait. This bear was said to have a regular trail through the swamps and to cross a public road not over 3 miles from Bayou Labatre by climbing a wire fence.

At Bon Secour a single bear was reported about 1905—the only one for many years. At Ashford, Houston County, bears are rarely found, but during a big freshet in July, 1916, the tracks of one were seen in a field near a swamp.

Four skulls of the southern Alabama bear have been examined and they indicate that the form found there is intermediate between

floridanus and *luteolus*. The skull of an old adult male from Carlton agrees in general with *luteolus* of comparable age, from Louisiana, but differs in having smaller teeth, a somewhat shorter muzzle, and a shorter palate. Compared with the type of *floridanus* (from Dade County, Florida) and with an adult from New Smyrna, Florida, this skull differs in having the palatal floor more level, the molars somewhat larger, the muzzle shorter and relatively broader, and the frontal region slightly less elevated. An old adult (probably female) from the same locality and a young adult male from Bayou Labatre agree with *floridanus* in size of teeth, depression of palatal floor, shape of muzzle, and elevation of frontal region. The single skin from Alabama (Bayou Labatre) is glossy black all over, except the muzzle, which is brownish black above, the sides of the face ochraceous-tawny.

The extermination of the bears of northern Alabama makes it impossible to say what race was found there; quite likely typical *americanus* ranged at least in the mountainous parts.

Family CANIDAE: Wolves and Foxes.

Canis floridanus Miller.

SOUTHEASTERN WOLF.

Canis floridanus Miller, Proc. Biol. Soc. Washington, vol. 25, p. 95, 1912.

Wolves in former times doubtless ranged over the greater part of Alabama, but are now on the verge of extinction. Their last stronghold appears to be the rough, hilly country stretching from Walker County northwestward to Colbert County.

It was reported that three or four wolves were killed in September, 1912, on the Blackwater near South Lowell by the O'Rear brothers, and during the spring of 1914 the animals were heard howling (according to reports) at points in Walker County within 12 miles of Jasper. C. H. Harbison, living on Ryan Creek, in western Cullman County, states that wolves were destructive to stock in that region in 1915, and that, after eating up most of the sheep and lambs, they left the country and moved westward into Winston and Marion Counties. This migration is apparently confirmed by the appearance of the animals about that time in Franklin and Colbert Counties. D. L. Paden, whose home is in the hill country, 12 miles south of Cherokee, writes (in 1917) that the wolves came into that country "several years ago"; that they killed thousands of dollars' worth of sheep and goats, and practically stopped the raising of these animals; and that some calves also were killed by them. In April, 1917, in the same locality, G. G. Paden killed an adult male wolf, the skin and skull of which were secured by the Biological Survey.

This is the only specimen from the Southeastern States, excepting a single one from Florida, that has come into the possession of any museum, and is therefore of extreme interest. It may be described as follows·

Upperparts mixed blackish and cinnamon-buff; shoulders, sides of neck and body, and fore back washed with light buff; top and sides of head grizzled iron gray (produced by a mixture of black and light buff), tinged medially with cinnamon-buff; muzzle light pinkish cinnamon, shading to light buff around edges of lips and on sides of face beneath the eyes; ears cinnamon-buff, shaded with blackish; front legs and feet light buff, washed with cinnamon-buff and with a faint median stripe of blackish; hind legs and feet light buff, strongly washed with cinnamon; tail mixed cinnamon and light buff, shaded above and on tip with blackish; underparts mixed light buff and cinnamon-buff, washed with whitish. Compared with the type of *Canis floridanus* (from Putnam County, Florida) the Alabama specimen differs in the following particulars; Top and sides of head more grayish; muzzle slightly paler; ears less tawny; fore legs paler and with less extensive median black line; hind legs paler (less strongly ochraceous). It differs from Michigan specimens (*lycaon?*) in being slightly paler, especially on the fore legs and muzzle, with the ears less intensely tawny.

The skull (adult ♂) agrees essentially with that of *floridanus* (type, adult ♀), but is slightly larger and relatively narrower across postorbital processes, with a slightly longer rostrum. It agrees in dental characters with the Louisiana wolf (specimens from Tallulah, Louisiana), but differs in being relatively broader with a shorter, broader rostrum. Compared with *lycaon* of eastern Canada (specimens from 40 miles northeast of Mattawa, Quebec) it differs as follows: Skull of nearly the same size, but with braincase and rostrum relatively narrower; upper premolars and carnassial longer and relatively narrower, the latter with antero-internal heel more strongly developed; first upper molar broader, with posterior middle cusp more strongly developed.

Wolves ranged in some numbers in the Talladega and Choccolocco Mountains until about 1896, in which year, in northern Clay County, 17 were said to have been killed in two days. The last one killed in that region was about 1905 and it was mounted and exhibited in Talladega for a number of years. Wolves were heard howling on Duggar Mountain near Piedmont as late as 1914, but at the present time they are almost, if not quite, exterminated in that region. A black wolf was reported to have been killed on La Grange Mountain, near Leighton, about 1906 and more recently another was seen there.

Strangely enough, in the big swamp country in Baldwin and Mobile Counties, where deer are still numerous, wolves apparently were exterminated many years ago; the last one of which there is record was reported killed near Carlton about 1894.

Little is known of the habits of the Alabama wolves except that they roamed the mountains in small droves and fed considerably on the smaller domestic animals—sheep, goats, pigs, and sometimes calves. Bartram, writing in 1791, mentions the occurrence of wolves on the lower Tombigbee River, and describes pups of a litter found

in July, 1776, on the Tallapoosa River, near Coolome, as "half the size of a small cur dog and quite black."[25]

Vulpes fulva (Desmarest).

Red Fox.

Canis fulvus Desmarest, Mammalogie, vol. 1, p. 203, 1820.

The red fox apparently is not native in the Southern States, but has been introduced or has extended its range into that region within historic times. Regarding the early history of the animal in America, Audubon and Bachman make the following statements:

> Red Foxes have gradually migrated from the Northern to the Southern States. This change of habitation may possibly be owing to the more extensive cultivation to which we have alluded * * * as a reason for this species having become more numerous than it was before the Revolution. This idea, however, would seem to be overthrown by the continued abundance of Gray Foxes in the Eastern States. In the early history of our country the Red Fox was unknown south of Pennsylvania, that State being its Southern limit. In process of time it was found in the mountains of Virginia, where it has now become more abundant than the Gray Fox. A few years afterwards it appeared in the more elevated portions of North Carolina, then in the mountains of South Carolina, and finally in Georgia, where we have recently observed it.
>
> This species was first seen in Lincoln County, Georgia, in the year 1840, since then it has spread over the less elevated parts of the country, and is not rare in the neighborhood of Augusta. We are informed by Mr. Beile, an intelligent observer of the habits of animals, that on one occasion near Augusta, as he was using a call for wild turkeys, a little before sunrise, in the vicinity of Augusta, two Red Foxes came to the call, supposing it to be that of a wild turkey, and were both killed by one discharge of his gun.[26]

Whether the species extended its range naturally into Alabama is not known. Numerous reports from residents, however, indicate that foxes from other States have been imported and liberated in many widely separated localities. Statements to this effect have been made by people at Dean, Wilsonville, Castleberry, Abbeville, and Orange Beach. Red foxes are reported to occur in small numbers also at Elkmont, Leighton, Sand Mountain, Woodville, Huntsville, Fort Payne, Mount Weogufka, Jackson, Dothan, and Bon Secour, and in Elmore, Wilcox, and Montgomery Counties. Two skulls from Alabama (Tennessee River, north of Leighton; Catoma Creek, Montgomery County) agree essentially with a specimen from Virginia assumed to be typical *fulva*.

The den of the red fox is said to be in caves or clefts of rocky bluffs, sometimes in old stumps or hollow logs, or in burrows in the ground. Merriam describes the animal's feeding habits as follows:

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[25] Bartram, William, Travels, pp. 396, 410, 1792.

[26] Audubon and Bachman, Op. cit., vol. 2, pp. 269–270.

He is both nocturnal and diurnal in habits, and preys upon skunks, woodchucks, muskrats, hares, rabbits, squirrels, mice, and small birds and eggs. He is a well-known and much-dreaded depredator of the poultry yard, destroying, with equal alacrity, turkeys, ducks, geese, hens, chickens, and doves; and has been known to make off with young lambs. He will also eat carrion, and even fish, and is said to be fond of ripe grapes and strawberries.[27]

Urocyon cinereoargenteus cinereoargenteus (Schreber).

GRAY FOX.

Canis cinereo-argenteus Schreber, Säugthiere, vol. 3, pl. 92, 1775.

The gray fox is reported from all sections of the State and is still common in many localities, though much reduced in numbers in the more thickly settled regions. Fox hunting with hounds is a favorite sport and has resulted in extermination of the species in some localities. The gray fox is a sly and cunning creature, but he lacks the wonderful shrewdness and sagacity of the red fox, which has made the latter so popular as an object of the chase. Audubon and Bachman give a good account of the animal's habits, from which the following is quoted:

The Gray Fox is shy and cowardly, and the snap of a stick or the barking of a dog will set him off on a full run. Although timid and suspicious to this degree, his cunning and voracity place him in a conspicuous rank among the animals that prey upon other species weaker than themselves. * * *

In the Southern States this species is able to supply itself with a great variety and abundance of food, and is consequently generally in good condition and often quite fat. We have followed the track of the Gray Fox in moist ground until it led us to the scattered remains of a marsh hare, which no doubt the fox had killed. Many nests of the fresh water marsh hen (*Rallus elegans*) are torn to pieces and the eggs devoured by this prowler. In Pennsylvania and New Jersey, the meadow mouse (*Arvicola Pennsylvanica*) is often eaten by this species; and in the Southern States, the cotton-rat and Florida rat, constitute no inconsiderable portion of its food. We have seen places where the Gray Fox had been scratching the decayed logs and the bark of trees in order to obtain insects.

Although this Fox is nocturnal in his habits we have frequently observed him in search of food at all hours of the day; in general, however, he lies concealed in some thicket, or in a large tuft of tall broom-grass, till twilight invites him to renew his travels and adventures.

On a cold starlight night in winter, we have frequently heard the hoarse querulous bark of this species; sometimes two of them, some distance apart, were answering each other in the manner of the dog.

Although we have often seen this Fox fairly run down and killed by hounds, without his having attempted to climb a tree, yet it not infrequently occurs that when his strength begins to fail he ascends one that is small or sloping, and standing on some horizontal branch 20 or 30 feet from the ground, looks down on the fierce and clamorous pack which soon comes up and surrounds the foot of the tree. * * * We were unable to obtain any information in regard to the manner in which the Fox climbs trees, as he does not possess the

[27] Merriam, C. Hart, Trans. Linnaean Soc. New York, vol. 1, p. 45, 1882.

retractile nails of the cat or the sharp claws of the squirrel, until we saw the animal in the act. At one time when we thus observed the Fox, he first leaped onto a low branch 4 or 5 feet from the ground, from whence he made his way upward by leaping cautiously and rather awkwardly from branch to branch, till he attained a secure position in the largest fork of the tree, where he stopped. On another occasion, he ascended in the manner of a bear, but with far greater celerity, by clasping the stem of a small pine. We have since been informed that the Fox also climbs trees occasionally by the aid of his claws, in the manner of a raccoon or a cat.[28]

This genus has not been revised, and material is lacking from eastern United States to determine the ranges of the various forms. Two skulls (adult ♂) from Cullman County agree essentially with skulls from Maryland, assumed to be typical *cinereoargenteus;* an adult (unsexed) from Orange Beach has somewhat larger molar teeth, in this respect apparently approaching subspecies *floridanus.* The skin of the latter does not differ appreciably from those of typical individuals. Immature specimens have been examined from Autaugaville, and the animal is reported by residents to occur at Leighton, Woodville, Huntsville, Elkmont, Sand Mountain, Fort Payne, Piedmont, Talladega Mountains, Natural Bridge, Ardell, Wilsonville, York, Reform, Hayneville, Jackson, Seale, Dothan, Castleberry, Carlton, Mobile, and Bayou Labatre. At Abbeville the native fox is said to have about disappeared, and fox hunters have imported and turned loose a number from Kentucky and Tennessee.

Family PROCYONIDAE: Raccoons.

Procyon lotor lotor (Linnaeus).

RACCOON.

[*Ursus*] *lotor* Linnaeus, Syst. Nat., ed. 10, vol. 1, p. 48, 1758.

The "coon" is one of the commonest and best known of the southern mammals. 'Coon hunting is one of the most popular sports and many animals are captured in nocturnal hunts; thousands are trapped also every season by boys and by professional trappers, so that in many localities the animal is now becoming scarce.

Raccoons dwell chiefly in timbered swamps and river bottoms, where they forage extensively along the banks of the streams. Although good swimmers they do not take to the water from preference, but usually cross a stream on a fallen tree. On the coast the salt marshes prove attractive, for in them 'coons find an abundance of shellfish and crustaceans, which are favorite articles of diet. In January, 1912, while hunting with dogs on a marsh island near the mouth of Perdido Bay, the dogs ran down and captured a 'coon that was hiding in the marsh grass. 'Coon tracks are numerous through-

[28] Audubon and Bachman, Op. cit., vol. 1, pp. 164, 166–167.

out these wet marshes and along the shores of the bays. In the big swamps of the Tensaw and Mobile Rivers, 'coons are, or have been, very numerous. In March, 1912, going up the Tensaw in a launch, the writer shot two out of the tops of tall trees in the swamp, where they were curled up asleep. The raccoon is by no means confined to the swamps, however, but makes frequent visits to the adjacent cornfields and feasts upon the ripening ears in the milk stage, often doing considerable damage.

The diet of the raccoon includes a great variety of food; wild fruits and berries are eagerly sought when available; shellfish, crustaceans, fish, small mammals, reptiles, and birds are secured as opportunity offers; and occasional raids are made on the farmers' hen roosts. Audubon and Bachman speak of the animal's fondness for birds' eggs and for those of the soft-shelled turtle, and of its habit of feeding on fresh-water mussels and the small oysters growing in shallow waters at the mouths of the rivers, known locally as "raccoon oysters." Stone and Cram speak of its feeding habits as follows:

> From the accounts of numerous eye-witnesses it would appear to be a pretty regular practice with them to lie in wait at the edge of the water and hook out any fish that comes within reach by a smart stroke of the fore paw with claws extended.
>
> Being night wanderers, they undoubtedly often manage to surprise sleeping birds, both on the ground and among the branches, as it is a common custom with them in thick woods to travel for long distances among the tree-tops without once descending to earth, robbing the nests of birds and squirrels on the way.[30]

Specimens examined from Huntsville, Sylacauga, Barachias, Castleberry, Hurricane, and Orange Beach are all referable to typical *lotor;* the skulls show no approach to the characters of the Florida form (*elucus*), although the skins are somewhat more ochraceous above than Maryland and Virginia specimens.

Family MUSTELIDAE: Weasels, Minks, Skunks, Otters, etc.

Mustela noveboracensis (Emmons).

NEW YORK WEASEL.

Putorius noveboracensis Emmons, Rept. Quadr. Massachusetts, p. 45, 1840.

The New York weasel occupies the northeastern United States, extending south into Alabama in the mountains of the northern counties. It is definitely known only from a single specimen trapped by the writer at the base of a cliff on Lookout Mountain, near Fort Payne, at an altitude of 1,500 feet. Records of weasels from Sand Mountain, Gunters Mountain, Talladega Mountains, Elkmont, and Woodville are provisionally referred to this species. A

[30] Stone, Witmer, and William Everitt Cram, American animals, p. 250, 1902.

resident of Carpenter (Jackson County) related that he had seen a den of weasels in a rock pile at that place; two weasels were reported to have been killed in April, 1910, in a sawmill slab pile at Dean. Stone and Cram describe the feeding habits of this weasel as follows:

> In winter the larger weasels kill large numbers of gray rabbits. * * * In summer they catch grasshoppers, crickets, and beetles of various sorts, and rob every bird's nest they find. Ground-feeding birds are especially liable to be caught by them, and they have even been seen to spring into the air and catch birds on the wing.[31]

Mustela peninsulae olivacea Howell.

Alabama Weasel.

Mustela peninsulae olivacea Howell, Proc. Biol. Soc. Washington, vol. 26, p. 139, 1913.

Weasels are apparently scarce everywhere in the Southern States and specimens are difficult to obtain. The Alabama weasel is related to the Florida weasel and not to the Alleghenian species. It inhabits practically the whole of the State except the mountainous regions of the northeastern part, but the limits of its range are at present unknown. Specimens have been examined from Autaugaville, Ardell, Leighton, and Muscle Shoals; the animals are reported from Greensboro, Myrtlewood, Oakchia, Reform, Teasley Mill (Montgomery County), Seale, Jackson, Castleberry, Newville, Dothan, Abbeville, and Point Clear.

This is a rather large weasel. The upperparts in winter are buffy brown, with a tinge of olivaceous; in summer mummy brown, decidedly darker than the winter pelage; the underparts are washed with straw color or buff.

Little is known of the habits of this species. It lives in the drier parts of the timbered swamps, making its den usually under the roots of a tree or in a hollow stump, and ranges also into the rocky hill country, where it inhabits crevices in cliffs or rock piles. J. S. Tharp, of Ashford, states that he once saw two of these weasels run under the roots of a large tree in a swamp near Dothan. The late Dr. W. C. Avery, of Greensboro, writes that the weasel, although not common, at times proved very destructive to chickens and young pigeons, cutting the throats and sucking the blood of a dozen or more fowls, the bodies of which it never touched except to drink the blood. L. S. Golsan, who secured the type specimen of this race near Autaugaville, states that these weasels have been found in nests of the swamp wood rat (*Neotoma floridana*). He says they take to trees almost as readily as squirrels.

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[31] Stone and Cram, Op. cit., pp. 236, 237.

Mustela vison mink Peale and Beauvois.[32]

MINK.

Mustela mink Peale and Beauvois, Catalog Peale's Mus., p. 39, 1796.

Minks are generally distributed over most of Alabama, except the most southern counties, where they are very scarce. In many localities they have been almost exterminated, and the recent high prices of fur have led to a great decrease in their numbers everywhere.

A series of 12 skulls from Barachias and Autaugaville and 4 from Winston and Cullman Counties are practically typical of this subspecies. A series of 5 skulls from the Mobile River swamps is also referable here, though showing approach to subspecies *vulgivaga*, of Louisiana, in the small size of the females; the single male skull is typical *mink*.

The species is reported also from Leighton, Elkmont, Woodville, Piedmont, Natural Bridge, Greensboro, Reform, Wilsonville, Talladega Mountains, Mount Weogufka, Hayneville, Thomasville, Myrtlewood, Carlton, Jackson, and Abbeville. At Dothan, Orange Beach, and Bayou Labatre it occurs rarely.

Minks are semiaquatic in habit, always found along streams or in swamps or marshes. They are rapid swimmers, perfectly at home in the water, and able to capture with comparative ease good-sized fish. They feed also on frogs, lizards, crawfish, rats, mice, and rabbits, and are destructive of ducks or other marsh-dwelling birds, and, to a less extent, of upland birds. Audubon and Bachman state that in the South the cotton rat furnishes a considerable part of their food, and mention on one occasion seeing a mink issuing from a hole in the earth dragging by the neck a large Florida wood rat. Minks are often very destructive of poultry, especially ducks. Dr. Avery mentions a case where a mink visited a poultry house at Greensboro several times in a single week and dragged off at least a dozen small hens, which it devoured beneath an outhouse.

Spilogale putorius (Linnaeus).

ALLEGHENIAN SPOTTED SKUNK.

Viverra putorius Linnaeus, Syst. Nat., ed. 10, vol. 1, p. 44, 1758.
Spilogale ringens Merriam, North Amer. Fauna No. 4, p. 9, 1890 (Greensboro, Alabama).

The little spotted skunk occurs commonly over the greater part of the State, where, in common with the large skunks, it is known as "polecat." It lives chiefly about cultivated lands, the borders of brushy swamps, and in waste lands generally, though not in wet swamps or in heavy timber. Its burrows are dug beneath the roots

[32] For use of this name, cf. Hollister, Proc. Biol. Soc. Washington, vol. 27, p. 215, 1914.

of a tree or stump, a rock or slab pile, or in a cut bank. These skunks are much more agile than their larger relatives (*Mephitis*), and readily climb small trees or bushes when pursued by dogs.

They subsist largely on insects (particularly beetles and grasshoppers), mice and other small mammals, lizards, salamanders, crawfish, and occasionally small birds, and are sometimes destructive to poultry and occasionally to peanuts. Henry Golson, of Autaugaville, informed the writer in November, 1916, that these little skunks had gained an entrance to a storehouse in a field where he keeps peanuts, peas, etc., and had eaten a considerable quantity of the peanuts; he caught several of the animals on the pile of peanuts; and quantities of chewed shells which they had left were in evidence.

This observation is confirmed by one related by the late Dr. Avery, of Greensboro, in a letter dated November 7, 1893, stating—

> Last summer I was told that something was destroying the ground peas of a neighbor. Some steel traps were set and a little striped skunk was caught. * * * The skunks were eating the ground peas and eight were caught in my traps in less than two months. The stomachs of these skunks contained ground peas mixed with the débris of insects. I found a persimmon seed in the rectum of a skunk of which I made a skin.

The late Dr. Charles Mohr, in a letter dated June 1, 1890, gives interesting original notes on the habits of this little skunk near Mobile; he says:

> I will give some notes on the habits of the small striped skunk, and in particular describe the manner in which it disposes of the eggs which it is very fond of stealing at its nightly visits to the chicken house. Its proceedings, in reaching its aim, seem to me strange, in fact almost incredible. I have, however, the facts from an intelligent and close observer, a personal friend of mine, one whose word I can not doubt. He says the skunk is unable to open the egg by the aid of its teeth or to take hold of it with its mouth in order to carry it away. It removes the egg from the nest, rolls it with the front paws to a place presenting a solid, hard surface, then the egg is taken in its paws, the animal assumes an erect posture, lifts it from the ground, then lets it drop from the height of its body to insure its breakage in striking the hard ground.
>
> This animal is at nearly all seasons a frequent visitor to the basements of the premises not only in the country but in the suburbs of the city. If not disturbed it becomes quite fearless. My friend tells me it hunts mice, young rats, roaches, etc., and in that way is of benefit when there are no hen nests to be depredated upon.

Specimens of the little spotted skunk have been examined from Leighton, Greensboro, Autaugaville, Prattville, Mobile, and Ashford. It is reported to occur also at Fort Payne, Piedmont, Ardell, Squaw Shoals, Talladega Mountains, Reform, Jackson, Castleberry, and Bon Secour. It seems to be unknown at Orange Beach.

Mephitis mephitis nigra (Peale and Beauvois).[33]

EASTERN SKUNK.

Viverra nigra Peale and Beauvois, Cat. Peale's Mus., p. 37, 1796.

The common skunk, or "polecat," is found in moderate numbers throughout the State, but the recent high prices of fur have led to a considerable reduction in its numbers. Skunks den in burrows of their own construction or in deserted burrows of other animals, choosing for their headquarters a thicket or brushy fence corner in a field, a rock pile or slab pile, a gully or wash, or some similar protected location. They frequently burrow beneath a house, barn, or shed, and in such situations are liable to become very objectionable to human residents.

The food of skunks consists largely of insects, small mammals, reptiles, and amphibians. Almost any animal food is relished by them and even carrion is frequently eaten. While occasional raids are made on the poultry yard or on the nests of wild birds, their destruction of insects and noxious mammals doubtless more than offsets any damage they may do to poultry or game.

Specimens examined from Ardell, Reform, Squaw Shoals, and Jackson indicate that the skunk of northern and central Alabama is fairly typical of *nigra*. As in other regions, there is great variation in the coloration, ranging from an animal with broad white stripes the entire length of the body to one nearly black except for a patch of white on the nape and shoulders.

Skunks are reported as occurring in moderate numbers at Leighton, Elkmont, Woodville, Sand Mountain, Fort Payne, Talladega Mountains, Anniston, Jasper, Auburn, York, Thomasville, and Teasley Mill (Montgomery County).

Mephitis mephitis elongata Bangs.

FLORIDA SKUNK.

Mephitis mephitica elongata Bangs, Proc. Boston Soc. Nat. Hist., vol. 26, p. 531, 1895.

The Florida skunk, characterized by long tail and rather heavy skull, occurs in the coast region of Alabama. Three specimens from Perdido Bay are all that are available, so that the northern limits of the range of the subspecies are unknown. Skunks reported from Ashford, Bon Secour, Bayou Labatre, Mobile, and Castleberry are provisionally referred to this race. On Dauphin Island, in February, 1912, numerous tracks of this animal were seen about logs and driftwood along the shores of the Sound.

[33] For use of this name, cf. Hollister, Proc. Biol. Soc. Washington, vol. 27, p. 215, 1914.

Lutra canadensis canadensis (Schreber).

OTTER.

Mustela lutra canadensis Schreber, Säugthiere, pl. 126 B, 1776.

The otter is generally distributed in the State, but in most places occurs rather sparingly. It is perhaps most numerous in the middle and southern counties, but is everywhere decreasing rapidly through persistent trapping. It is an exceedingly shy and retiring creature, choosing for its home the most remote and unfrequented swamps, streams, or ponds.

The species is reported to occur at Muscle Shoals, Ardell, Myrtlewood, Oakchia, Wilsonville, Mount Weogufka, Hayneville, Teasley Mill (Montgomery County), Jackson, Carlton, Mobile, Bayou Labatre, Bon Secour, Point Clear, Orange Beach, Ashford, and Abbeville. A trapper at Whistler caught four otters in the creek near his home during the winter of 1911–12; Will Matthews shot four at one time near Castleberry, in 1911, as they were playing around a log in the creek.

The only specimen at hand is one caught by a trapper in Mobile River, near the Louisville & Nashville Railroad bridge, in January, 1917, and with so little material it is impossible satisfactorily to define the status of the Alabama otters. The single specimen is very dark blackish brown, shaded about the lips and throat with grayish, thus agreeing in color with the otters of the Northern States, and differing from the Florida form (*vaga*), which is decidedly redder; the skull of the Alabama specimen, however, approaches that of *vaga* in being relatively long and narrow, with the postorbital region constricted. This specimen weighed 17 pounds in the flesh. A skin, taken near Jackson, which I examined in a dealer's store, was also of the same dark color, and the animals referred to above, killed by Mr. Matthews, were described as being black.

Otters are almost as aquatic as seals, which, indeed, they somewhat resemble in appearance and actions in the water. In the Southern States, according to Audubon and Bachman, the young are brought forth about the middle of March.[34] The habits of the species are well described by Stone and Cram, as follows:

> When traveling overland otters follow the smoothest course they can find, going round stumps and hummocks and beneath logs in preference to climbing over them. Following the same course week after week, often in families of four or five together, they soon establish a distinct path clear of obstacles; crooked and tortuous yet keeping to the same general direction, and in most cases leading to some rapid or springhole beneath the bank where the water seldom freezes.
>
> Otters are beautiful swimmers; they glide and shoot along through the water, twisting and turning like the fish they so delight in chasing. I have seen one

[34] Audubon and Bachman, Op. cit., vol. 2, p. 10.

pursuing a muskrat, as a pickerel pursues a shiner, splashing through the shallow water where the stream had overflowed its banks. At times both would be invisible beneath the surface for several minutes, to appear again perhaps out in the current at a distance, the muskrat always diving and dodging for its life.

Otters will also catch wild ducks on the water, raising and seizing them from beneath. They catch their fish by fairly swimming them down in spite of all their twisting and darting. * * *

The otter's home is a den beneath the bank, usually with the entrance under water for safety. This is evidently not regarded as absolutely essential, however, for otters have been known to have their nests in caves, high up in the banks and at the bottom of hollow trees. * * *

They get the greatest fun from sliding; where the bank is sufficiently steep and slanting they make a roundabout path leading up to the top of the bank and from there they slide down the slippery surface into the water one after another like boys sliding down hill on the snow.[34]

Family FELIDAE: Cougars, Wildcats, etc.

Felis couguar Kerr.

COUGAR; PANTHER; PUMA.

Felis couguar Kerr, Animal Kingdom, p. 151, 1792.

The cougar, or "panther," as this animal is usually called, doubtless in early times occupied the greater part of the State; it is now nearly, if not quite, exterminated. Bartram, writing in 1791, speaks of "tygers" as occurring on the lower Tombigbee River, this statement probably referring to the cougar.[35] Hodgson records one killed in March, 1820, on "Ouchee Creek," and mentions seeing a mounted specimen near Blakeley, Baldwin County, the same year.[36] Hallock in 1877 reported the "panther" occasional in Dekalb County.[37] An old resident of Sand Mountain, near Carpenter, reported seeing one there some 20 years ago [1896]. Recent reports, although rather indefinite, indicate that a very few may still remain in the big swamps of the southern counties. Tracks of two of these animals were seen by an experienced trapper about 1912 in Big Uchee Creek Swamp, near Seale, and one is reported to have been seen about 1905 in the region of Nigger Lake, Baldwin County. Lack of any specimens from the State makes it impossible to say which form of the species occurs here.

The cougar is a shy, retiring beast, of cowardly disposition, inhabiting the wildest parts of the forest, the cliffs among the mountains, and the deep canebrakes of the river-bottom swamps. With the advent of settlers it quickly disappeared from the vicinity of civilization and retired to more secluded regions.

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[34] Stone and Cram, American animals, pp. 220–223, 1902.
[35] Bartram, William, Travels, p. 410, 1792.
[36] Hodgson, Letters from North America, vol. 1, pp. 123, 149, 1834.
[37] Hallock, Charles, Sportsman's Gazetteer, p. 3 [of Sportsman's Directory], 1877.

Roosevelt describes the habits of the cougar as follows:

In its essential habits and traits, the big, slinking, nearly uni-colored cat seems to be much the same everywhere, whether living in mountain, open plain, or forest, under arctic cold or tropic heat. When the settlements become thick, it retires to dense forest, dark swamp or inaccessible mountain gorge, and moves about only at night. In wilder regions it not infrequently roams during the day and ventures freely into the open. Deer are its customary prey where they are plentiful, bucks, does, and fawns being killed indifferently. Usually the deer is killed almost instantaneously, but occasionally there is quite a scuffle, in which the cougar may get bruised, though, as far as I know, never seriously. It is also a dreaded enemy of sheep, pigs, calves, and especially colts, and when pressed by hunger a big male cougar will kill a full-grown horse or cow, moose or wapiti. It is the special enemy of mountain sheep. In 1886, while hunting white goats north of Clarke's fork of the Columbia, in a region where cougar were common, I found them preying as freely on the goats as on the deer. It rarely catches antelope, but is quick to seize rabbits, other small beasts, and even porcupines.

No animal, not even the wolf, is so rarely seen or so difficult to get without dogs. On the other hand, no other wild beast of its size and power is so easy to kill by the aid of dogs. There are many contradictions in its character. Like the American wolf, it is certainly very much afraid of man; yet it habitually follows the trail of the hunter or solitary traveller, dogging his footsteps, itself always unseen. I have had this happen to me personally. When hungry it will seize and carry off any dog; yet it will sometimes go up a tree when pursued even by a single small dog wholly unable to do it the least harm. It is small wonder that the average frontier settler should grow to regard almost with superstition the great furtive cat which he never sees, but of whose presence he is ever aware, and of whose prowess sinister proof is sometimes afforded by the deaths not alone of his lesser stock, but even of his milch cow or saddle horse.[38]

Mr. Roosevelt states also that the cougar has been known to attack human beings, but authentic instances of such attacks are exceedingly rare.

Lynx ruffus floridanus Rafinesque.

FLORIDA WILDCAT; BOBCAT; CATAMOUNT.

Lynx floridanus Rafinesque, Amer. Monthly Mag., vol. 2, p. 46, 1817.

Wildcats occur in moderate numbers throughout the wilder parts of the State. In the mountains they live about the gulches and rocky bluffs, while in the lowlands they seek the shelter of the swamps and of brushy thickets. On the outer beach bordering Perdido Bay numerous tracks were seen in the palmetto scrub, and the animals are trapped every winter in this vicinity. Specimens from Orange Beach and Castleberry agree closely with specimens of *floridanus* from Florida; the race is characterized by dark colors, with abundant, distinct blackish spots on the body and legs and narrow blackish streaks along the median line of the back.

[38] Roosevelt, Theodore, With the cougar hounds: Scribner's Mag., vol. 30, no. 4, pp. 431–432, October, 1901.

Whether this race ranges throughout the State or whether typical *ruffus* occurs in the northern part can not, in the absence of specimens, be determined. Wildcats are reported from many localities, including Sand Mountain, Talladega Mountains, Mount Weogufka, Piedmont, Ardell, Natural Bridge, Autaugaville, Hayneville, Seale, Oakchia, Myrtlewood, Jackson, Carlton, Abbeville, Dothan, and Mobile.

These cats destroy many young pigs and some lambs, kids, and poultry. Hunters secure the animals both by chasing with hounds and by trapping. Audubon and Bachman describe the habits of the wild cat in the Southern States as follows:

It is abundant in the Canebrakes (patches or thickets of the *Miegia macrosperma*, of Michaux, which often extend for miles, and are almost impassable) bordering the lakes, rivers, and lagoons of Carolina, Louisiana, and other Southern and South Western States. This species also inhabits the mountains and the undulating or rolling country of the Southern States, and frequents the thickets that generally spring up on deserted cotton plantations, some of which are two or three miles long, and perhaps a mile wide, and afford, from the quantity of briers, shrubs, and young trees of various kinds which have overgrown them, excellent cover for many quadrupeds and birds. In these bramble-covered old fields, the "Cats" feed chiefly on the rabbits and rats that make their homes in their almost impenetrable and tangled recesses; and seldom does the cautious Wild Cat voluntarily leave so comfortable and secure a lurking place, except in the breeding season, or to follow in very sultry weather, the dry beds of streams or brooks, to pick up the cat-fish, etc., or cray-fish and frogs that remain in the deep holes of the creeks, during the drought of summer.

The Wild Cat not only makes great havoc among the chickens, turkeys, and ducks of the planter, but destroys many of the smaller quadrupeds, as well as partridges, and such other birds as he can surprise roosting on the ground.
* * *

The domicile of the Wild-Cat is sometimes under an old log, covered with vines such as the *Smilax*, *Ziziphus volubilus*, *Rubus*, etc., but more commonly in a hollow tree. Sometimes it is found in an opening twenty or thirty feet high, but generally much nearer the ground, frequently in a cavity at the root, and sometimes in the hollow trunk of a fallen tree, where, after collecting a considerable quantity of long moss and dried leaves to make a comfortable lair, it produces from two to four young. These are brought forth in the latter end of March in Carolina; in the Northern States, however, the kittens appear later, as we have heard of an instance in Pennsylvania where two young were found on the 15th day of May, apparently not a week old.[39]

Order RODENTIA.

Family MURIDAE: Mice, Rats, etc.

Reithrodontomys humulis merriami Allen.

MERRIAM HARVEST MOUSE.

Reithrodontomys merriami J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 7, p. 119, 1895.

The Merriam harvest mouse is known from only a few localities, but probably ranges nearly throughout the State. It inhabits old

[39] Audubon and Bachman, Op. cit., vol. 1, pp. 6, 13.

fields and the brushy borders of cultivated land, selecting usually for its home a thick tangle of matted grass, weeds, or briers, often in a wet bottom or the edge of a marsh.

At York, in February, 1912, these mice were numerous in wet patches of broom sedge and about the brushy borders of fields. Holt has taken a number of specimens on the prairie at Barachias in dry broomsedge fields, where they travel in runways made by cotton rats. A few were caught by him also at Carlton, Jackson, and Dean (Clay County); and the writer took one near Autaugaville.

Reithrodontomys humulis humulis (Bachman).

Eastern Harvest Mouse.

Mus humulis Bachman, Proc. Acad. Nat. Sci. Philadelphia, p. 97, 1841.

Two specimens of the eastern harvest mouse, trapped in weedy fields on Sand Mountain, in the extreme northeastern corner of Jackson County, at an elevation of 1,500 feet, are decidedly paler than specimens from the central part of the State, and although not typical of *humulis*, they are best referred to that form. The older one of the two (an adult female) is less intensely brownish than typical examples of *humulis*, being strongly shaded with fuscous; the younger is uniform fuscous above.

In habits this subspecies does not differ from *merriami*, which occupies most of Alabama. Audubon and Bachman state that its food consists largely of the seeds of wild grasses, they having found in its nest small stores of seeds of broom grass, crab grass, and other meadow grasses.[40]

Peromyscus polionotus polionotus (Wagner).

Old-field Mouse.

Mus polionotus Wagner, Wiegmann's Arch. f. Naturg., IX, vol. 2, p. 52, 1843.

The little old-field mouse occurs rather commonly in suitable situations throughout the eastern, central, and northeastern parts of the State. It ranges northward to the extreme northeastern corner of Jackson County, but apparently is not found north of the Tennessee River. Its western limit is not known with certainty; it has been taken at Centerville, Bibb County, but rather careful trapping at Reform, Pickens County, and Jackson, Clarke County, failed to secure it (fig 1).

At Abbeville it was found abundant in a neglected sandy field on a hillside, where cactus grows in abundance but grasses only sparsely. Where cactus was most abundant the mice were most numerous. Their burrows were found at frequent intervals, each one marked

[40] Audubon and Bachman, Op. cit., vol. 2, p. 105.

by a heap of soil, usually about 6 or 8 inches across and 2 inches high. The entrance holes were of irregular shape, about 1½ inches in diameter; a few were found plugged with sand, but the majority were open. No definite trails were observed in this colony and the soil was too hard to show tracks well.

In the sandy fields of Autauga County this species is apparently more abundant than in other sections visited. Here they live chiefly in cultivated land, particularly in cornfields, but range also into open timbered tracts. Numerous burrows, scratched out by the mice, are seen in both these situations, and fresh scratchings observed in the cornfields seem to indicate that the mice dig up some freshly planted corn. The holes are in some cases considerably larger than seems necessary for the mouse to enter and the piles of dirt indicate burrows of considerable depth. L. S. Golsan, however, frequently has dug out the mice with his hands.

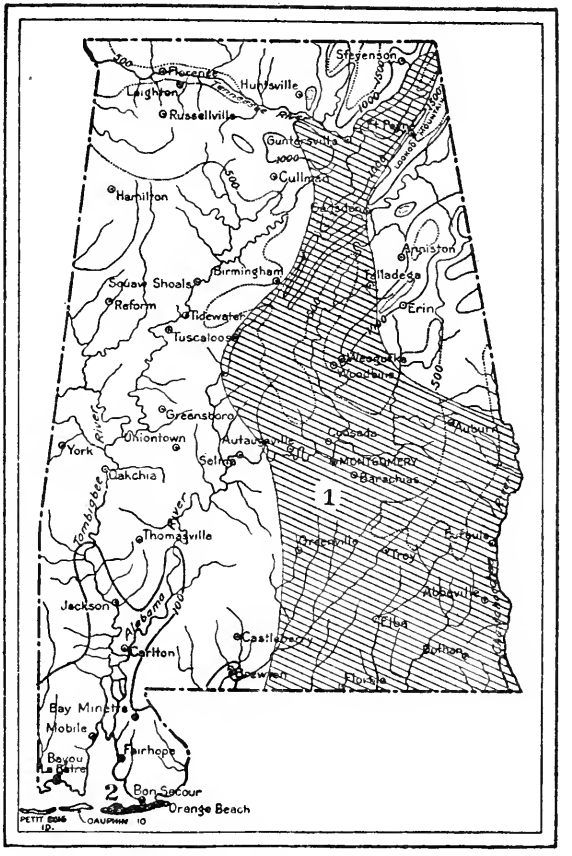

FIG. 1.—Provisional distribution of races of the old-field mouse in Alabama.

1. *Peromyscus polionotus polionotus.*
2. *Peromyscus polionotus albifrons.*
(Limits of range imperfectly known.)

On Sand Mountain these mice were found in fair numbers in two localities—Bucks Pocket, near Grove Oak, and at a point about 9 miles southeast of Carpenter Station. Here they live in cultivated fields of cotton and corn, preferring sandy soils, but ranging into some that are rather clayey and also to some extent into weedy hedgerows and the edges of open timber. In Greenbrier Cove, on Cane Creek, Marshall County, they were common in similar situations.

Little is known of the food habits of this species, but it is believed to feed largely on the seeds of grasses, weeds, and grain; several stomachs from Abbeville contained remains of blackberries with other finely chewed food.

The Alabama examples of this race agree well with specimens from Georgia—the type region.

Peromyscus polionotus albifrons Osgood.

WHITE-FRONTED BEACH MOUSE.

Peromyscus polionotus albifrons Osgood, North Amer. Fauna No. 28, p. 108, 1909.

The white-fronted beach mouse, a pale race of the old-field mouse, is confined in Alabama, so far as is known, to the drifting sand dunes along the coast of Baldwin County; it may occur, however, in sandy tracts at some distance from the coast and doubtless intergrades with *Peromyscus p. polionotus* in some of the southern counties. Mobile Bay apparently forms a barrier to its westward distribution, as no signs of its presence have been found on the beaches of Mobile County or on the Gulf coast of Mississippi (fig. 1).

In the dunes which extend along the Gulf coast from the Little Lagoon eastward to the mouth of Perdido Bay these mice occur in abundance in situations where their pale colors harmonize with the very light-colored sand. They seem to be most numerous in the line of dunes nearest the surf, where the cover is very sparse, consisting of stunted live-oak bushes, yaupon, pokeberry, patches of "sea oats" (*Uniola paniculata*), and a few low herbaceous plants. Here their tracks and trails are seen everywhere in the sand, leading in and out among the clumps of sea-oats or from one clump of bushes to another.

The mice dig little burrows in the sand, usually beneath a bush, the entrance holes being usually small and round, though sometimes larger than the size of the animal. Most of these entrances are left open, but a few were found closed with sand. On the rolling sand flats nearer the bay, where the growth of bushes and palmetto scrub is more dense, the mice were found in smaller numbers. The stomach of one contained remains of red berries, and of another finely chewed vegetable matter, probably seeds.

Peromyscus leucopus leucopus (Rafinesque).

WHITE-FOOTED MOUSE.

Musculus leucopus Rafinesque, Amer. Monthly Mag., vol. 3, p. 446, 1818.

The white-footed mouse is one of the commonest and most widely distributed species of eastern United States, the typical race ranging

from Virginia to Arkansas and Louisiana; in Alabama, however, it is restricted, so far as known, to the northern half of the State, from Montgomery County northward, and is in general less numerous than in the more northern parts of its range. Specimens have been taken at Muscle Shoals, Leighton, Woodville, Stevenson, Sand Mountain (near Carpenter), Erin (Clay County), Choccolocco Mountain, Greensboro, and Barachias (fig. 2).

This species lives in a great variety of situations, but usually in or near timber tracts. It is not so fond of the swampy bottomlands as its relative, the cotton mouse, but is parial to upland woods, the borders of cultivated fields and brushy hedge rows; it ranges also up to the summits of the mountains, where it lives in rock piles and crevices in the cliffs. At Leighton, while hunting for wood rats (*Neotoma*) along the osage-orange hedges, the writer punched two of these mice out of a large rat nest about 10 or 12 feet high, among the branches of one of the trees. This species, like the cotton mouse, often dwells in hollow logs or stumps, or sometimes in hollow trees at no great distance from the ground. At times it appropriates the deserted nest of a bird in a bush or low tree, adding to it sufficient material to make a warm, covered nest; it is said, also, occasionally to construct a complete nest of its own in the branches of a bush, 5 to 15 feet from the ground. Audubon and Bachman describe such

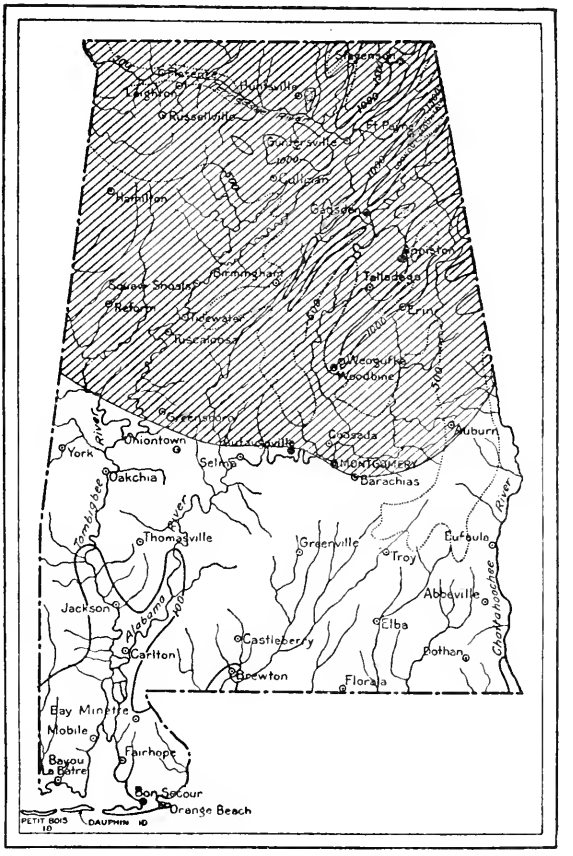

FIG. 2.—Distribution of the white-footed mouse (*Peromyscus leucopus leucopus*) in Alabama.

nests as being of oval shape, 7 inches long and 4 inches broad, composed of dried moss, shreds of grape vine bark, and dry leaves.[41] The food of this mouse is described by the same authors as follows:

> In its wild state it is continually laying up little stores of grain and grass seeds. We have seen it carrying in its mouth acorns and chinquapins. In the Northern States these little hoards are often composed wholly of wheat; in the South, of rice. This species, like all rats and mice, is fond of Indian-corn, from which it only extracts the choicest, sweetest portions, eating the heart and leaving the rest untouched.[42]

Stone and Cram state that the white-footed mouse climbs for rose hips and red alder berries and also gathers and stores the seeds of the garget.[43]

Peromyscus gossypinus gossypinus (LeConte).

COTTON MOUSE.

Hesperomys gossypinus, LeConte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 411, 1853.

The cotton mouse is probably the most abundant and widely distributed mammal in the State, where it is often called "wood rat."

The name "cotton mouse" suggests a habitat in cotton fields, but this species is scarcely ever found in such places, unless the fields are on the borders of a timbered swamp. It is a typical timber mouse and most abundant in the heavy swamps of the river bottoms; it is found also in upland timber, and wherever rocky ledges or bluffs occur it utilizes the shelter afforded by the crevices or caves in these formations. In the swamps, hollow trees or logs, or rotten stumps and woodpiles furnish convenient retreats. LeConte, who discovered and named this species, says of it:

> It forms its nest under logs and under the bark of decaying trees, generally of cotton, frequently using more than a pound of this material for its purpose.[44]

Little is known of the food habits of this mouse, but in view of its close relationship to *Peromyscus leucopus* its food is probably similar, consisting largely of wild berries, nuts, seeds, and such insects as can be obtained. The mice are frequently captured in traps baited with either salt or fresh meat.

The typical race (*gossypinus*) has been taken at Orange Beach, Point Clear, Ashford, Castleberry, Carlton, and Jackson. It may range somewhat farther north than these records indicate, but material is lacking to show its exact northern limit (fig. 3). Intergradation with the northern race (*megacephalus*) takes place in the region between Castleberry and Montgomery.

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[41] Audubon and Bachman, Op. cit., vol. 1, p. 302.
[42] Op. cit., p. 303.
[43] Stone and Cram, American animals, pp. 132–133, 1902.
[44] LeConte, John, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 411, 1853.

Peromyscus gossypinus megacephalus (Rhoads).

RHOADS COTTON MOUSE.

Sitomys megacephalus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, p. 254, 1894.

The Rhoads cotton mouse, distinguished chiefly by larger size, occupies the northern half of the State, south at least to Autauga County. The type specimen came from Woodville, and a fine series of 32 topotypes in winter pelage (March) secured by the Biological Survey includes a number of old adults as well as younger individuals. Specimens have been taken, also, at Muscle Shoals, Leighton, Scottsboro, Sand Mountain (near Carpenter Station), Cane Creek (Marshall County), Guntersville, Bucks Pocket, Fort Payne, Attalla, Ardell, Melville, Squaw Shoals, Erin (Clay County), Autaugaville, Elmore, and Montgomery (fig. 3).

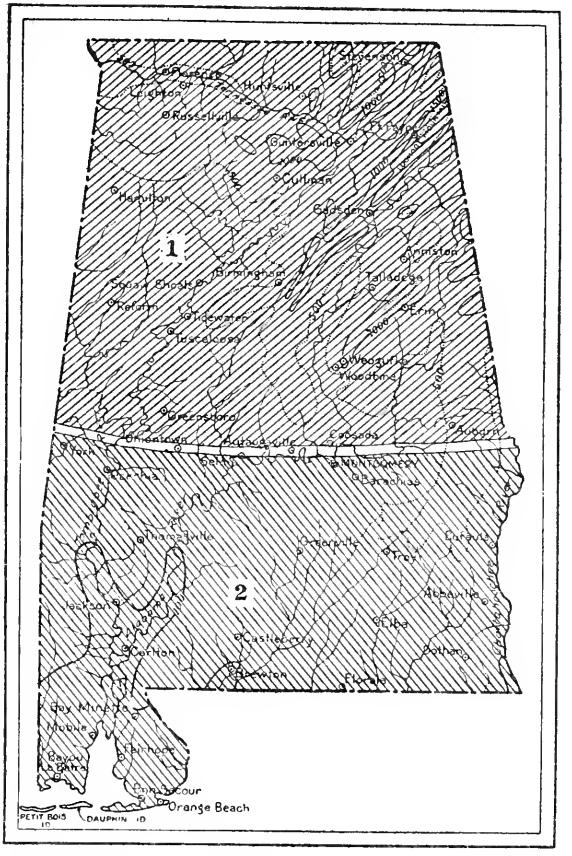

FIG. 3.—Distribution of races of the cotton mouse in Alabama.

1. *Peromyscus gossypinus megacephalus.*
2. *Peromyscus gossypinus gossypinus.*

(Unshaded area represents region of intergradation from which no specimens have been examined.)

The series of 12 from Autaugaville (taken chiefly in and around Bear Swamp) is clearly referable to *megacephalus*, but two specimens from Montgomery indicate that in this region intergradation with typical *gossypinus* takes place. A series of 5 specimens from Guntersville also are decidedly smaller than typical *megacephalus* (the hind foot averaging about 21.5 mm.), and thus strongly approach *gossypinus;* their assignment to that race, however, is inconsistent with our knowledge of the ranges of the two forms in the State, the latter being found chiefly in the coast region.

Occasional specimens taken in the range of this race seem to be intermediate in characters between it and *leucopus*, which also occupies in part the same territory. These specimens—two from Ardell and one each from Dean and Tidewater—resemble *leucopus* rather closely in external appearance and measurements, but have decidedly larger skulls; the writer regards these individuals as hybrids between the two species.

In habits this race is, of course, quite similar to the typical form of the species (*gossypinus*). Since its habitat includes much hilly and mountainous country, where cliffs and rocky bluffs abound, it is very frequently found about caves, crevices, and "rock houses" in company with the Florida wood rat or the Allegheny cliff rat. In the Big Bear Swamp it was common in brushy thickets, living in rotten logs and stumps not only around the borders but in the wet interior of the swamp. On one occasion (Oct. 15, 1911) L. S. Golsan captured a female of this species which was carrying a young one in her mouth. In the stomach of a rattlesnake killed on the rocky, pine-covered slope of Choccolocco Mountain, near Piedmont, October 20, 1916, the writer found the remains of a mouse of this species.

Peromyscus nuttalli aureolus (Audubon and Bachman).

SOUTHERN GOLDEN MOUSE.

Mus (*Calomys*) *aureolus* Audubon and Bachman, Proc. Acad. Nat. Sci. Philadelphia, vol. 1, p. 98, 1841.

The golden mouse occurs nearly throughout the lowlands of the State, being confined here, as elsewhere, almost exclusively to the Lower Austral Zone. Specimens examined from Huntsville, Ardell, Seale, Dothan, Brewton, Mobile, and Point Clear agree well with specimens of this race from Florida.

This mouse lives chiefly in canebrakes and swampy woodland, more rarely in dry, thickety flatwoods or among the hills. It is somewhat arboreal in habits, and builds for itself a globular or oval-shaped nest in a bunch of cane, a bush, or a tree. The nest is beautifully woven of grass or shreds of bark and lined with fur or fine grass stalks. Audubon and Bachman state that they have observed this mouse run up tall trees with great agility and conceal itself in a hole at least 30 feet from the ground. In a swamp at Dothan, Alabama, the writer caught one as it was running up the trunk of a tree. Dr. A. K. Fisher found a nest in the Dismal Swamp, Virginia, in dead brush, about 2 feet from the ground; when the nest was touched a female golden mouse with two young clinging to her teats dropped to the ground, and after a few moments ran up the stem of a bush and reentered the nest.

Oryzomys palustris palustris (Harlan).

SWAMP RICE RAT.

Mus palustris Harlan, Silliman's Amer. Journ. Sci., vol. 31, p. 386, 1837.

The rice rat, or marsh rat, apparently is generally distributed in the State, living in wet, marshy areas in fields, as well as in wooded swamps and in the coastal salt marshes. It is particularly numerous in the latter situations, as on Blakely Island, in Mobile River, and about Little Lagoon, on the coast of Baldwin County. Fishermen who ply their trade at night on the Lagoon state that these rats are common there and that at night they often come around the tents on the shore of the lagoon to feed on scraps of fish and other food thrown out by the men.

Although living to some extent in cultivated lands, this rat probably is not sufficiently numerous to do any appreciable damage to crops. It is similar in appearance to the common barn rat, but slightly smaller, with a slenderer tail and whiter belly. Specimens have been taken at Huntsville, Sand Mountain (near Carpenter), Reform, Weogufka, Elmore, Gallion, Autaugaville, Seale, Mobile, Bayou Labatre, and Little Lagoon, Baldwin County. Audubon and Bachman describe the habits of this species in South Carolina as follows:

> The Rice Meadow-Mouse, as its name implies, is found in particular localities in the banks of the rice-fields of Carolina and Georgia. It burrows in the dykes or dams a few inches above the line of the usual rise of the water. Its burrow is seldom much beyond a foot in depth. It has a compact nest at the extremity, where it produces its young in April. They are usually four or five. * * * We have observed it scratching up the rice when newly planted and before it had been overflowed by the water. When the rice is in its milky state this animal commences feeding on it, and continues during the autumn and winter, gleaning the fields of the scattered grains. We have also seen its burrows in old banks on deserted rice-fields, and observed that it had been feeding on the large seeds of the Gama grass (*Tripsicum dactyloides*), and on those of the wild rye (*Elymus Virginicus*). * * * Its nest is suspended on a bunch of interlaced marsh grass. In this situation we observed one with five young. At certain seasons this little animal feeds on the seeds of the marsh grass (*Spartina glabra*). When these fall it sometimes retires to the shore for food, but has no disrelish to the small crustacea and mollusks that remain on the mud at the subsiding of the tide.
>
> This species swims rapidly, and dives in the manner of the European water rat (*Arvicola amphibia*), or of our *Arvicola Pennsylvanica*. In an attempt at capturing some alive, they swam so actively, and dived so far from us, that the majority escaped. Those we kept in captivity produced young in May and September; they were fed on grains of various kinds, but always gave the preference to small pieces of meat.[45]

[45] Audubon and Bachman, Op. cit., vol. 3, p. 215.

Sigmodon hispidus hispidus Say and Ord.

COTTON RAT.

Sigmodon hispidus Say and Ord, Journ. Acad. Nat. Sci. Philadelphia, vol. 4, pt. 2, p. 354, 1825.

The cotton rat is perhaps the most abundant rodent on the farm lands of Alabama. It lives in grassy fields, brushy pastures, marshes, and along the brushy or weed-grown borders of cultivated fields, practically in all sections except on the mountains. It makes well-defined beaten trails through the grass and under fallen vegetation and brush piles, and apparently lives both in shallow burrows and in grass nests constructed above ground. Its food consists mainly of the stems and seeds of various wild grasses or other plants, and it doubtless consumes some grain also, but in this section of the country is not accused of damaging crops to any extent. It is partly diurnal and may often be seen in broad daylight scurrying across a road or other open space. The only vernacular name I have heard applied to it is "gopher rat." The species has been found in abundance at Leighton, Woodville, Ardell, Dean, Barachias, Jackson, Carlton, Bon Secour, Ashford, and Bayou Labatre; specimens have been taken also on Sand Mountain (near Carpenter), at Piedmont, Cane Creek (Marshall County), Greensboro, Gallion, Catherine, Auburn, Seale, Castleberry, and Abbeville.

Neotoma floridana floridana (Ord).

FLORIDA WOOD RAT.

Mus floridana Ord, Bull. Soc. Philom. Paris, p. 181, 1818.

The Florida wood rat occurs abundantly over the greater part of Alabama from the Tennessee Valley southward. It dwells in a variety of situations, but is most frequently found in wooded bottoms or swamps, where it constructs medium-sized nests of sticks, leaves, and rubbish, placed on or near the ground in hollow logs or trees. In the cultivated lands of the Prairie Belt and the Tennessee Valley the rats live chiefly in the osage orange hedges, where they build very large nests in the branches of the trees, often 10 or 15 feet above the ground. When driven from their nests they run swiftly and deftly about among the branches. In many places it is a common pastime for boys to poke the rats out of their nests and hunt them with dogs. Wherever rocky bluffs or cliffs occur within the range of this species, the rats may be found dwelling in them, seeming to prefer (as do most members of the genus) rocks to trees or logs. When occupying such situations they do not build large nests, but are content to carry a small quantity of sticks and rubbish into crevices in the rocks or into caves. On Sand Mountain, in niches in the cliffs in Long Island Creek Gulch, I found small nests or "forms" made of grass and small sticks, similar to those made by

Neotoma pennsylvanica. These, I believe, were constructed by the rats and probably are used at night as resting places, as were those of *pennsylvanica* at Mammoth Cave, Kentucky, in the daytime.

Judging from the accumulation of hickory-nut shells found about the cliffs occupied by these wood rats, nuts must form an important item of their food in winter. Papaw seeds have also been found near their dens. In summer the rats doubtless feed largely on succulent herbs and berries.

The range of this species in Alabama, so far as worked out, seems to be strictly complementary to that of *pennsylvanica*, the latter being found only north of the Tennessee River, and *floridana* only south of it. At Muscle Shoals *pennsylvanica* lives in the cliffs on the north shore and *floridana* in the cliffs directly opposite. The present species has been taken also at Leighton, Sand Mountain (Long Island Creek, near Carpenter), Choccolocco Mountain (2,000 feet altitude), Dean (Cedar Mountain, 1,500–2,000 feet), Lock 14 on Warrior River, Autaugaville, Barachias, Castleberry, Mobile, Point Clear, and Orange Beach (fig. 4).

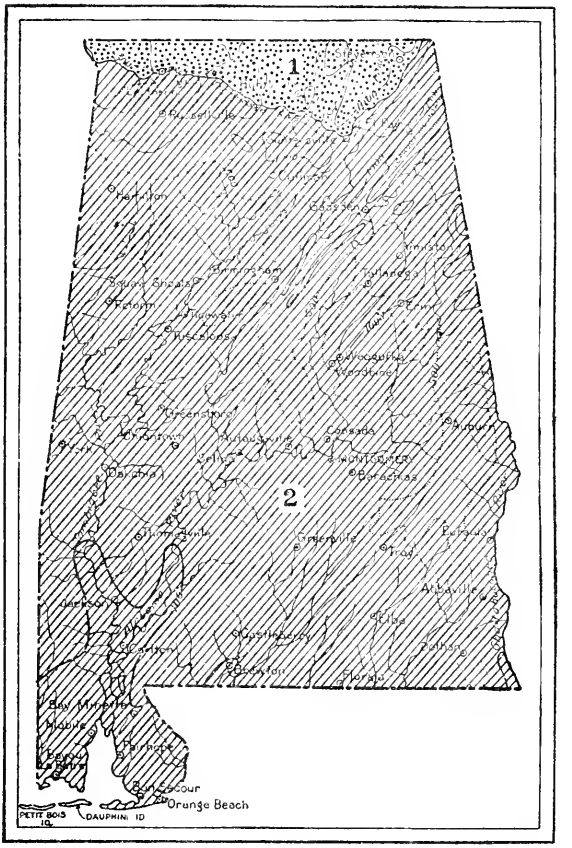

FIG. 4.—Distribution of wood rats in Alabama.

1. *Neotoma pennsylvanica*.
2. *Neotoma floridana floridana*.

Neotoma pennsylvanica Stone.

ALLEGHENY CLIFF RAT.

Neotoma pennsylvanica Stone, Proc. Acad. Nat. Sci. Philadelphia, p. 16, 1893.

The Allegheny cliff rat, a large gray species, ranges from southern New York and Pennsylvania southward to northern Alabama, where

apparently it is limited by the Tennessee River. It has been taken at Woodville, Monte Sano (near Huntsville), Gunters Mountain (near Fort Deposit), and at Muscle Shoals (north shore) (fig. 4).

It occurs in scattering colonies, chiefly about cliffs on the mountain sides, but sometimes descends to low altitudes along streams, where it dwells in rock bluffs or in caves. It is never found, however, in lowland swamps, as is its relative, the Florida wood rat. This species carries into its dens in the crevices of the cliffs considerable quantities of sticks, leaves, nut shells, and other rubbish, but does not construct large stick nests such as the rats of the *floridanus* group use. At Mammoth Cave, Kentucky, the writer found these wood rats living in small nests or "forms" made of finely shredded cedar bark, placed on ledges or on the floor of a small cave.[46]

The food of this species is mainly of vegetable origin and consists in part of hickory nuts, acorns, chestnuts, and the tender leaves and stems of herbaceous plants. The cliff rats, dwelling as they do in the remoter parts of the mountains, rarely cause any damage to man's industries. Sometimes, however, where the cliffs in which they live are close to farm buildings, the rats may enter corn cribs and destroy some of the corn.

Pitymys pinetorum pinetorum (LeConte).

PINE MOUSE.

Psammomys pinetorum LeConte, Ann. Lyc. Nat. Hist. New York, vol. 3, p. 133, 1830.

Pine mice occur in moderate numbers over the greater part of the State, at least as far south as Houston County. Specimens from Autaugaville, Prattville, Greensboro, and Ashford are provisionally referred to the typical race, which occupies the South Atlantic coastal plain of the Carolinas and Georgia, but additional material from southern Alabama may render necessary a different decision as to the status of this form. In color, and size of ears, the specimens agree well with *pinetorum*, and the skulls, although decidedly smaller, have the V-shaped interpterygoid notch characteristic of that race.

These mice are moderately common in sandy fields near Autaugaville, and one was taken also in a grassy bog in the heavy timber on the borders of Bear Swamp. The name "pine mouse" is somewhat a misnomer, for, although the animal occasionally lives in open pine lands, it is more often found in cultivated fields, meadows, or even in wet bottom-land timber. It is largely subterranean in habit, and for that reason is not very well known to most people. It is a sleek, silky little mouse of a rich tawny-brown color, with a blunt nose, small, beady eyes, and a very short tail. It makes little bur-

[46] See Howell, Proc. Biol. Soc. Washington, vol. 23, pp. 27–28, 1910.

rows and runways in the grass of meadows or under the dead leaves and rubbish in the woods, and also makes extensive use of the runways of the common mole. This habit has resulted in fastening on the innocent mole the responsibility for the damage done by the pine mouse to vegetables, bulbs, etc.

This species is probably the most destructive of any of the native field rodents of the Eastern States. It attacks white potatoes, sweet potatoes, bulbs, strawberry, blackberry, and other plants, nursery stock, orchard trees, and stores of vegetables of all kinds. Freshly planted seeds of melons or cantaloupes are extensively eaten, as well as the roots of the growing plants. The damage to orchards, which consists in gnawing off the bark near the surface of the ground, is often extensive, and in the apple-growing regions of Virginia and West Virginia, where the mice are abundant, presents a serious problem.

Pitymys pinetorum auricularis (Bailey).

BLUEGRASS VOLE; PINE MOUSE.

Microtus pinetorum auricularis Bailey, Proc. Biol. Soc. Washington, vol. 12, p. 90, 1898.

The bluegrass vole, an interior race of the pine mouse, occupies the lower Mississippi Valley, ranging northward through northern Alabama, Tennessee, and Kentucky. Typical specimens have rather larger ears than the other subspecies. Specimens examined from Ardell, Woodville, and Sand Mountain (near Carpenter) are referred to this race because of the close resemblance in skull characters, the interpterygoid fossa being U-shaped rather than V-shaped. In habits this race probably does not differ much from the other subspecies. On Sand Mountain their signs were rather numerous in cultivated land, where as usual these rodents travel mainly in mole runways. At Ardell and Woodville, L. J. Goldman found them in heavy timber and trapped specimens under rotten logs.

Fiber zibethicus zibethicus (Linnaeus).

MUSKRAT.

[*Castor*] *zibethicus* Linnaeus, Syst. Nat., ed. 12, vol. 1, p. 79, 1766.

The common muskrat of the Northern States occurs in moderate numbers in most of the streams and ponds in the northern part of Alabama, south as far at least as Clarke, Lowndes, and Pike Counties. In the southern part of the State no muskrats are found, except in southern Mobile County, where *Fiber rivalicius* occurs (fig. 5). It is difficult to understand why the present species does not range all the way to the coast, as conditions in the southern counties seem as well suited to its needs as in the more northern parts.

Specimens have been examined from Reform and Autaugaville, and the animal is reported from Leighton, Elkmont, Scottsboro, Guntersville, Erin (Clay County), Ardell, Squaw Shoals (Warrior River), Greensboro, Mount Weogufka, Barachias, Seale, Hayneville, Teasley Mill (Montgomery County), Myrtlewood, and Coffeeville. Inquiries made of many residents and trappers indicate that the species occurs at Jackson only sporadically. Most of the people questioned had never seen a muskrat, but two persons had seen a few taken there.

C. W. Howe, a trapper of long experience, states that muskrats first appeared near Linwood, Pike County, in 1906, and are now quite plentiful on the upper Conecuh River between Troy and Union Springs, where in 1898 none were to be found. He states also that in 1912 he found unmistakable signs of muskrats in Little River, on the northern line of Baldwin County. The animals are very scarce so far south, and Mr. Howe thinks this colony probably drifted down from a point higher up the river. In the spring of 1916 he saw a single individual still farther south, in Mobile River at Twelve Mile Island, where by the light of a jack lantern it was plainly seen swimming in the river at night. As no other signs of muskrats have ever been found in that vicinity, this individual doubtless was a stray. Muskrats are chiefly of nocturnal habit and are rarely seen abroad in daylight except in the dusk of evening, when they emerge from their dens and begin to feed.

The muskrat's method of constructing its house varies in different parts of its range. In a region of ponds and marshes it constructs large domed houses of rushes, sticks, leaves, mud, and other rubbish. In creeks and rivers where the banks are steep, however, it tunnels into the banks from beneath the surface of the water and constructs its nest in a cavity excavated at the upper end of the tunnel, above high-water mark. This appears to be the usual habit of the species in Alabama.

The food of the muskrat consists largely of the stems, leaves, and roots of various aquatic plants, including rushes, sedges, arrowhead (*Sagittaria*), pondlilies, golden club (*Orontium*), and various marsh grasses. It is said to feed on timothy, redtop (*Agrostis*), and clover, as well as on Indian corn and various garden vegetables. Joel Burgess, of Dean, Clay County, states that he has known the muskrats to cut 100 or more stalks of corn in three nights and drag them into the creek. The animal varies its fare in some localities by feeding on mussels; and piles of shells are often found about shallow places in the rivers, where they have been left by muskrats.

Fiber rivalicius Bangs.

Louisiana Muskrat.

Fiber zibethicus rivalicius Bangs, Proc. Boston Soc Nat. Hist., vol. 26, p. 541, 1895.

The small, dark-colored Louisiana muskrat is found at present in Alabama only in the coast region west of Mobile Bay (fig. 5). The animal has apparently extended its range into the State within very recent times, since it is unknown to most hunters and trappers in the region where it is now found, and many of those who are acquainted with it state that it first appeared there shortly after a big storm in 1906.

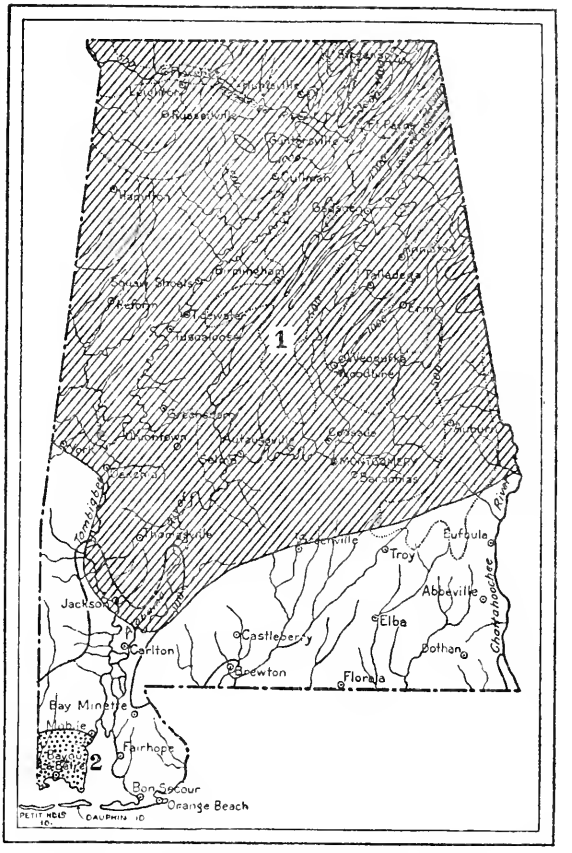

Fig. 5.—Distribution of muskrats in Alabama.
1. *Fiber zibethicus zibethicus.*
2. *Fiber rivalicius.*

This species is not as yet widely dispersed, as it is known at present only from the coast marshes about Bayou Labatre. Signs of its presence were seen also in Three Mile Creek, near Mobile, in 1913, by the late Kenneth Beale, but no specimens have been taken there. It will undoubtedly spread out and become more abundant along the coast of Mississippi Sound and the western shore of Mobile Bay, and there seems to be no reason why it should not extend its range into the big marshes of the Delta region and along the eastern shore of the Bay.

At Bayou Labatre, residents reported a number of muskrat houses on the marshes between the mouth of the bayou and Little River, but a storm and high tide in the fall of 1915 apparently broke up this colony, and in December of that year search for them in that locality was unsuccessful. A considerable colony, however, was located close

to the town in a little marsh between the public road and the pine woods. The animals had constructed four large houses of rushes, the largest fully 6 feet in diameter and 3 or 4 feet high. For quite a space around each house all the growing rushes had been cut close to the ground, and the marsh was honeycombed with underground trails leading in various directions from the houses to the banks of the bayou, most of the exits being under water except at very low tide.

This species is a valuable fur bearer, and as it increases in numbers doubtless will provide a profitable industry for the residents of the coast counties. In the rice-growing districts of Louisiana it is a serious pest by reason of its habit of burrowing into dikes and levees.

Rattus norvegicus (Erxleben).

NORWAY RAT; BARN RAT; "GOPHER RAT."

[*Mus*] *norvegicus* Erxleben, Syst. Regni Anim., vol. 1, p. 381, 1777.

The common Norway rat—an exotic species, imported from the Old World—is widely distributed in the State, and is everywhere a serious pest. It lives chiefly in towns and around farm buildings, but often ranges out into the fields for a considerable distance, particularly along ditch banks and about the borders of marshy bottoms. In the open it digs burrows in the banks of ditches or streams, and becomes practically a "wild" animal. It does an immense amount of damage to stores of feed or grain, to corn in cribs or in the field, to rice and sugar cane, and to young poultry. The losses resulting from its depredations are much greater than those occasioned by all the native species of rodents combined.

Rats are responsible also for the dissemination of bubonic plague, trichinosis, and other serious diseases. Every effort, therefore, should be made to reduce their numbers and to exclude them from storehouses and farm buildings.[47]

Rattus rattus rattus (Linnaeus).

BLACK RAT.

[*Mus*] *rattus* Linnaeus, Syst. Nat., ed. 10, vol. 1, p. 61, 1758.

The black rat was introduced into North America soon after the settlement of the early colonies, and before long was established in the towns and villages. After the arrival of the brown rat, however, it began to decrease in numbers and at present is rare and local in the eastern United States. Specimens were taken near Greensboro in 1891 and on Lookout Mountain, near Fort Payne, in

[47] Suggestions for destroying rats are contained in Farmers' Bulletin 896, U. S. Dept. Agr., "House Rats and Mice," by David E. Lantz; pp. 24, 1917. Cf. also Separate 725, Yearbook 1917, U. S. Dept. Agr., pp. 235–251, 1918, "The House Rat: the Most Destructive Animal in the World," by the same author.

1911. It is slenderer and longer tailed than the brown rat, and is said to live almost exclusively in the walls of houses.

Rattus rattus alexandrinus (Geoffroy).

ROOF RAT.

Mus alexandrinus Geoffroy, Descr. de l'Egypte, Mamm., p. 733, 1818.

The roof rat is believed to be a native of Egypt. It resembles the black rat closely in size and proportions, but differs in color, being of about the shade of the brown rat, but with whiter or more yellowish underparts. It is well established in the Southern States, and has been taken in Alabama at Greensboro, Castleberry, Bayou Labatre, and Abbeville. Roof rats live chiefly about the roofs of dwellings or outhouses, but occasionally wander out into the fields. At Abbeville the writer observed them on a moonlight evening in June climbing silently and dexterously up and down the branches of an oleander bush growing close to the hotel porch.

Mus musculus musculus Linnaeus.

HOUSE MOUSE.

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

The house mouse, a species introduced from Europe, is abundant and generally distributed throughout the State. It is by no means confined to the vicinity of buildings but ranges widely in waste lands and cultivated fields. So far as known, however, it does not seriously damage farm crops except as they are stored in granaries or shocks. In houses and farm buildings it is a serious pest, though to a less extent than its larger relative, the brown rat.

Family GEOMYIDAE: Pocket Gophers.

Geomys tuza mobilensis Merriam.

ALABAMA POCKET GOPHER; "SALAMANDER."

Geomys tuza mobilensis Merriam, North Amer. Fauna No. 8, p. 119, 1895.

The pocket gopher (usually, though incorrectly, known in the South as "salamander") is found rather locally in southern Alabama, east of the Tombigbee River, and ranges north to Tuscaloosa County (fig. 6). The Tombigbee-Warrior Basin marks the western limit of its range, and no member of the genus is again encountered until after crossing the Mississippi River.

The usual habitat of the pocket gopher is in sandy pine flats, but in Tuscaloosa County, near Lock 14, Warrior River (the most northern point from which the species is known), it is found on gravelly ridges in mixed timber—longleaf pine, oaks, etc. Its presence is

easily detected by the numerous mounds of earth which it throws up at frequent intervals, usually in a more or less continuous line. Only rarely may the pocket gopher be seen above ground, and then only for a few seconds as it pushes the earth from its burrow. By digging open the mound, however, until a clear tunnel is exposed, and setting a steel trap or pocket gopher trap in the runway, the animal may easily be captured.

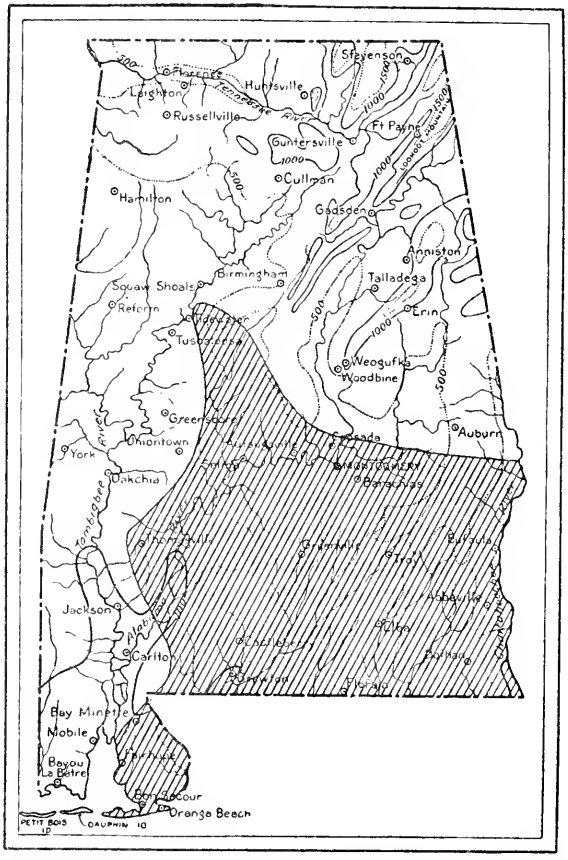

FIG. 6.—Distribution of the Alabama pocket gopher (*Geomys tuza mobilensis*) in Alabama.

Unlike its western relative, the Alabama pocket gopher is not injurious to cultivated crops. It lives almost entirely in waste lands, in poor, sandy, or gravelly soil, and is said to desert a locality as soon as cultivation is begun.

Specimens have been examined from Orange Beach, Point Clear, Brewton, Steadham, Seale, and Lock 14, Warrior River. Evidences of the animal's presence have been seen at Castleberry, Evergreen, Andalusia, Ewell, Thomasville, Magnolia, Selma, Kingston, and Chehaw.

Family SCIURIDAE: Marmots, Squirrels, etc.

Marmota monax monax (Linnæus).

SOUTHERN WOODCHUCK; GROUND-HOG.

[*Mus*] *monax* Linnaeus, Syst. Nat., ed. 10, vol. 1, p. 60, 1758.

The woodchuck, or ground-hog, as it is usually called in the South, occurs plentifully in the rough, hilly country of northern Alabama as far south as Tuscaloosa and Coosa Counties and the Talladega

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FIG. 1.—MOUNDS OF POCKET GOPHER (GEOMYS TUZA MOBILENSIS) IN OPEN PINE FOREST.

Gravelly hills near Lock 14, Warrior River.

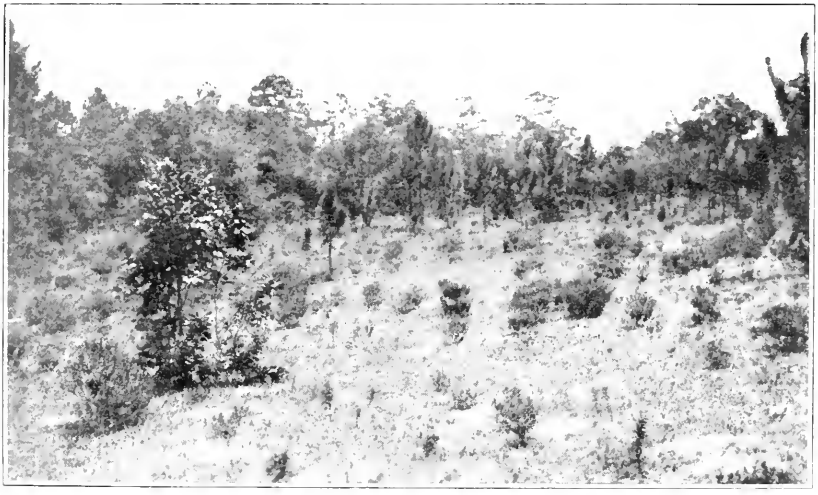

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FIG. 2.—MOUNDS OF POCKET GOPHER IN SANDY FIELD.

Waste land near Point Clear.

Mountains of Talladega and Clay Counties (fig. 7). Stragglers are sometimes found somewhat farther south. L. S. Golsan states that a single individual—the only one ever known in the vicinity—was killed near Autaugaville a number of years ago (about 1890); and Peter Brannon states that he has seen the woodchuck a few times at Seale.

In the South woodchucks live chiefly in rocky bluffs along streams or on mountain sides, their burrows usually being constructed under bowlders or ledges of rock or beneath roots of trees—almost always on a steep, wooded slope. From these retreats they pay visits to near-by fields and do considerable damage to such farm crops as oats, hay, corn, and pumpkins, and to beans and other garden vegetables.

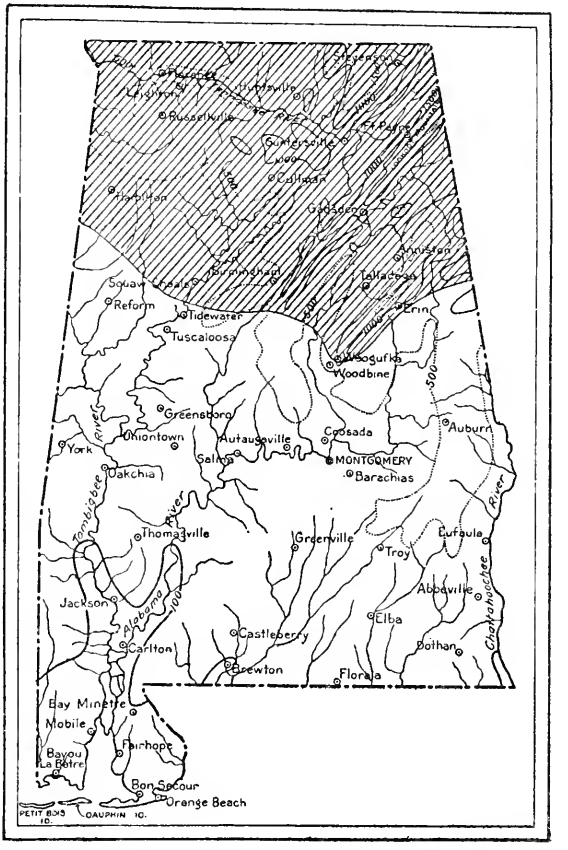

FIG. 7.—Distribution of the southern woodchuck (*Marmota monax monax*) in Alabama.

The woodchuck is a famous sleeper, spending usually from four to six months during the winter season in its burrow in a state of torpor. In the Northern States it retires in fall often as early as the last of September, remaining until the middle or last of the following March; in the South it remains out later, perhaps till November, and reappears early in February.

Specimens of the woodchuck have been examined from Ardell, Cullman County, and the species is reported also from Leighton, Monte Sano, Sand Mountain, Woodville, Guntersville, Natural Bridge, Piedmont, Attalla, Jasper, Squaw Shoals, Mount Weogufka, and the Talladega Mountains, near Erin.

Tamias striatus venustus Bangs.

SOUTHWESTERN CHIPMUNK.

Tamias striatus venustus Bangs, Proc. Biol. Soc. Washington, vol. 10, p. 137, 1896.

The chipmunk, or ground squirrel, occurs abundantly in certain of the northern counties of the State and sparingly in the central part as far south as Carlton, Castleberry, and Dothan. It is apparently shyer and less noisy than the chipmunk of New England, but this may be due in part to its relative scarcity.

In most localities in the State where the species is reported to occur, it has been possible usually to see only an occasional individual and that for only a brief moment. The usual haunts of the chipmunk are the heavily forested hillsides and rocky mountain slopes where there is an abundance of brush and fallen timber, over and beneath which it loves to romp and in the shelter of which it finds safe retreats. In the low country chipmunks are found in the moist bottomland woods and even in timbered swamps. They live chiefly on or near the ground and make burrows in the side of a hill or bank, beneath a rock or the roots of a tree, or in a decaying stump. Audubon and Bachman describe a burrow which was excavated in January (locality not stated, but probably New York) when the snow lay about 5 inches deep on a piece of ground covered with leaves to a depth of 8 inches:

> The hole descended at first almost perpendicularly for about three feet. It then continued with one or two windings, rising a little nearer the surface until it had advanced about 8 feet, when we came to a large nest made of oak leaves and dried grasses. Here lay, snugly covered, three Chipping Squirrels. Another was subsequently dug from one of the small lateral galleries, to which it had evidently retreated to avoid us. They were not dormant, and seemed ready to bite when taken in the hand; but they were not very active, and appeared somewhat sluggish and benumbed, which we conjectured was owing to their being exposed to sudden cold from our having opened their burrow.
>
> There was about a gill of wheat and buckwheat in the nest; but in the galleries we afterwards dug out, we obtained about a quart of the beaked hazel nuts (*Corylus rostrata*), nearly a peck of acorns, some grains of Indian corn, about two quarts of buckwheat, and a very small quantity of grass seeds.[48]

From this account it is evident that the chipmunk does not hibernate in the true sense, but stores up food for winter use. The same authors state that in Louisiana they caught a chipmunk which had in its cheek pouches no less than 16 chinquapin nuts and that another received from Pennsylvania contained "at least one and a half tablespoonfuls of bush trefoil (*Hedysarum cannabinum*) in its widely distended sacks."[49] Merriam states that the chipmunk feeds upon a variety of nuts and roots, corn and other grain, and the larvae of cer-

[48] Audubon and Bachman, Op. cit., vol. 1, pp. 69–70.
[49] Op. cit., p. 69.

tain insects; and that in the Adirondack region of New York beechnuts form its principal food.[50]

Chipmunks with varying quantities of nuts and grain in their pouches have been observed by Mr. Sewell, of Dean; one had 90 grains of small corn; and others, 2 chestnuts and 1 or 2 chinquapins; 5 chinquapins; 2 hickory nuts; and 5 peanuts in the shell. In Bucks Pocket, on Sand Mountain, chipmunks were feeding on acorns, one individual taken having five large pieces of acorn in its pouches. At this locality these animals were more numerous than the writer ever saw them elsewhere in the South. In the timber at the foot of the steep slopes of the canyon they were constantly seen and heard. Their call notes, which were heard throughout the day, were of two forms—one a low *chuck* or *cluck*, the other a high-pitched *tchip*, much like the alarm note of the hooded warbler. When badly frightened the chipmunks uttered a hurried chippering note, twitched their tails nervously, and scurried into their retreats.

The species is reported to occur commonly in the Talladega Mountains, at Guntersville, and at Elkmont; in smaller numbers at Leighton, Huntsville, Squaw Shoals, Mount Weogufka, and Greensboro; and sparingly at Jackson, Carlton, Castleberry, Booth, Wilsonville, Seale, Teasley Mill, and Dothan.

The Alabama series as a whole is intermediate between *Tamias striatus striatus* and *T. s. venustus*, but rather nearer the latter. The skulls are decidedly larger than typical *striatus* from the Carolinas (Roan Mountain specimens) and agree with those of *venustus* from Arkansas. In color, some individuals agree with *venustus* in having lighter gray backs and brighter rumps than *striatus*, while others are almost as dark as typical *striatus*. The grayest specimens are from Ardell, Guntersville, Bucks Pocket, and Talladega Mountains. Those from Woodville and Greensboro approach *striatus* in color. The series differs also from *striatus* in having a larger hind foot (average 36.6 mm. instead of 33.6), this being even larger than typical *venustus* (which measures 35.5).

Sciurus carolinensis carolinensis Gmelin.

GRAY SQUIRREL; "CAT SQUIRREL."

[*Sciurus*] *carolinensis* Gmelin, Syst. Nat., vol. 1, p. 148, 1788.

The gray squirrel is one of the most abundant and generally distributed mammals in the State. It inhabits for the most part moist bottom lands and swamps, where there is an abundance of oak, hickory, and other nut-bearing trees. It is found also in lesser numbers on the wooded hills and the lower slopes of the mountains, but does not range at all into pine timber.

[50] Merriam, C. Hart, Mamm. Adirondack region: Trans. Linnaean Soc. New York, vol. 2, pp. 135–136, 1884.

Gray squirrels live both in hollow trees and in nests among the branches, constructed of leaves, Spanish moss, etc. The young, usually five or six in number, are brought forth early in spring, and sometimes a second litter is born in the summer. This species is said to be irregularly migratory, its wanderings probably induced by a search for desirable feeding places. Acorns and hickory nuts form its principal food, but it is fond also of the fruit of the great magnolia (*Magnolia foetida*). It is most active during the early morning hours and about sundown; and Audubon states that it is to some extent nocturnal, having frequently been observed by moonlight.

The flesh of the gray squirrel is tender and juicy and is highly esteemed for food. Thousands are shot by local hunters, and in many localities the species has been greatly reduced in numbers. As its tameness renders it usually an easy mark to one who understands its habits, if it is not afforded better legal protection it will before many years become very scare.

Typical specimens have been examined from Sand Mountain (near Carpenter), Lookout Mountain (near Fort Payne), Ardell, Greensboro, Barachias, Castleberry, Point Clear, Bon Secour, and Orange Beach. Four specimens from the Tensaw River swamps above Hurricane and two from Stiggins Lake are intermediate between *carolinensis* and *fuliginosus*. The species is recorded also from Cherokee, Muscle Shoals, Elkmont, Guntersville, Talladega Mountains, Piedmont, Mount Weogufka, Squaw Shoals, Natural Bridge, Auburn, Autaugaville, Reform, Oakchia, Seale, Teasley Mill, Jackson, Carlton, Abbeville, and Ashford.

Sciurus carolinensis fuliginosus Bachman.

BAYOU GRAY SQUIRREL.

Sciurus fuliginosus Bachman, Proc. Zool. Soc. London, p. 97, 1838.

The bayou gray squirrel ranges from the coast of Louisiana to the head of Mobile Bay, being confined to the shores of the bayous and the deep cypress swamps. At Stiggins Lake (3 miles east of Mount Vernon), these squirrels were abundant on May 26, 1914, and of three specimens obtained, one is typical of *fuliginosus*, the others intermediate between it and *carolinensis*. A typical specimen was taken also at Chuckvee Bay, May 12, 1911, and one at Bayou Labatre, January 6, 1917.

Sciurus niger niger Linnaeus.

CAROLINA FOX SQUIRREL.

[*Sciurus*] *niger* Linnaeus, Syst. Nat., ed. 10, vol. 1, p. 64, 1758.

The Carolina fox squirrel is the form ranging through South Carolina, southern Georgia, and northern Florida; it enters Alabama only in the southeastern counties, ranging west to Castle-

berry, where it intergrades with the interior form, *texianus* (fig. 8). Six specimens from Abbeville are typical *niger*, with grayish backs and whitish underparts; one is solid light gray above except the head, which is black, this one agreeing perfectly with specimens from South Carolina, the type region. Of 11 specimens from Castleberry, 5 are typical *niger*, 2 typical *texianus*, and 4 intermediate, perhaps nearer *texianus*. This squirrel is reported to occur in some numbers at Headland, and rarely at Seale.

The fox squirrel is a lover of the dry pine forests and is never found in the low bottoms inhabited by the gray squirrel. It is a very shy species and is seldom seen moving about except by hunters who remain concealed near its haunts. It is easily "treed," however, by the aid of a good squirrel dog, and in most places, through persistent hunting, has become very scarce. When surprised on the ground (so Bachman tells us), these squirrels will usually run for a considerable distance to reach a tree containing a hollow, in which they take refuge. Their usual nesting place is in a hollow tree, but outside nests, composed of sticks, leaves, and moss placed in the forks of a tree, are used for temporary homes during a part of the year.

This squirrel is wholly diurnal and is said to remain in its retreats until the sun is well up. Its alarm note is rather harsh barking, not unlike that of the gray squirrel, but usually recognizable. Audubon and Bachman have given a good account of its feeding habits, as follows:

> The food of the Fox Squirrel is various; besides acorns, and different kinds of nuts, its principal subsistence for many weeks in autumn is the fruit extracted from the cones of the pine, especially the long-leaved pitch pine (*Pinus palustris*). Whilst the green corn is yet in its milky state, this Squirrel makes long journeys to visit the fields, and for the sake of convenience frequently builds a temporary summer house in the vicinity, in order to share with the little Carolina squirrel and the crow a portion of the delicacies and treasures of the husbandman; * * * The Fox Squirrel does not appear to lay up any winter stores—there appears to be no food in any of his nests, nor does he, like the red squirrel (*Sciurus hudsonius*), resort to any hoards which in the season of abundance were buried in the earth, or concealed under logs and leaves. During the winter season he leaves his retreat but seldom, and then only for a little while and in fine weather in the middle of the day. He has evidently the power, like the marmot and raccoon, of being sustained for a considerable length of time without much suffering in the absence of food. When this animal makes his appearance in winter, he is seen searching among the leaves where the wild turkey has been busy at work, and gleaning the refuse acorns which have escaped its search; at such times, also, this squirrel does not reject worms and insects which he may detect beneath the bark of fallen or decayed trees. Toward spring he feeds on the buds of hickory, oak, and various other trees, as well as on several kinds of roots, especially the wild potato (*Apios tuberosa*). As the spring advances farther he is a constant visitor to the black mulberry tree (*Morus rubra*), where he finds a supply for several weeks. From this time till winter, the fruits of the field and forest enable him to revel in abundance.[51]

[51] Audubon and Bachman, Op. cit., vol. 2, p. 136.

Sciurus niger texianus Bachman.

BACHMAN FOX SQUIRREL.

Sciurus texianus Bachman, Proc. Zool. Soc. London, p, 86, 1838.

The Bachman fox squirrel ranges from southern Louisiana through Mississippi and the greater part of Alabama (except the southeastern counties) to eastern Tennessee (fig. 8). It is a richly colored form, somewhat resembling the common fox squirrel of the northern Mississippi Valley (*rufiventer*), but differing in having the head black and the nose and ears white.

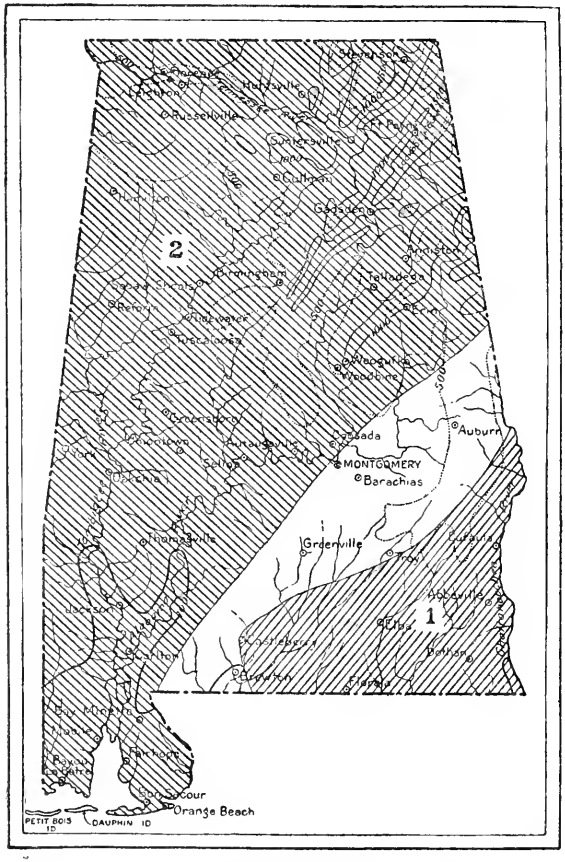

FIG. 8.—Distribution of fox squirrels in Alabama.
1. *Sciurus niger niger.*
2. *Sciurus niger texianus.*
(Unshaded area indicates region from which no specimens have been examined.)

Six specimens from Autaugaville and two from Sand Mountain (near Carpenter) are typical *texianus*, except that one from the latter place has buffy ears; the underparts vary from light ochraceous-buff to deep ochraceous-orange; one from Autaugaville is nearly black. One specimen from Jackson is very dark, the underparts, legs, tail, and ears being rich tawny, and the back overlaid with the same color; another from the same place, however, is of the normal buff color, with buff-tipped ears. Two specimens from Orange Beach and two from Castleberry also have the upperparts rather heavily tinged with tawny. Four specimens from Castleberry are clearly intermediate between *texianus* and *niger*, showing more or less gray on the sides. Others from this locality, as already stated, are typical *niger*.

This race has practically the same habits as the Carolina fox squirrel; in the mountainous regions of the State, however, it is not confined to pine timber, but ranges as well into the mixed woods of pine, hickory, and oak. Like the other forms of the species, it is never found in wet bottoms, but always on dry uplands or mountain slopes. It is reported to occur plentifully at or near Cherokee, Scottsboro, Piedmont, Talladega Mountains, and Mount Weogufka, and rarely at Huntsville, Woodville, Fort Payne, Ardell, Reform, Myrtlewood, Carlton, and Bayou Labatre.

Family PETAURISTIDAE: Flying Squirrels.

Glaucomys volans saturatus Howell.

SOUTHEASTERN FLYING SQUIRREL.

Glaucomys volans saturatus Howell, Proc. Biol. Soc. Washington, vol. 28, p. 110, 1915.

Flying squirrels occur commonly in all parts of the State, but on account of their nocturnal habits are seldom seen unless driven from their retreats. They inhabit chiefly hollow trees or stumps, but frequently take up their abode in an attic or outbuilding. If one wishes to observe their interesting and graceful movements, he may easily dislodge them from their retreats in hollow trees by rapping sharply on the trunk with an axe or club. Launching from a point well up in a tree the squirrels glide swiftly to a lower point on a near-by tree, then scramble up among the branches and are ready for another flight.

Flying squirrels feed chiefly upon various nuts, berries, and seeds; they are fond of meat and occasionally destroy insects. They are looked upon with disfavor by many people by reason of their depredations on pecan groves or on stores of nuts in the lofts of houses; but the damage done by them is usually inconsiderable.

Specimens of this dark southern race have been examined from Sand Mountain (near Carpenter), Ardell, Greensboro, York, Autaugaville, Carlton, Dothan, Mobile, and Perdido River, and there are records of its occurrence at many other localities.

Family CASTORIDAE: Beavers.

Castor canadensis carolinensis Rhoads.

CAROLINA BEAVER.

Castor canadensis carolinensis Rhoads, Trans. Amer. Philos. Soc., N. S., vol. 19, p. 420, 1894.

The beaver in early times doubtless occupied practically the entire State; with the coming of the settlers the animals decreased greatly in numbers, but in some localities have held their own remarkably

well, even in well-settled farming districts. Apparently they are more numerous at present in the central part of the State, in Montgomery and Lowndes Counties, than in either the wild hill country of the northern part or the big swamps of the south.

Old residents in Montgomery County, near Teasley Mill, stated that in the early days of the settlement of the country beavers were found in abundance, often building extensive dams and forming large ponds in the swampy bottoms. Although comparatively few were trapped, they are said to have disappeared entirely from this region for a number of years. About 1908 they appeared again, working up from the lower stretches of Catoma Creek, and at present they seem to be confined to this creek where it runs through Catoma Swamp.

In December, 1913, E. G. Holt visited this locality and secured one young beaver, and in April and May, 1914, the writer spent several days there and trapped an adult female. At the point where the adult specimen was trapped were several "slides" on the steep bank of the creek and two well-worn trails leading through a dense canebrake to a shallow slough. The animals were living in the creek where it runs through the timber and beside cultivated fields. Here the stream is not over 10 to 20 feet wide and for the most part shallow, though in places perhaps 8 or 10 feet deep. Beavers had constructed small dams across the creek, generally utilizing the trunks of fallen trees (not of their own cutting) for a foundation, filling in the space beneath the logs with sticks, brush, cane stalks, leaves, and mud. They had constructed no houses, but were living in burrows in the banks of the creek. Occasional small trees had been felled by them, the largest, a cottonwood 27 inches in circumference; the end of this log, which rested in the middle of the stream, showed marks of the beavers' teeth where they had gnawed the bark; a few other trees growing along the creek showed marks of their gnawings—a pine (*Pinus glabra*), a water beech (*Carpinus caroliniana*), and a sweet gum (*Liquidamber styraciflua*).

In April, 1915, L. J. Goldman visited the region about Hayneville, Lowndes County, and noted considerable evidence of the occurrence of beavers in numbers. Several dams were found at intervals along Big Swamp Creek and in Jones Lake. At the latter place three houses had been constructed of sticks, cane stalks, and mud, but they were not in use at the time, although they had been occupied the previous summer. Wherever cornfields bordered the lake Mr. Goldman found deeply worn trails leading into the fields, and he was informed that in summer beavers resort regularly to the corn patches and consume a considerable quantity of corn.

Beavers are occasionally surprised in the fields even in daylight, and a large one was reported to have been taken in that manner on Pintlala Creek in the spring of 1915. At Teasley Mill a planter

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FIG. 1.—DENSE CANE BRAKE BORDERING CATOMA CREEK.

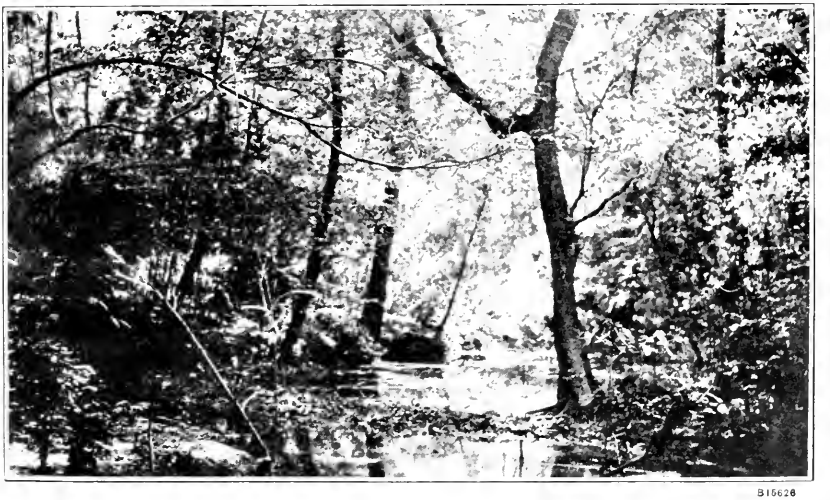

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FIG. 2.—BEAVER DAM IN CATOMA CREEK.

Views in Catoma Swamp near Teasley Mill, Montgomery County.

told of finding a beaver in a cornfield, some 100 yards from the creek, standing up reaching for an ear of corn. On moonlight nights it is often possible by remaining concealed near the creek to observe beavers as they swim by in the stream. During periods of low water, by cutting the dams and lowering the stream so that the entrances to the burrows are exposed, they can be driven from their dens with the aid of dogs and easily secured. At present there seems to be very little trapping done for their fur, but the flesh is eagerly sought for food, especially by negroes on the plantations. Beavers have been protected by many of the planters, which doubtless is the reason they have not been exterminated. They are now protected by law between March 1 and November 1 each year.

B. I. Garner, a trapper working in Autauga County, caught two beavers on the Alabama River, 12 miles below Prattville, in November, 1916. A colony was reported to be living on Beaver Creek, Conecuh County, a few miles from Evergreen, in 1919, where they are said to occupy a body of water covering many acres of ground.[52] Beavers were common until a few years ago in Big Uchee Creek, Russell County. Hundreds are said to have been taken in a pond in a dense canebrake about 12 miles northwest of Seale, the last having been trapped about 1912. A small colony was still located on the Moreland plantation, about 8 miles northeast of Seale, in 1915. In 1912 a few were reported living on Horse Creek, near Thomasville, and on Beaver Creek, near Myrtlewood. In 1911, a small colony was reported near Mount Weogufka, and in 1915 L. J. Goldman found signs of a small colony on the lower part of Rock Creek, Winston County, where during the year previous 3 or 4 had been caught.

In the northern part of the State beavers seem almost to have been exterminated; they formerly occurred in small numbers in the Tennessee River at Muscle Shoals, but disappeared about 1895; they lived about the "towheads" (small islands) in the river and burrowed into the banks, but did not build dams. A few were reported in 1916 in Big Wills Creek, near Collinsville. They disappeared from Talladega Creek, near Dean, about 1896.

In the southern counties rather vague reports of the beaver have been gathered, indicating that a few may still remain near Jackson, Abbeville, and Bayou Labatre. A professional trapper reports taking three in Bassett Creek, near Jackson, in February, 1913,[53] and C. W. Howe, also a trapper of long experience, relates that in 1915 he noticed a few signs of beavers in Little River, on the northern line of Baldwin County.

Besides the adult female and young male from Montgomery County, there has been obtained through C. H. Harbison an adult

[52] Montgomery (Ala.) Advertiser, October 24, 1919.
[53] Kuhn, A. L., Hunter-Trader-Trapper, vol. 28, pp. 41–42, June, 1914.

male skull taken at Ardell, Cullman County. Comparison with specimens of *canadensis* from interior Canada (Oxford House) shows that the present form has a shorter and relatively broader skull; heavier, broader, and more widely expanded zygomata; wider braincase and interorbital region; and larger audital bullae. The lower jaw is relatively heavier, the inferior border of the angle flattened into a broad ledge, and the coronoid process heavy.

The adult female specimen taken in Catoma Creek weighed 38½ pounds; one taken at Jackson, by A. L. Kuhn, weighed 54 pounds;[54] and one killed on Pintlala Creek was reported to weigh 65 pounds, which probably represents about the maximum size attained by this species. External measurements of the adult from Catoma Creek are as follows: Total length, 1,035 mm.; length of tail, 290 mm.; greatest breadth of tail, 163 mm.; hind foot, 170 mm.

Order LAGOMORPHA.

Family LEPORIDAE: Hares and Rabbits.

Sylvilagus floridanus mallurus (Thomas).

EASTERN COTTONTAIL.

L[epus] n[uttalli] mallurus Thomas, Ann. and Mag. Nat. Hist., ser. 7, vol. 2, p. 320, 1898.

The cottontail rabbit occurs abundantly in all parts of Alabama; it lives chiefly in old fields, brier patches, and the brushy borders of woodland, and to some extent in swampy bottoms. Cottontails are chiefly nocturnal in habit, and usually spend most of the daylight hours concealed in a "form" in a tussock of grass or a bunch of weeds or briers, or beneath a small bush. When startled from their retreats, they run with great swiftness, twisting and doubling through the brush, and seek shelter in a near-by thicket or a hollow log or stump. They make occasional inroads upon the farmer's kitchen garden and often seriously damage orchards and nursery stock by gnawing the bark, coming out to feed in the early morning and again about sundown. Nelson, in his revision of the rabbits of North America,[55] referred most of the Alabama cottontails to the subspecies *alacer*, the type locality of which is Stillwell, Oklahoma; more abundant material, now available, however, indicates that they should be placed with *mallurus*, the form ranging throughout the South Atlantic States. They agree very closely with this race in color and differ only in having slightly smaller audital bullae.

Specimens have been examined from Sand Mountain (near Carpenter), Huntsville, Talladega Mountains (Erin), Ardell, Auburn,

[54] Kuhn, Arthur L., Op. cit.
[55] Nelson, E. W., North Amer. Fauna No. 29, pp. 174–176, 1909.

Carlton, Castleberry, Mobile, Alabama Port, Bon Secour, Point Clear, Orange Beach, and Dothan. The species is reported, also, from Leighton, Elkmont, Natural Bridge, Attalla, Greensboro, Anniston, Barachias, Seale, Abbeville, Bayou Labatre, and many other places.

Sylvilagus transitionalis (Bangs).

NEW ENGLAND COTTONTAIL.

Lepus sylvaticus transitionalis Bangs, Proc. Boston Soc. Nat. Hist., vol. 26, p. 405, 1895.

The New England cottontail ranges from New York and New Hampshire southward to northern Georgia and Alabama, inhabiting chiefly mountain slopes and the rough foothill country. By reason of its close external resemblance to the common eastern cottontail (*Sylvilagus floridanus mallurus*) it is difficult to distinguish between the two except by critical examination of specimens, and as a result little is known of the peculiar habits or exact distribution of the New England cottontail. It resembles the common rabbit rather closely, but differs in smaller size, shorter ears, a greater amount of black on the back, and in peculiar skull characters. Its range overlaps that of *mallurus* with no indications of intergradation. It is said to be more of a forest-inhabiting species than is the common rabbit.

At present, *transitionalis* is known from only one locality in Georgia (Brasstown Bald Mountain, where it was taken by the writer in 1908) and three localities in Alabama—Erin and Dean, at the foot of the Talladega Mountains, in Clay County, and Ardell, in the rough hill country along Sipsey Fork, Cullman County—from each of which a single specimen has been obtained (fig. 9). More extensive collecting in the northern part of the State will doubtless result in a considerable extension of its known range.

Sylvilagus aquaticus aquaticus (Bachman).

SWAMP RABBIT; "CANE-CUTTER."

Lepus aquaticus Bachman, Journ. Acad. Nat. Sci. Philadelphia, vol. 7, p. 319, 1837.

The large swamp rabbit is abundant and generally distributed over the lowlands of the State except in the extreme southern counties east of Mobile Bay, which region is occupied by the eastern marsh rabbit (*Sylvilagus palustris*) (fig. 10). It is found in all the river swamps and ranges up along the small streams to the very foot of the mountains, where it reaches an altitude of 1,200 feet in Clay County. In the Tennessee Valley it is reported as far north as Crowtown Island and Big Crow Creek, near Stevenson.

Although living by choice in the wet bottoms, these rabbits when pursued will sometimes leave the swamp and cross the dry, wooded

hillsides. They usually remain hidden most of the day in thick brush, but occasionally one may be seen sitting in an opening in the swamp, and if the observer remains quiet it will often wait a few seconds before running off, or rarely it will stop after running a few steps and look around. When pursued by dogs these rabbits make very fast time and usually have no difficulty in distancing the pack. When hard pressed, however, they are quite likely to take refuge in a hollow tree, up which they scramble for a distance of several feet. In such situations hunters often secure them by inserting in the hollow a slender switch, which being twisted into the fur and gently pulled, usually induces the rabbit to come down far enough to be seized by hand or by a dog. When running from hounds they very frequently jump into a creek and swim across or some distance up or down the stream. During periods of high water these rabbits are often compelled to seek safety on the high ridges or small islands in the bottoms, and at such times large numbers are sometimes killed by hunters with guns or clubs.

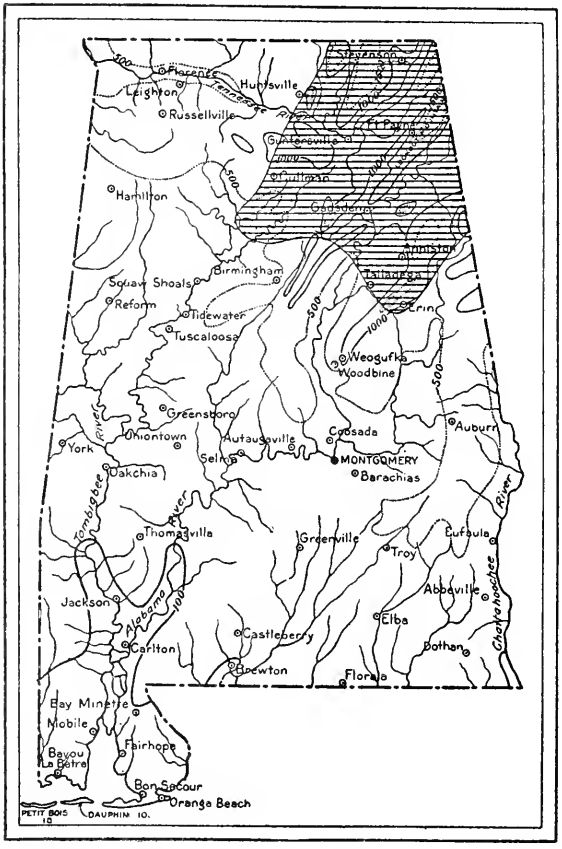

FIG. 9.—Distribution of the New England cottontail rabbit (*Sylvilagus transitionalis*) in Alabama.

Bachman states that this rabbit feeds on the roots of various aquatic plants, especially on a species of iris growing in water. The common name in use for this animal in many parts of the South—"cane-cutter"—indicates its fondness for the stems of the cane (*Arundinaria*), which grows in abundance in its favorite haunts. Where cultivated fields adjoin the swamps, swamp rabbits often for-

age in corn or other crops and at times causes considerable damage. Bachman states that the young, which are from four to six in number, "are frequently found in nests formed of leaves and grasses, placed on hillocks in the swamps, or in the hollow of some fallen tree."[56]

Bachman described this species in 1837 from specimens sent to him by Dr. J. M. Lee and Capt. Benjamin Logan from western Alabama. Typical specimens have been examined from Ardell, Dean, Huntsville, Reform, Greensboro, Auburn, Teasley Mill, Castleberry, Carlton, and Abbeville. The animal is recorded also from Elkmont, Leighton, Fort Payne, Piedmont (Nance Creek), Natural Bridge, Squaw Shoals, Weogufka, York, Autaugaville, Jackson, and Seale. Specimens from Stockton and Whistler are approaching the subspecies *littoralis*. Its southern limit is apparently between Castleberry and Flomaton and between Abbeville and Dothan. As yet, it never has been taken at the same locality with *palustris*.

Sylvilagus aquaticus littoralis Nelson.

COAST SWAMP RABBIT.

Sylvilagus aquaticus littoralis Nelson, North Amer. Fauna No. 29, p. 273, 1909.

The coast race of the swamp rabbit is confined to a narrow belt along the coast from Matagorda Bay, Texas, eastward to the west side of Mobile Bay. It ranges but a short distance from the coast marshes (specimens from so near as Whistler being referable to the interior form, *aquaticus*) and is practically limited to the tidewater region. In the marshes of Blakely Island, opposite Mobile, it is very numerous and three specimens taken there are typical of the race. Specimens from the Tensaw River, four miles north of Hurricane, however, are intermediate between *littoralis* and *aquaticus*, but are best referred to the former. The species occurs only sparingly about Bayou Labatre and the coast region westward; it is occasionally taken on Grand Batture Island. In habits this rabbit differs very little from the typical race, but those observed in the Blakely Island marshes seemed less fleet of foot and very averse to leaving the cover of the marsh. In fact, about the only way to get them out of the rushes is to set fire to the vegetation; when driven out by the flames, they skulk along with ears laid back and dart into the nearest patch of cover.

Sylvilagus palustris palustris (Bachman).

MARSH RABBIT.

Lepus palustris Bachman, Journ. Acad. Nat. Sci. Philadelphia, vol. 7, p. 194, 1837.

The marsh rabbit occurs in Alabama only in the southern counties east of Mobile Bay; its northern limit has not been definitely ascer-

[56] Audubon and Bachman, Op. cit., vol. 1, p. 289.

tained, but is roughly indicated by records of its occurrence at Gordon, Ashford, Dothan, Orange Beach, and Flomaton (fig. 10).

In the salt marshes of Perdido Bay and Bon Secour River the rabbits are abundant, and there their droppings and well-beaten trails may be seen everywhere. In localities back from the coast they live in the small, wet, timbered swamps which are found at frequent intervals along the streams and around ponds in the timber. They never leave the cover of the swamps unless driven out by dogs or fire, and on such occasions they quickly seek the nearest thicket or take refuge in a hollow log or tree. Their short legs prevent them from attaining much speed; when pursued they depend for escape on their facility in doubling and twisting. When driven from a marsh by the firing of the dry grass, often many are killed by men waiting for them with clubs. In the marsh they are frequently caught by dogs. They take to the water readily and swim easily and swiftly.

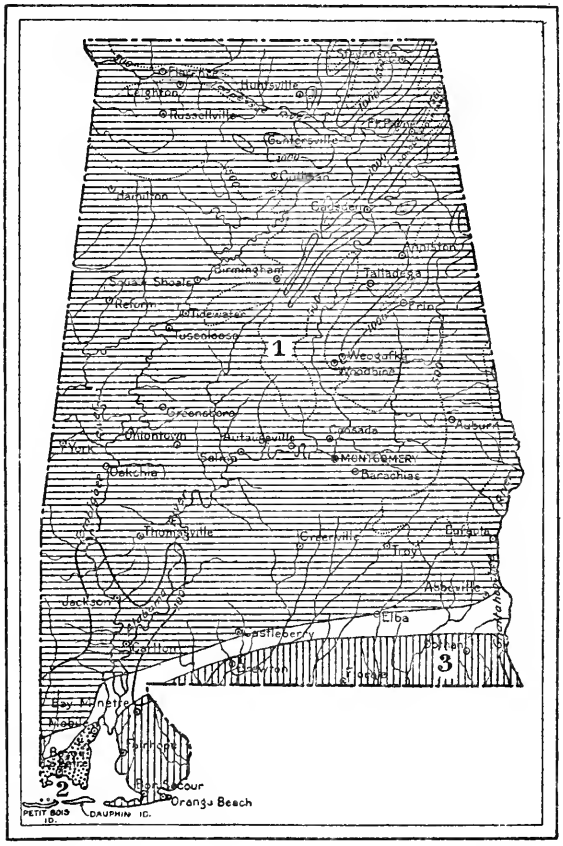

FIG. 10.—Distribution of swamp and marsh rabbits in Alabama.

1. *Sylvilagus aquaticus aquaticus.*
2. *Sylvilagus aquaticus littoralis.*
3. *Sylvilagus palustris palustris.*

Bachman states that the marsh rabbit feeds on various grasses and gnaws the twigs of young sassafras and of the pond spice (*Benzoin*). He has also found it digging for the bulbs of the wild potato (*Apios apios*) and the atamasco lily.[57] Nelson states that the marsh rabbits examined from Bon Secour are intermediate between *palustrus* and *paludicola*, but nearer the former.[58]

[57] Audubon and Bachman, Op. cit., vol. 1, p. 155.
[58] Nelson, E. W., North Amer. Fauna No. 29, p. 268, 1909.

Order ARTIODACTYLA.

Family CERVIDAE: Deer.

Odocoileus virginianus virginianus (Boddaert).

VIRGINIA DEER.

Cervus virginianus Boddaert, Elenchus Animalium, vol. 1, p. 136, 1785.

Deer once ranged in large numbers over all of Alabama, but they are now exterminated in all but the wilder and more inaccessible parts. Their former abundance is attested by the records of early travelers. Bartram, who visited the State in 1776, notes that in the region of the lower Tombigbee River, about 300 deer were killed annually by one planter;[59] and Gosse records them as being very abundant in Dallas County in 1858, when 70 were killed in a single hunt.[60]

The only part of the State where deer are still abundant is in the big wooded swamps of the lower Tensaw and Mobile Rivers. In that region a number are killed during the open season every fall. They are hunted with dogs, each hunter selecting a "stand," where he remains in expectation that the deer will pass within range of his gun—usually a shotgun loaded with buckshot. The deer take readily to the water and swim easily from one island to another in this great swamp; in this way they are able to keep ahead of the dogs, but are often shot while swimming a creek or river or when crossing an opening in the timber. Deer are still found in moderate numbers in the sandhills and swamps of southern Baldwin County. In 1915 they were reported to be numerous between Foley and the shores of Perdido Bay and were occasionally seen near Orange Beach, on the south side of the bay. Twenty years ago or more they were common in the sandhills and small swamps of Mobile County, but now apparently all have been exterminated from that region.

Small numbers of deer still range over the hill country from Winston to Colbert Counties; three were killed in November, 1916, on Buzzard Roost Creek, south of Barton. Reports during the same year indicated that a few deer still remained in northern Cleburne County near Borden Springs. In Russell County they are said to have been exterminated within the last decade. A specimen in the National Museum collection was taken at Selma in 1891.

Specimens have been examined from Orange Beach, Gravine Island (Tensaw River), Mount Vernon Barracks, Selma, and Barton. These all agree rather closely with a skin of *virginianus* from Hali-

[59] Bartram, W., Travels, p. 410, 1792.
[60] Gosse, P., Letters from Alabama, p. 266, 1859.

fax, North Carolina, and differ from skins of *osceola* in darker color. The skulls also of both the Barton and the Tensaw River specimens agree essentially with the two skulls of *virginianus* examined (Halifax, North Carolina, and Meadow Creek Mountain, Greenbrier County, West Virginia); compared with skulls of *osceola* from Florida, these Alabama specimens (as well as those from North Carolina and West Virginia) differ but little in size or other characters, except that in *osceola* (as stated by Bangs in the original description) the nasal and premaxillary bones meet, while in *virginianus* they are separated by an arm of the maxillary. In describing *osceola*, Bangs made comparison with the large northeastern deer, since separated by Miller under the name *borealis*, so that the differences between the Florida deer and typical *virginianus* are much less than would be inferred from reading Bangs's description.

The horns of the Alabama deer are of medium size, decidedly smaller than those of the Louisiana deer (*Odocoïleus louisianae*); the breadth of beam in a fully adult buck from Tensaw River is $14\frac{3}{4}$ inches. The hoofs on the hind feet in the specimen from the Colbert County hills are decidedly shorter and broader than those from the swamps and sandhills of the coast or than those of the Florida deer.

The general color tone of the upperparts and legs in winter pelage is cinnamon-drab, much mixed with blackish, the muzzle and ears light drab; in the Barton specimen there is a band of blackish along the middle line of the back and the upper surface of the tail is cinnamon, becoming fuscous toward the tip; in the Baldwin County specimens the surface hairs on the tail are likewise cinnamon, but by reason of wearing away of the tips the basal color (blackish brown or clove-brown) appears as a solid band. The summer coat is a bright tan color, very different from the drab winter coat.

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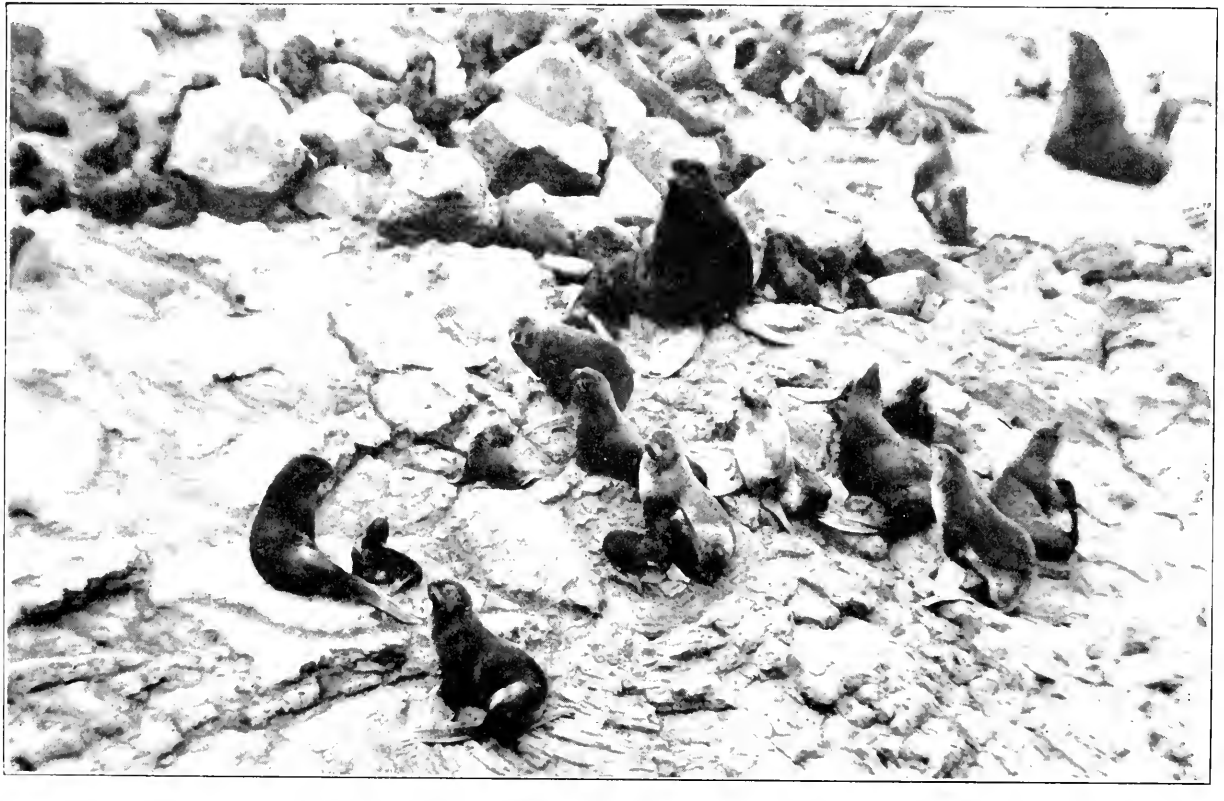


SMALL HAREM OF FUR SEAL (CALLORHINUS ALASCANUS).

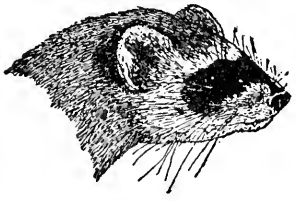
Only a few of the cows are present, the remainder having gone to sea to feed. Photograph by G. Dallas Hanna, summer, 1920, on Kitovi Rookery, St. Paul Island, Pribilof Islands, Alaska.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 46

[Actual date of publication, June 20, 1923]



A BIOLOGICAL SURVEY OF THE PRIBILOF ISLANDS, ALASKA

I. BIRDS AND MAMMALS

By EDWARD A. PREBLE, Assistant Biologist, Division of Biological Investigations, and W. L. MCATEE, In Charge Food Habits Research; Bureau of Biological Survey

II. INSECTS, ARACHNIDS, AND CHILOPODS

By VARIOUS ENTOMOLOGISTS, With an Introduction by W. L. MCATEE, Biological Survey

WASHINGTON
GOVERNMENT PRINTING OFFICE
1923

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., May 8, 1922.

SIR: I have the honor to transmit herewith, recommending that it be published as No. 46 in the series of the North American Fauna, a report on a biological survey of the Pribilof Islands, Bering Sea, Alaska, by Edward A. Preble, assistant biologist, and W. L. McAtee, in charge of food habits research, of this bureau, assisted by a number of specialists in entomology. This report treats of the birds and mammals of the group, together with the insects and related invertebrates, and the life-zone relationships of the region. The Pribilof Islands constitute a national reservation and are especially noteworthy as being the sole breeding place of the largest herds of fur seals in the world, which are the property of the United States Government and are managed by the Bureau of Fisheries of the Department of Commerce. Numbers of valuable blue foxes, which by selective breeding under normal conditions have been developed to a point of excellence nowhere else attained, are also found on the islands, as well as two herds of reindeer. The present report will be of great assistance to students and others interested in the natural history of Alaska.

Respectfully,

E. W. NELSON,
Chief of Bureau.

Hon. HENRY C. WALLACE,
Secretary of Agriculture.

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A BIOLOGICAL SURVEY OF THE PRIBILOF ISLANDS, ALASKA.

Part I. BIRDS AND MAMMALS.

By Edward A. Preble, *Assistant Biologist, Division of Biological Investigations,* and W. L. McAtee, *In Charge Food Habits Research; Bureau of Biological Survey.*

INTRODUCTION.

By Edward A. Preble.

THE ISLANDS.

The Pribilof Islands consist of five small islands situated in Bering Sea, in latitude 57° north and longitude 170° west, 200 miles from the nearest lands, being this distance north of the Aleutian Chain and approximately the same distance south of St. Matthew Islands. The largest and best known of the group are St. Paul and St. George, the former, about 13 miles long, with a coast line of 45 miles; and the latter, 12 miles long, with a coast line of 30 miles (Pls. II, III, and IV). The smaller islands are all close to St. Paul—Walrus, about 6 miles to the east; Otter, about 4 miles to the south; and Sealion Rock, a mere rock close to the south shore (Pl. III).

The group is of volcanic origin and the shore lines are mainly rocky, in many places precipitous (Pl. V). On St. Paul these rough stretches are interrupted by sandy beaches, which often extend for miles; on St. George, the beaches are few in number, and not extensive. Back from the shore the land usually rises, gradually sloping plateaus being surmounted by rocky or sandy eminences, in some cases the craters of extinct volcanoes. These hills are most numerous on St. Paul, where two attain elevations of 590 and 665 feet, respectively. The highest hill on St. George, Ulekiah, has an elevation of 945 feet.

The Pribilofs were discovered by Russian fur traders in 1786, while searching for the summer home of the hordes of fur seals which had been noted pushing northward each spring past the Aleutians. The islands were then uninhabited, but were at once colonized by Aleutian natives, planted there by the Russians to col-

lect the skins of the myriads of seals. In 1799 the islands passed into the hands of the Russian American Co., and there remained until 1867, when the United States purchased Alaska from Russia.

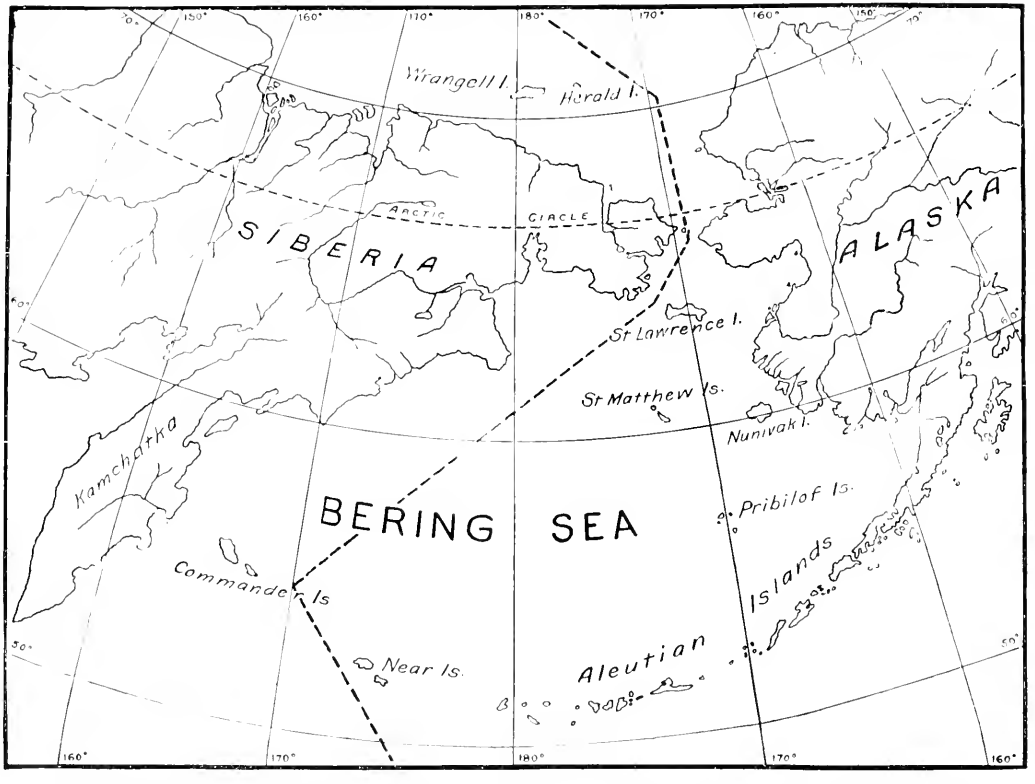
The Pribilof Islands now constitute a national reservation. In 1870 St. Paul and St. George Islands were made in effect a fur-seal reservation, under the administration of the Secretary of the Treasury. The remaining islands, Walrus and Otter, were set aside by Executive order as the Pribilof Bird Reservation in 1909, and in 1910 jurisdiction over the entire group was transferred to the Secretary of Commerce.

The three larger islands—St. Paul, St. George, and Otter—though supporting no tree growth, and only a few low shrubs, are thickly clothed with herbaceous vegetation, the moist summers inducing a luxuriance almost tropical. The list of plants includes many notable species, which, because of the peculiar summer climate, have a very long season of flowering. In consequence, large fields of arctic poppies, lupines, saxifrages, and other flowers of great beauty are found throughout the summer. Certain annuals attain so rank a growth as to add seriously to the labor of foot travel over the rougher areas.

SCIENTIFIC OBSERVATIONS AND COLLECTIONS.

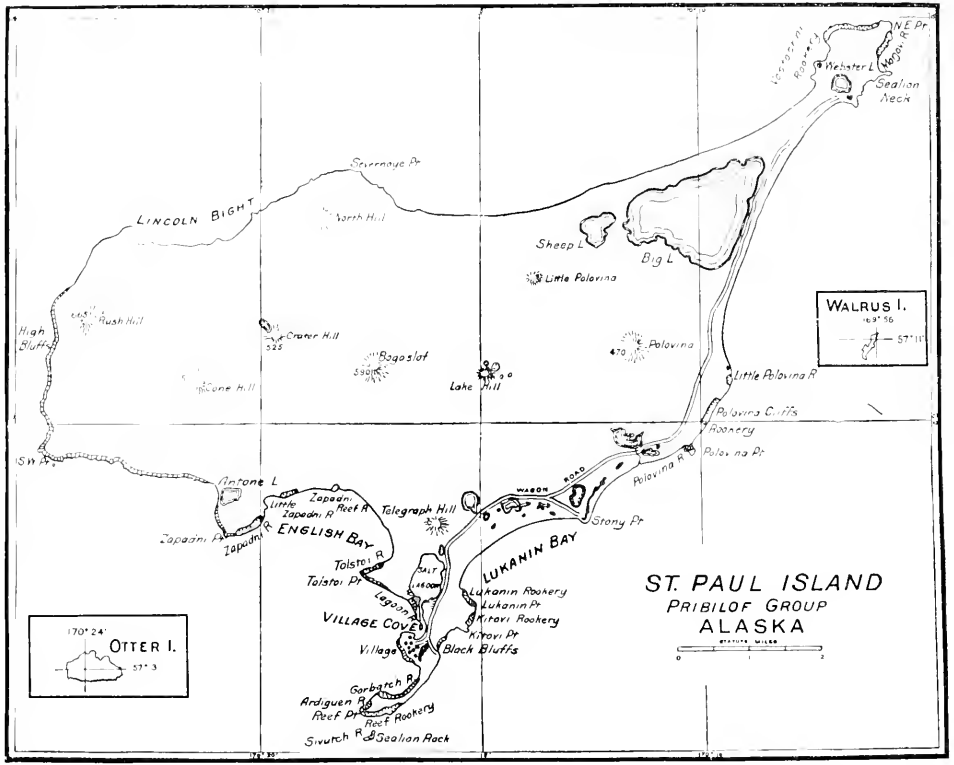
The teeming hordes of fur seals and the swarms of breeding sea birds seem to have interested the early inhabitants merely in a utilitarian way. It was not until 1840 that any work enumerating even the more conspicuous species of birds and mammals appeared. (See Veniaminof, 1840, in Bibliography.) William Palmer (1899, p. 360) summed up the history of the ornithological collections and observations made on the Pribilofs up to 1899, as follows:

> Coinde in 1860 made a list of but nine species that were collected by an officer of the Russian Navy, Mr. Warneck, in 1852. The jealous care exercised by the Russians for the preservation of the seals prevented any outsiders from studying the avifauna, so that it was not until the islands passed under the control of this Government, and Mr. Elliott made his investigations, that any great effort was made to study the bird life. Dr. W. H. Dall had indeed in 1868 spent a short time at the islands and, together with the officers of his surveying vessel, had collected some specimens, one of which was described as new by Prof. S. F. Baird, but the first systematic investigation was made by Mr. Henry W. Elliott [in 1872 and 1873]. The result of this gentleman's work was a list of 40 species, based on copious notes and numerous specimens which were named and elaborated by Dr. Elliott Coues in Mr. Elliott's report for 1873 [=1874], and which was reprinted in 1875. Mr. Elliott made another more extensive elaboration in his monograph of the seal islands in 1882. Besides the above, various other Government expeditions which have visited the waters of Bering Sea for different reasons during the past 16 years have generally touched at the seal islands and given several naturalists opportunities for collecting and noting the bird life. Thus, Mr. L. M. Turner in 1878, Dr. T. H. Bean in 1880, Mr. E. W. Nelson in 1881, Lieut. J. E. Lutz in 1884,



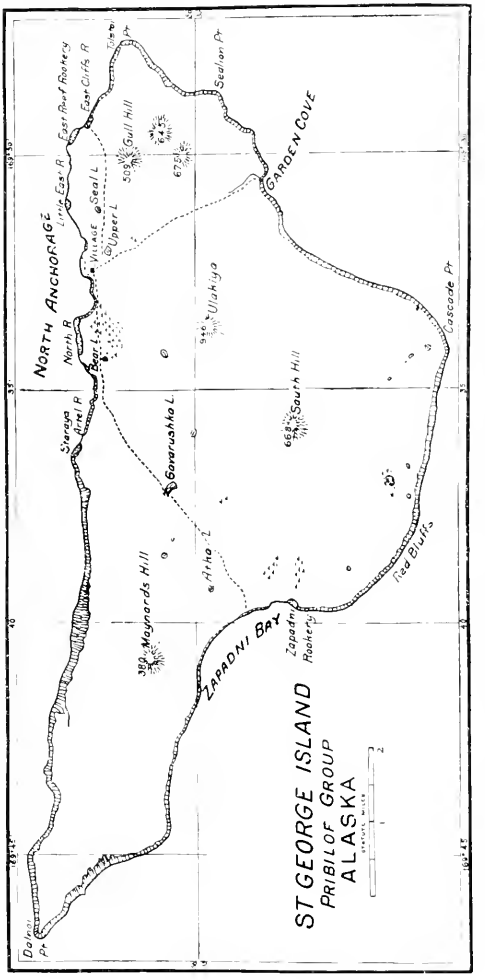
MAP OF BERING SEA, SHOWING POSITION OF PRIBILOF ISLANDS RELATIVE TO OTHER LANDS.

Their central position accounts in part for the variety of their transient bird life.



ST. PAUL ISLAND, PRIBILOF ISLANDS, ALASKA.

The large extent of sandy beach affords many easy landing places.



ST. GEORGE ISLAND, PRIBILOF ISLANDS, ALASKA.

On this island the shore line is generally rocky and often precipitous, making landing difficult and hazardous.

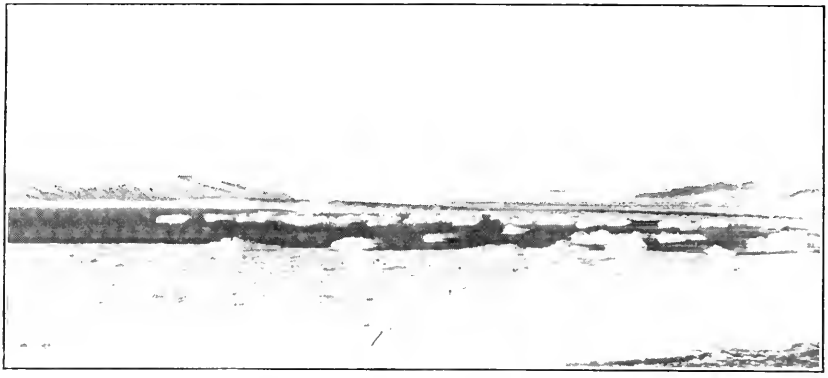


FIG. 1.—WINTER ON ST. PAUL ISLAND.

View looking toward head of lagoon from beach near Village Landing. Photograph by G. Dallas Hanna.

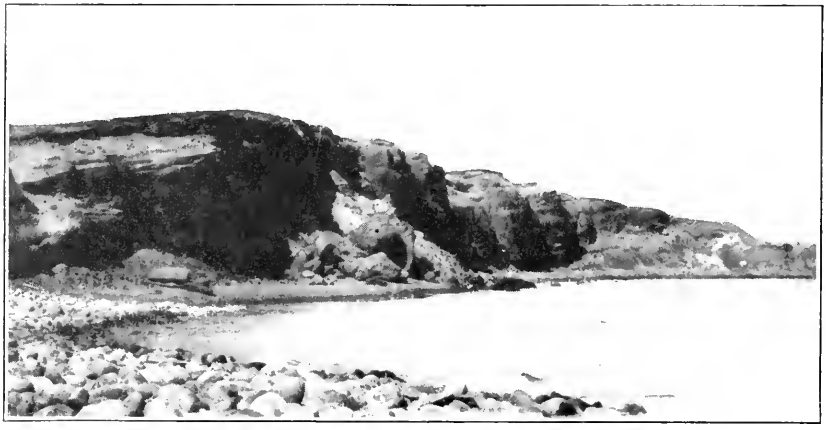


FIG. 2.—BLACK BLUFFS, NEAR VILLAGE, ST. PAUL ISLAND.

This is the most notable of the exposures of fossiliferous rock on the Pribilofs. Photograph by A. Christoffersen.

FIG. 3.—SURF-LASHED SHORE, ST. PAUL ISLAND.

In these seething waters the young seals play for hours. Photograph by A. Christoffersen.

Mr. C. H. Townsend in 1885 to 1896, myself in 1890, Messrs. F. W. True and D. W. Prentiss, jr., in 1895, Mr. F. A. Lucas in 1896–97 have spent from a day or two to several months on the islands.

Palmer spent the period from May 27 to August 11, 1890, on the Pribilofs, mainly on St. Paul. His time was spent largely in the study of the birds, but owing to regulations then in vogue regarding the use of firearms his opportunities for collecting specimens were somewhat restricted. His report, which is a painstaking and scholarly work, has remained the only completely annotated list of the birds of the group up to the present time.

In 1910, when the Pribilof Islands were placed in charge of the Bureau of Fisheries of the Department of Commerce, in furtherance of the policy to make a thorough study of the life of the islands, the breeding place of the fur seal, Dr. Walter L. Hahn was appointed naturalist. Evermann (1913, p. 15) thus refers to his work, and that of his successor:

> Dr. Walter L. Hahn, at that time head of the department of biology in the State normal school at Springfield, S. Dak., was appointed naturalist in the summer of 1910. He arrived at St. Paul Island August 24 and immediately entered upon his duties with an energy and intelligence which could scarcely be excelled. His untimely death on May 31, 1911, from exposure in the ice-cold water of the village lagoon, resulting from the capsizing of a boat, was a severe loss to the fur-seal service and to biological science. During his few months on St. Paul Island, Doctor Hahn, from the voluminous notes and records which he left, appears to have been indefatigable in his field work and marvelously painstaking in recording his observations. His notes, typewritten up to noon of the very day of his death, record a vast number of new and important observations on the fur seals and blue foxes. They also teem with records of interesting observations on the birds and other animals of the islands.
>
> Mr. Millard C. Marsh, pathologist of the Bureau of Fisheries, was appointed to the vacancy caused by the death of Doctor Hahn. He reached St. Paul Island August 23, 1911, and took up and continued with commendable industry and intelligence the work so ably begun by his predecessor.

As a result of this work Evermann (l. c.) was able to add 18 species of birds to the Pribilof list; four of these were for the first time added to the North American list. In addition, the present writer has been able, through the courtesy of the Bureau of Fisheries, to use the notes on occurrence of many species recorded by Hahn and Marsh. Copies of the notes in the St. Paul Island log relating to many species of birds and mammals, carefully transcribed by Hahn, and arranged under specific headings, have also been available.

Alvin G. Whitney, school-teacher on St. Paul Island from the summer of 1912 to the summer of 1914, made considerable collections of insects and shells and some other invertebrates, but his contributions to ornithology and mammalogy were small.

The next naturalist to work on the Pribilofs was G. Dallas Hanna. He arrived on St. Paul in July, 1913, and was transferred during the next month to St. George. Although his regular duties as school-

teacher and volunteer radio operator involved long hours, he found time to make notes and collections. In early August of 1914 he was transferred to St. Paul, where he remained (with the exception of two trips to St. George in the summer of 1915) until September, 1915, when he returned to the United States. During all this period he devoted most of his spare time to ornithology. In 1916, mainly as a result of his own work, he added 13 species to the Pribilof list in a paper published in The Auk.

In the meantime the visit of the writer and his colleagues, Wilfred H. Osgood, of the Field Museum, Chicago, Ill., and Prof. George H. Parker, of Harvard University, Cambridge, Mass., on a special investigation of the fur-seal herd in the summer of 1914, afforded an opportunity for further study of the fauna. It is needless to state that the extremely interesting wealth of bird life on these islands, then for the first time observed by the writer, determined him to prepare a fully annotated list of the birds, and this forms a part of the present report.

Mr. Hanna returned to St. Paul in June, 1916, and remained there (excepting short visits to St. George each summer and a residence there from October, 1916, to May, 1917) until September, 1918. As a result of the work done there, he was able to publish a paper adding 21 species of birds to the Pribilof list, 4 of which were new to North America. He later spent two summer seasons on the islands (June to September, 1919 and 1920) on seal work, and each season made additions to the list. In 1919 he published a list of all the birds known at that time to have occurred on the Pribilofs, 129 in number, in which the various species are classed as breeders, regular migrants, or transients, and the author first reporting the species from the group is indicated. In addition, he has published other papers of a general nature or relating to certain species, and he has very generously furnished the writer with numberless unpublished notes on the occurrence of birds and mammals, extending practically throughout his period of service on the islands. Without his records and those of Hahn, above referred to, the preparation of the present lists would scarcely be justified. Notes on a number of species of birds made by H. P. Adams on St. George Island in 1915, 1916, and 1917, have also been available. All such notes, when lacking citations, are understood to be hitherto unpublished.

The foregoing account has been written mainly from the standpoint of the ornithologist; since the birds are so abundant and so far outnumber the other vertebrates in species and individuals, it is natural that they should have received the greater share of attention. Practically all workers, however, have done some work on the mammals. In the bibliography (pp. 121–128), therefore, the titles are merged in one list; indeed, many articles refer to both groups.

LIFE ZONE RELATIONSHIPS.

By Edward A. Preble.

While the Pribilof group as regards its zoogeography is most closely related to the Arctic, there are many elements that forbid its unqualified reference to that zone. The small size of the islands, their distance from other lands, and probably to some extent the ocean currents have all been factors which helped to determine its present faunal and floral characteristics. The severe winds which sweep the islands have also had their influence. Other important contributing causes have been the original freedom of the islands from human habitation, and their rugged topography, combined with an abundant food supply, which have favored their selection as breeding stations for myriads of aquatic birds and a number of species of mammals. All these factors have combined to produce a fauna and flora peculiar in many respects.

MAMMALS.

Among land mammals we find only three species, all more or less peculiar to the group. Of these the foxes (*Alopex pribilofensis*) were probably originally brought to the islands by floating ice and have become slightly differentiated from the original mainland stock. The shrew (*Sorex pribilofensis*) and the lemming (*Lemmus nigripes*), peculiar to St. Paul and St. George Islands, respectively, have been so modified that their origin can not be determined. The fox and lemming, however, and perhaps the shrew, belong to groups which are essentially Arctic in distribution. All the other mammals, excepting those introduced by man, are aquatic and can not be discussed in terms applicable to the distribution of the others. The boundaries of their habitats are probably determined by the temperature of the water, acting to some extent directly, but more especially through their food supply. Of the strictly aquatic mammals, the bowhead whale (*Balæna mysticetus*), if correctly identified, is near the southern limit of its range; all the others, with the exception of the killer whale (*Orcinus rectipinna*), which visits the Arctic Ocean in summer, are near their northern limit.

In regard to the pinnipeds, less strictly aquatic, the Pribilofs are the meeting point of both southern and northern types. The Steller sea lion (*Eumetopias jubata*), Pribilof fur seal (*Callorhinus alascanus*), and Pribilof harbor seal (*Phoca richardii pribilofensis*) are at or near their northern limit; while the walrus (*Odobenus divergens*), ribbon seal (*Phoca fasciata*), and bearded seal (*Erignathus barbatus nauticus*) there approach their southern boundary.

The sea otter (*Latax lutris lutris*), now exterminated there, found about the Pribilofs one of its northernmost stations.

BIRDS.

In discussing the zonal relation of the group as reflected in its bird life it is advisable to deal only with species which regularly breed. These are as follows:

Lunda cirrhata.
Fratercula corniculata.
Phaleris psittacula.
Aethia cristatella.
Aethia pusilla.
Uria troille californica.
Uria lomvia arra.
Rissa tridactyla pollicaris.
Rissa brevirostris.
Larus hyperboreus hyperboreus.
Larus glaucescens.
Fulmarus glacialis rodgersi.
Phalacrocorax pelagicus robustus.
Phalacrocorax urile.
Clangula hyemalis.
Lobipes lobatus.
Arquatella maritima ptilocnemis.
Leucosticte griseonucha.
Plectrophenax nivalis townsendi.
Calcarius lapponicus alascensis.
Nannus troglodytes alascensis.

Sixteen of these (excepting *Rissa brevirostris*, *Larus glaucescens*, *Phalacrocorax urile*, and *Nannus t. alascensis*) breed commonly on the St. Matthew group to the northward (a number of them still farther north, to and beyond Bering Strait), and one other, *Plectrophenax nivalis townsendi*, is represented there by a closely related species, *P. hyperboreus*. *Rissa brevirostris* reaches its northern limit on the Pribilofs, and *Larus glaucescens* in the northern part of Bering Sea. *Phalacrocorax urile* is a summer visitor from the Siberian coast, and *Nannus t. alascensis* is peculiar, but has close relatives on the Aleutian Islands. It will be noted that these are mainly sea birds, some of which nest as far south as California, but which, finding abundant food combined with convenient nesting sites on these northern islands, breed successfully there also regardless of the lower temperature. These, like the aquatic mammals, can not be regarded as coordinate in value with land vertebrates as regards zonal significance. *Clangula hyemalis* and *Lobipes lobatus*, which nest about fresh-water ponds, and *Arquatella m. ptilocnemis*, *Leucosticte griseonucha*, *Plectrophenax n. townsendi*, and *Calcarius l. alascensis*, are distinctly Arctic types.

It will thus be seen that both the mammalian and avian inhabitants of the Pribilofs, excluding those which can not legitimately be considered as furnishing criteria for the definition of life zones as currently considered, favor the reference of this group to some division of the Arctic Zone.

But while the aquatic species of mammals and birds must be considered from a standpoint different from that accorded those inhabiting the land, they can hardly be ignored in the consideration of a fauna of which they constitute an overwhelming majority. Palmer, indeed, our principal authority on Pribilof birds, considered

the breeding water-birds as mainly characterizing a zoogeographic area to which he accorded the rank of a subregion of the Holarctic—the Aleutican. This is practically the same as the Aleutian Faunal District of Nelson, extended to include the Pribilofs and other islands and the immediate coasts of Alaska and Siberia north to Bering Strait, and includes the insular and coastal portions of the Alaskan Province of the Holarctic region of Newton. (Dictionary of Birds, Part II, p. 331, 1893.)

PLANTS.

The botany of the Pribilofs has been carefully studied by James M. Macoun, who has published an annotated list of 184 species, including the vascular cryptogams. His paper includes a table, prepared in collaboration with Theodor Holm, one of our most eminent students of Arctic plants, which shows the distribution of the various species in other parts of the Arctic region. Regarding the phaenogams only, 172 species, we find that 141 species are found on the east coast of Bering Sea, and 126 on the west coast, while 101 grow on both coasts; 74 are found in Arctic America. Twenty-three are not known from either the east or west coasts of Bering Sea, and of these 23 only 6 are found in Arctic America; of the remaining 17 the majority are species which have been described from the Pribilofs, while the remainder are presumably found also on the Aleutians.[1] It will thus be seen, as might be expected, that the great majority of the Pribilof plants are arctic or subarctic species.

The phaenogams classed as Arctic by Macoun and Holm are the following:

Ranunculus tricophyllus Chaix.
Ranunculus hyperborcus Rottb.
Ranunculus pygmacus Wahl.
Ranunculus reptans L.
Ranunculus eschscholtzii Schl.
Coptis trifolia Salisb.
Papaver radicatum Rottb.
Draba hirta L.
Draba wahlenbergii Hartm.
Eutrema edwardsii R. Br.
Cochlearia officinalis L.
Cardamine bellidifolia L.
Cardamine pratensis L.
Silene acaulis L.
Lychnis apetala L.
Arenaria peploides L.
Stellaria humifusa Rottb.
Stellaria longipes Goldie var. *laeta* Was.
Cerastium alpinum L.
Sagina linnaci Presl.
Sagina nivalis Fr.
Rubus chamaemorus L.
Rubus arcticus L.
Potentilla anserina L.
Comarum palustre L.
Potentilla emarginata Pursh.
Saxifraga hieracifolia Waldst. and Kit.
Saxifraga stellaris L. var. *comosa* Poir.
Saxifraga hirculus L.

[1] The late James M. Macoun, in 1914, informed me that a few species of Pribilof plants, evidently of Aleutian origin, were known by him to occur only near Southwest Point, St. Paul Island. Since Mr. Macoun on that occasion added several species to the list, which I do not now remember, and which are probably yet unpublished, the particular ones referred to by him can not be determined. A direct comparison of lists of the Pribilof and Aleutian species would be desirable in the present connection, but I have found no work giving a complete list of the plants of the latter region.

Chrysosplenium alternifolium L.
Parnassia kotzebuei Cham. and Schl.
Hippuris vulgaris L.
Epilobium spicatum Lam.
Sclinum benthami Wat.
Valeriana capitata Pall.
Achillea millefolium L.
Chrysanthemum arcticum L.
Petasites frigida Fries.
Campanula uniflora L.
Pyrola minor L.
Armeria vulgaris Willd.
Veronica serpyllifolia L.
Pedicularis sudetica Willd.
Pedicularis lanata Willd.
Euphrasia officinalis L.
Gymandra stelleri Cham. and Schl.
Koenigia islandica L.
Polygonum viviparum L.
Polygonum bistorta L.
Oxyria reniformis Hook.
Rumex acetosella L.
Salix arctica Pall.
Salix reticulata L.
Empetrum nigrum L.
Lloydia serotina Reich.
Streptopus amplexifolius DC.
Juncus biglumis L.
Eriophorum polystachyon L.
Eriophorum vaginatum L.
Carex vulgaris Fries, and vars.
Carex membranopacta Bailey.
Carex rariflora Smith.
Carex saxatilis L.
Hierochloa pauciflora R. Br.
Alopecurus alpinus Smith.
Arctogrostis latifolia Grisb.
Calamagrostis purpurascens V.
Trisetum subspicatum Beauv.
Phippsia algida R. Br.
Arctophila effusa Lange.
Dupontia psilosantha Rupr.
Glyceria angustata Fries.
Festuca ovina L.
Elymus mollis Trin.

The following species of plants have been described as new from Pribilof specimens (some of these are not currently considered valid):

Papaver macounii Greene.
Nesodraba grandis Greene.
Cardamine umbellata Greene.
Crysosplenium beringianum Rose.
Primula macounii Greene.
Primula eximia Greene.
Polygonum macounii Small.
Salix rotundata Rydberg.
Salix cyclophylla Rydberg.
Carex pribylovensis Macoun.
Alopecurus howellii Vasey var. *merriami* Beal.
Elymus villosissimus Scribner.
Calamogrostis arctica Vasey.

ZOOGEOGRAPHY OF NEIGHBORING AREAS.

It is scarcely possible to discuss the zoogeographic aspects of the Pribilofs without considering also the neighboring Aleutian Peninsula and Islands. The latest treatment seems to be that of Osgood,[2] who has discussed the zoogeography of the Alaska Peninsula at some length, and while assigning the treeless part of that region to the unqualified Arctic Zone admits the possibility that a more extended study may show the terminal part of the peninsula and the adjoining islands to belong to a subdivision of the Arctic. The writer believes that recognition of such a subdivision is desirable, and would retain the name first applied to it by Nelson, the Aleutian Faunal District,[3] considered as a subdivision of the Arctic Zone, and includ-

[2] A Biological Reconnaissance of the Base of the Alaska Peninsula: North American Fauna No. 24, pp. 21–25, 1904. I have also had the benefit of suggestions from Dr. Alexander Wetmore, who spent the summer of 1911 on the Aleutian Islands and the Peninsula.

[3] Report on Nat. Hist. Collections made in Alaska, p. 26, 1887.

ing the western end of the Alaska Peninsula, the Aleutian Islands, and the Pribilofs. The St. Matthew group and perhaps other islands in Bering Sea might also best be included here.

It is evident, however, that this subdivision, and especially the Alaska Peninsula, by no means shares its characteristic fauna and flora exclusively or even principally with the Arctic proper. In the first place it should be borne in mind that although the summer temperatures alone on the Pribilofs and at Unalaska are sufficiently low to limit the growth of trees, absence of trees over large areas on the peninsula is evidently due in part to some other factor. There is little doubt that this contributing cause, as suggested by Osgood, is the severe wind which sweeps the region at all seasons. This, however, has not sufficed to prevent a luxuriant growth of alders and willows in the more sheltered parts of the peninsula beyond the line of tree growth, and these afford breeding sites for the following birds, which over most of their ranges are not considered to nest above the Hudsonian Zone:

Pica pica hudsonia.
Zonotrichia coronata.
Passerella iliaca unalaschensis.
Melospiza melodia insignis.
Riparia riparia.
Dendroica aestiva rubiginosa.
Wilsonia pusilla pileolata.
Hylocichla ustulata swainsoni.
Hylocichla guttata guttata.

The dipper, or water ousel (*Cinclus mexicanus unicolor*), a bird nesting in the Canadian and Hudsonian zones, also breeds in this area.

Opposed to this list is the following, including birds which may be considered truly Arctic in their affinities, and most of which nest largely on the higher grounds:

Lagopus lagopus albus.
Lagopus rupestris nelsoni.
Calcarius lapponicus alascensis.
Leucosticte grisconucha.
Plectrophenax nivalis townsendi.
Acanthis hornemanni exilipes.
Anthus spinoletta rubescens.

The remainder of the breeding land birds of the Alaska Peninsula, all wide-ranging forms, may be classed as follows:

Falco peregrinus pealei. Breeding from Transition to Arctic Zones.
Corvus corax principalis. Breeding from Canadian to Arctic Zones.
Passerculus sandwichensis sandwichensis. Breeding regularly to Hudsonian Zone.
Archibuteo lagopus sancti-johannis. Breeding in Hudsonian and Arctic Zones.
Haliaeetus leucocephalus alascanus. Breeding from Canadian to Arctic Zones.

It seems evident, therefore, that while it may be desirable to include the terminal part of the Alaska Peninsula in the Aleutian Faunal District, a majority of its breeding land birds belong at least in part to zones below the Arctic.

BIRDS OF THE PRIBILOF ISLANDS, ALASKA.

By Edward A. Preble and W. L. McAtee.

In the annotated list of birds of the Pribilofs, the portions of the accounts relating to distribution, migration, nesting, and general habits are by Edward A. Preble. The attempt has been made to collect all available data referring to the various species, with special reference to dates of arrival, nesting, departure, and occurrence in winter, and in most cases the notes are presented in the order here indicated. The circumstances under which the observations were made have been described in detail in the general introduction, and need not be here repeated.

BREEDING BIRDS.

Of the 137 species now known to have occurred on the Pribilofs, only 23 are known to breed; of these *Anas platyrhyncha platyrhyncha* and *Nettion carolinense* are rare. The list follows:

Lunda cirrhata.
Fratercula corniculata.
Phaleris psittacula.
Aethia cristatella.
Aethia pusilla.
Uria troille californica.
Uria lomvia arra.
Rissa tridactyla pollicaris.
Rissa brevirostris.
Larus hyperboreus hyperboreus.
Larus glaucescens.
Fulmarus glacialis rodgersi.
Phalacrocorax pelagicus robustus.
Phalacrocorax urile.
Anas platyrhyncha platyrhyncha.
Nettion carolinense.
Clangula hyemalis.
Lobipes lobatus.
Arquatella maritima ptilocnemis.
Leucosticte griseonucha.
Plectrophenax nivalis townsendi.
Calcarius lapponicus alascensis.
Nannus troglodytes alascensis.

In addition, *Histrionicus histrionicus pacificus* is present in abundance all summer, but has not been found actually nesting. *Cepphus columba* and *Larus schistisagus* also have been stated to breed, but on insufficient evidence.

REGULAR MIGRANTS.

Several of these, even some which breed abundantly, occur in greater numbers during migration. Examples are *Larus hyperboreus hyperboreus*, *Anas platyrhyncha platyrhyncha*, *Histrionicus histrionicus pacificus* and *Arquatella maritima ptilocnemis*. Sixteen others are known to be more or less regular migrants; these are the following:

Xema sabinii. Spring and fall.
Sterna paradisaea. Spring and fall.
Dafila acuta tzitzihoa. Spring and fall.
Somateria v-nigra. Mainly in winter.
Somateria spectabilis. Mainly in winter.
Oidemia deglandi dixoni. Mainly in winter.
Branta canadensis minima. Spring and fall.
Philacte canagica. Spring and fall.
Phalaropus fulicarius. Spring and fall.
Pisobia acuminata. Mainly in fall.
Pisobia maculata. Mainly in fall.
Limosa lapponica baueri. Spring and fall.
Heteroscelus incanus incanus. Spring and fall.
Pluvialis dominica fulva. Spring and fall.
Arenaria interpres interpres. Mainly in fall.
Anthus spinoletta rubescens. Mainly in fall.

OCCASIONAL VISITORS.

All the remaining species of the list are transients which have been detected once or in some cases a number of times. A considerable number of these, as more observations are afforded, will probably be transferred to the list of regular migrants. In addition to those migrants which occur mainly as winter visitors from farther north, the following, of less regular occurrence, have also been noted chiefly in winter.

Colymbus auritus.
Cepphus columba.
Polysticta stelleri.
Arquatella maritima couesi.
Hierofalco rusticolus sacer.
Nyctea nyctea.

VISITORS FROM EURASIA.

Those members of the avifauna which may fairly be classed as transients or accidental visitors number over 80 species. Of these the following are Eurasian, with general ranges as given; unless otherwise indicated specimens taken on the Pribilofs have proved to be the first records for North America:

Mareca penelope. Breeds in northern Eurasia from Scandinavia to Kamchatka, wintering to the southward.
Eunetta falcata. Occurs regularly in eastern Asia to Kamchatka, Korea, and Japan.
Nettion crecca. Of general distribution in northern Eurasia, breeding easterly to the eastern Aleutian Islands, where it was recorded previous to its capture on the Pribilofs.
Fuligula fuligula. Breeding in Eurasia eastward to Kamchatka, migrating in winter to northern Africa, India, China, and Japan.
Aithyia ferina. Breeding in Eurasia east to Lake Baikal, wandering in migration and winter eastward to China and Japan.
Glaucionetta clangula clangula. Breeding generally throughout northern Eurasia.
Limnocryptes gallinula. Breeds in Eurasia east to the Kolyma River. In migration and winter occurs south to India and Burma, and occasionally to Japan and Formosa.

Pisobia subminuta. Breeds in eastern Siberia, Kamchatka, and the Commander and Kurile Islands. Migrates in winter as far as Australia and the Philippines.

Rhyacophilus glareola. Breeds in northern Eurasia eastward to Kamchatka and Bering Island, wintering south to Africa, southern Asia, Japan, and the Philippine Islands. Recorded previously from Alaska (Littlejohn, The Condor, vol. 6, p. 138, 1904, Sanak Island).

Heteroscelus incanus brevipes. Breeds in eastern Siberia and Kamchatka. Migrates southwardly to China, Japan, the Malay Peninsula, and Australia. Taken at least once on Bering Island in May.

Philomachus pugnax. Occurs in central Europe and Asia, eastward rarely to Japan and China, wintering in Africa and India. First record for western coast of North America, but has been taken many times in the eastern United States.

Numenius tahitiensis. Occurs on many of the Pacific islands, mainly in winter; has been taken several times in summer on the mainland of Alaska, once at least previous to its capture on the Pribilofs.

Thallasoactus pelagicus. Breeds in Kamchatka, and has been taken on Bering Island.

Cryptoglaux funerea magna. Described from the Kolyma River; probably of general range in northeastern Siberia.

Cuculus canorus telophonus. Breeds in Kamchatka, Manchuria, Japan, and China.

Micropus pacificus. Breeds in eastern Asia, including Kamchatka, Japan, and northern China. Has also been reported from the Commander Islands.

Coccothraustes coccothraustes japonicus. Occurs in Japan, Korea, northern China, and eastern Siberia.

Fringilla montifringilla. Breeds in northern Europe and Asia east to Kamchatka; in migration to southern Asia.

Pinicola leucura kamtschathensis. Breeds in Kamchatka.

Anthus spinoletta japonicus. Breeds in eastern Siberia and Kamchatka and the Kurile Islands; winters in Japan, China, and India.

In addition, *Pluvialis dominica fulva*, added to the list of North American species from the Pribilofs, has since been found to be the breeding bird of northern and western Alaska.

BIRDS DESCRIBED FROM THE PRIBILOFS.

Five valid forms have been described from Pribilof specimens as follows:

Rissa tridactyla pollicaris. Ridgway, in Baird, Brewer, and Ridgway, Water Birds of North America, vol. 2, p. 202, 1884. Type from St. George Island. Ranges generally over the North Pacific.

Arquatella maritima ptilocnemis. Coues, in Elliott's Rept. Seal Islands of Alaska, 1874 (unpaged), p. 182, 1875. Type from St. George Island. Breeding on the Pribilof and St. Matthew Groups, and on St. Lawrence Island.

Plectrophenax nivalis townsendi. Ridgway, Manual North American Birds, p. 403, 1887. Type from Otter Island. The breeding form on the Pribilof, Aleutian, and Commander Islands.

Calcarius lapponicus alascensis. Ridgway, The Auk, vol. 15, p. 320, October, 1898. Type from St. Paul Island. The breeding form on the islands and mainland of northern and western Alaska.

Nannus troglodytes alascensis. Baird, Trans. Chicago Acad. Sci., vol. 1, p. 315, 1869. Type from St. George Island. Confined to the Pribilof Group.

GENERAL OBSERVATIONS ON MIGRATION.

Although it seems very remarkable that so many species of birds otherwise known as regular breeders or migrants only on the neighboring coasts of Alaska or Asia have been taken on the comparatively small and distant Pribilofs, the fact that they have been detected is perhaps more to be wondered at than that they have reached there. During migration birds are often driven out to sea by winds of unusual velocity or become bewildered by fogs, while some habitually cross wide expanses of ocean. Such travelers, when weary and hungry, eagerly grasp the opportunity to seek the solid land. During the rather brief periods when the fogs lift, both the main islands are visible for a considerable distance. But the most potent factor in aiding the birds to find a landing place is probably the noisy herds of fur seals and sea lions.

During the seasons when most of the smaller birds are migrating the beaches are occupied by the thronging thousands, whose combined voices produce a clamor which can be heard above all other sounds of nature at a distance of several miles. So far reaching is this sound that it is frequently useful to navigators, helping them to locate the islands when driven from their course by winds and currents. There is no doubt that many storm-driven birds are thus guided to this haven, either to be put on record as rare visitors, or after resting again to try to traverse the storm-lashed pathway.

The fact that the Pribilofs have furnished so many additions to the list of North American birds, and that species from both North America and Asia continue to be taken there, has suggested comparison with Helgoland, the islet in the North Sea which has proved such a rich ornithological field. However, when we come to consider the characteristics of these two stations, and their data on migration, it is apparent that they have little common ground for comparison.

Although the Pribilofs and Helgoland are in nearly the same latitude, the climatic conditions and other phenomena affecting the avifauna are very different. Helgoland is so situated relative to Scandinavia, Germany, Russia, and the other parts of northern Europe as to lie directly in the migration pathway of vast numbers of birds which breed in those comparatively temperate lands, and which winter in southern Europe and in Africa. Furthermore, these hordes of regular migrants carry along with them many species, both northern and southern, which otherwise would not wander from their native haunts, and some of which have been detected while pausing on Helgoland. Other causes, apparently, have operated in the case of many species which are breeders in southern and eastern Asia and in North America.

The Pribilofs, on the other hand, lie in the midst of Bering Sea, in an environment essentially Arctic, and not on a migration route which is followed by any considerable number of birds, either those passing between their summer and winter homes in western America or those which habitually cross between America and Asia. Those which do use the islands as a stepping stone are certain waders and swimmers which nest in northwestern Alaska, and winter in the Aleutians, the Pacific Islands, or southeastern Asia. The more notable of this class are the following: *Philacte canagica*, *Limosa lapponica baueri*, *Heteroscelus incanus incanus*, *Pluvialis dominica fulva*, and *Arenaria interpres interpres*.

As regards land birds, however, it is a notable fact that none of the small species of birds which are essentially Asiatic, but which cross each summer to nest in Alaska (including *Budytes flavus alascensis* and *Acanthopneuste borealis*), have been detected on the Pribilofs.

A canvass of the list of birds which have been observed on Helgoland, leaving out those crag-nesting species which are influenced in their choice of homes by the presence of suitable cliffs and an abundant marine food supply, shows that about 283 species nest south of the limit of trees, while only 83, or less than 23 per cent of the total thus considered, are Arctic, nesting north of the tree limit. Applying the same test to Pribilof birds the proportion is exactly 50 per cent in each class. Helgoland has had the advantage of more intensive observations, continued over a much longer period, but since collections and observations in both places have been made indiscriminately it is unlikely that the relative numbers of species nesting above and below the limit of trees would be found to be materially different were the data more comparable in this regard.

It is evident, therefore, that the avifauna of the two places is radically different in character, since we have on Helgoland an overwhelming majority of non-Arctic species, many of which are wanderers from their regular homes in Africa, Asia, or America, while those found on the Pribilofs which may be classed as strays are in all cases natives of the neighboring coasts of Asia and America. Furthermore, those transient land birds which have been detected on the Pribilofs seem to have reached there largely by chance rather than by following any regular migration routes.

FOOD HABITS OF BIRDS.

The notes on food habits of each species and also the following general account of the food resources of Pribilof birds and of the circumstances attending the elaboration of the available data on the subject were prepared by W. L. McAtee:

All pertinent previous reports on Pribilof birds have been examined and remarks on bird food quoted from them when desirable. Field notes of various naturalists who have visited the islands also have been drawn upon and when used the source is acknowledged. The contents of 32 bird stomachs from the Pribilofs were reported on by Dr. S. D. Judd in William Palmer's "Avifauna of the Pribilof Islands" (1899, pp. 380–427). In some cases these stomachs have been reexamined; in others the original report has been referred to. For the present account a considerable collection of stomachs has been available for examination, largely due to the efforts of G. Dallas Hanna.[a]

Features of the food habits of birds of the Pribilofs that seem of sufficient interest to merit special mention are the great diversity of organisms fed upon by some of the birds resorting to the kelp beds, and the unusual preponderance of two-winged flies in the diet of birds feeding on land. In both cases, the phenomenon mentioned undoubtedly is merely a reflection of relative availability of food items. It is well known that Diptera are the dominant insects of high latitudes, and collections made in connection with the present investigation emphasize this fact. They are the most numerous insects both in species and individuals and consequently contribute most voluminously to the subsistence of the chief predatory creatures of the region, namely, birds.

The kelp pastures are the richest sort of feeding places for omnivorous birds, and such species as the eider duck seem to draw on all the inhabitants of these beds for sustenance. Representatives of most of the main branches of the animal kingdom in addition to various kinds of algae are frequently found in single stomachs. The following brief list of the mixed contents of four Pacific eiders will illustrate how the whole range of food items is drawn upon by these birds: Plume-algae (2 species), kelp, hydroids (2 kinds), mussels (3 kinds), sea snails (7 species), marine worms (2 kinds), starfishes, sea urchins, amphipods (2 sorts), hermit crabs (2 species), barnacles, sea-squirt, and sculpin. To some it may be surprising that so varied an assemblage of marine organisms is available in

[a] Most of the stomach contents were analyzed by W. L. McAtee, but numerous stomachs of certain groups of birds were examined by the following: Ira N. Gabrielson, finches; Charles C. Sperry, shorebirds; and Alexander Wetmore, grebes and shoreblrds. Identifications of many items found in the stomachs were based on the collections of invertebrates reported upon in the appendix to the present paper, and to the determiners thereof is due much of the credit for details in the statements relating to bird food. In addition many other specimens were directly referred to specialists for identification. Those who cooperated in this way were: W. A. Setchell, algae; Agnes Chase and F. P. Metcalf, grass seeds; C. C. Nutting, hydroids; W. H. Dall and Paul Bartsch, mollusks; R. C. Osburn, bryozoans; A. H. Clark, starfishes, sea urchins, and ascidians; Mary J. Rathbun, crabs; W. L. Schmitt, other decapods; Clarence L. Shoemaker, amphipods; H. A. Pilsbry, barnacles; S. A. Rohwer, sawflies; Leon J. Cole, pycnogonids; and Alexander Wetmore, birds. To all of these grateful acknowledgment is made.

this far-northern region, and this, too, during the winter months as well as the summer. It would seem that these Boreal kelp beds rival in abundance and diversity of life the famed tide-pools of the Tropics. While the birds frequenting them must necessarily be of hardy races that can endure the cold and buffeting of the wintry gales of the Bering Sea, it is apparent that insufficient and monotonous diet decidedly is not a characteristic of this environment, one usually thought of as extremely rigorous.

Family COLYMBIDAE.

Colymbus holboellii (Reinhardt). HOLBOELL GREBE.

The Holboell grebe was first recorded from the islands by Coues (in Elliott, 1874, unpaged, and 1875, p. 201), who recorded the specimen as *Podiceps griseigena*. This specimen, still in the U. S. National Museum collection (No. 64302 im.), has been correctly identified as *Colymbus holboellii* by Nelson (1887, p. 35) and Palmer (1899, p. 383). It was taken by Elliott at St. George Island, June 22, 1873.

A second specimen (No. 237485, male, U. S. Nat. Mus.) was taken by G. Dallas Hanna at St. Paul Island, December 6, 1914. It was feeding in the surf off Kitovi Rookery when shot.

Food.—The stomach contents of the December specimen was composed of a few feathers, and food items as follows: Otoliths of 40 or more small fishes, further unidentified, 99 per cent; and numerous amphipods of the family Pontogeneidae, 1 per cent.

Colymbus auritus Linnaeus. HORNED GREBE.

The horned grebe was first recorded from the Pribilofs by G. Dallas Hanna, who obtained specimens from both St. Paul and St. George Islands in 1913 and 1914, as recorded by him (1916, p. 401). Following are the records of the several specimens: Female, shot in Cemetery Lake, St. George, October 13, 1913 (stomach contained a quantity of decayed vegetation from bottom of lake); female, in surf, St. George, December 19, 1913 (feet and bill slate color; eye, orange); male, November 30, 1914, Southwest Bay, St. Paul; one (sex not recorded), January 6, 1915, St. Paul. Mr. Hanna states that other single birds were seen in the surf about St. Paul on December 4 and 13, 1914, and in the Salt Lagoon on at least two occasions, and that the natives consider it quite common in winter. All the specimens above listed are in the collection of the U. S. National Museum.

Food.—The contents of the stomachs of the three last mentioned have been analyzed. As in the case of grebes collected elsewhere, the bird's own feathers are a prominent part of the stomach contents,

varying in the samples at hand from 5 to 98 per cent of the entire bulk. Ignoring these, the food in these three stomachs was composed of Crustacea, 75 per cent; marine worms (*Nereis*), 23.3 per cent; and fish, 1.7 per cent. The crustaceans were exclusively amphipods identified as *Chironesimus multiarticulatus* and *Pontogeneia* sp., of the family Pontogeneidae, and others of the families Calliopiidae, Metopidae, and Gammaridae.

Family GAVIIDAE.

Gavia adamsii (Gray). YELLOW-BILLED LOON.

The yellow-billed loon is a transient visitor, first recorded from the islands by C. H. Townsend, who says (1887, p. 98): "I saw a skin of the white-billed loon at the house of the United States Treasury agent on St. Pauls Island. It was killed there by a native in August, 1885." A second specimen was taken by M. C. Marsh on St. Paul, May 18, 1912, and is now in the Biological Survey collection. It is a male, and measured in the flesh: Length, 34 inches; extent, 61. The only other record refers to 10 individuals observed by G. Dallas Hanna off St. George Island, August 18, 1913.

Gavia viridigularis Dwight. GREEN-THROATED LOON.

The green-throated loon was first recorded by Coues in Elliott's Report (1874, unpaged, and 1875, p. 201) under the name *Colymbus arcticus*, from a bird found cast up nearly dead on the beach at Zapadni, St. George Island, June 22, 1873. This specimen, which is still in the collection of the U. S. National Museum (No. 64303, male), has been several times recorded under the name *arcticus*, and has played no small part in the claim of that species to be considered a North American bird. This specimen has been recently examined and found to be referable to the species lately described by Dr. Jonathan Dwight, *Gavia viridigularis* (Auk, 1918, p. 198), as, indeed, was intimated by Dwight in the introduction to his article (p. 196). Another of the two remaining specimens which have been referred to *G. arcticus* (No. 76004, U. S. Nat. Mus., St. Michael, Alaska, August 24, 1877, E. W. Nelson), is also plainly referable to *G. viridigularis*. Both these specimens have a decided green reflection on the dark areas of the throat, when viewed toward the light, while in *G. arcticus* and all its races these areas have a purplish reflection. As far as known *Gavia viridigularis* (type locality, Gichega, northeastern Siberia) is confined to northeastern Siberia and extreme western Alaska.

Family ALCIDÆ.

Lunda cirrhata (Pallas). TUFTED PUFFIN.

The tufted puffin was first recorded specifically from the islands by Coinde (1860, p. 403), although Veniaminof in 1840 (quoted by

Elliott, 1874, unpaged, and 1875, p. 242) mentions puffins as occurring and probably refers in part to the present species.

An abundant summer resident on the Pribilofs, breeding on all the five islands of the group. It arrives about the middle of May and the majority leave the islands by the last of August.

Elliott gives May 10 as about the time of its arrival; the earliest dates I have for recent years are as follows: St. Paul, March 5, 1911, specimen, perhaps wintered (Hahn); St. Paul, May 20, 1911, several seen (Hahn); St. Paul, May 20, 1912, specimen (Hahn); St. Paul, May 19, 1914, eight observed (Hanna); St. Paul, May 15, 1915, three seen, arrivals (Hanna); St. George, May 21, 1917 (Hanna).

The eggs are usually laid in burrows dug by the birds in turfy soil at the edge of cliffs or on the summits of the smaller islands. Numbers nest in easily accessible locations on Walrus Island, Otter Island, and Sealion Rock, where they are safe from the foxes. On the other islands the birds nest among the rocks for protection. Dates for eggs are as follows: Otter Island, June 24, 27, 1884 (Lutz, 1889, p. 31); Sealion Rock, June 29, 1914, some fresh, but mostly heavily incubated (Preble); St. George, July 1, 1914 (Hanna); Walrus Island, July 7, 1911, eggs being incubated (Bent, 1919, p. 83); Otter Island, July 4, 1890; Walrus Island, August 7, 1890, slightly incubated (Palmer, 1899, p. 384). That many birds nest late in the summer is shown by the fact that, as elsewhere mentioned, Hahn observed many young birds taken from nests on Walrus Island as late as October 2.

The bulk of the individuals have left the islands before September. Later notable dates are as follows: St. Paul, early September, 1910, still common (Hahn); Walrus Island, October 2, 1910, about 40 young birds taken from nests by natives, adult and young specimens taken, numerous at sea (Hahn); St. Paul, December 8, 1910, one young bird found dead (Hahn); St. George, September 4, 1913, 150 observed (Hanna); St. George, September 15, 1913, 25 seen (Hanna); St. Paul, September 22, 1914, 75 seen (Hanna); St. Paul, December 6, 1914, 4 seen (Hanna); St. Paul, December 13, 1914, 10 seen (Hanna).

The following notes made by the collectors, and relating to fresh specimens, are of interest: No. 63, Hahn, female adult, St. Paul Island, March 5, 1911: Length, 15½ inches; extent, 27⅜; bill, deep orange on distal half; culmen and cutting edges washed with plumbeous; iris, pinkish; feet, pale flesh-color. No. 187, Marsh, female adult, St. Paul, May 20, 1912, length, 15¼ inches; extent, 27$\frac{11}{16}$. No. 35, Hahn, Walrus Island, October 2, 1910 (young bird with much down remaining on neck and rump): Upper mandible, plumbeous; lower mandible, paler toward tip; eyelids, dusky; feet, dusky gray

above, with web sooty below. No. 36, Hahn, female adult, October 2, 1910, Walrus Island: Length, 15 inches; extent, 29; base of bill horn-color, tip deep orange; iris, yellow; feet, pale orange.

Fratercula corniculata (Naumann). HORNED PUFFIN. Pl. VI, fig. 2.

The horned puffin is an abundant summer resident on the Pribilofs, arriving early in May and usually departing in early September. It seems to be more abundant than the tufted puffin. Puffins were listed by Veniaminof in 1840; among the species occurring on the islands he could hardly have failed to notice this conspicuous one (Trans. by Elliott, 1874, unpaged, and 1875, p. 242). First recorded specifically by Coues, in Elliott (l. c., p. 202).

Arrival notes in recent years are as follows: St. Paul, May 9, 1911, one shot (Hahn); St. George, May 19, 1914, May 9, 1915, 5 observed (Hanna); St. Paul, May 10, 1915, 10 observed (Hanna); St. George, May 21, 1917, observed (Hanna).

The bird nests on all of the five islands of the group, laying its single egg in a cavity among the rocks. The egg is white with obscure spotting about the larger end. Dates for eggs are as follows: St. George, July 4, 1873, Elliott (Palmer, 1899, p. 385); Otter Island, June 19, 20, 24, 26, 30, 1884 (Lutz, 1889, p. 31); St. George, July 1, 1914 (Hanna). The majority leave the islands by early September. Some definite later dates follow: St. Paul Island, September 1, 1910, 25 observed; September 7, 10; September 8, 6; September 9, 10; September 11, 3; October 2, many observed on Walrus Island but less numerous at sea than the tufted puffin; October 18, 1 shot on North Shore; October 19, observed; November 29, about 20 seen off Kitovi Rookery, St. Paul; December 6, specimen (all by Hahn). September 28, 1913, about 500 birds seen about Garden Cove, St. George Island, although most of the birds had then left the cliffs on the north side of the island (Hanna). St. Paul Island, September 22, 1914, 100 birds observed; December 6, 5 observed; December 13, 75 observed, and many found dead on the beach (Hanna).

The following notes were made from fresh specimens; Adult male, St. Paul Island, September 18, 1910, Hahn; length 13¾ inches; extent, 25; eyelids deep orange; eye tuft plumbeous; legs deep orange; bill lemon at base shading to deep orange at tip. Adult female, St. Paul Island, December 6, 1910, Hahn; length, 13 inches; extent, 24¼; bill dusky, feet pearl gray above, dusky below. Male, St. Paul Island, September 23, 1911, length, 13 inches; extent, 25¼; bill uniform light yellowish on all basal portions including collar of upper mandible, the rest or terminal third dark orange-red; the grooves darkened. No vermilion red on the bill; edge of eyelids bright red; angle of mouth lemon-yellow; legs and feet orange, deepest on webs; yellow on outer surface of tarsus and outer toes, and more or less on

all toes. Male, St. George Island, August 23, 1913, Hanna; bill waxy olive-green; light orange in corner of mouth; point of upper mandible dark orange; of lower, light orange; a dark patch at edge of each mandible near tip, darkest on posterior edge.

Food.—The stomach of a specimen collected December 6, 1910, was reported in field notes of W. L. Hahn to contain a few isopods and fragments apparently of seaweed.

Phaleris psittacula (Pallas). Paroquet Auklet Pl. VI, fig. 1.

The paroquet auklet, a beautiful and interesting species, the "Baillie Brushkie" of the Aleuts, is a rather common summer resident on the Pribilofs. It appears to have been first recorded from the islands by Veniaminof in 1840 under the name "white-breasted auk" (Trans. by Elliott, 1874, unpaged, and 1875, p. 242).

Spring records follow: St. Paul Island, May 1 and 2, 1900 (common, notes from island log by Hahn); St. Paul Island, May 1, 1911, some taken by natives (Hahn); St. Paul Island, April 30, 1912 (specimen by Marsh); St. George Island, March 28, 1914, 8 observed; April 3, observed; April 8, 20 observed; April 19, begun lighting on cliffs; April 22, 20 observed (Hanna); April 24, 1915, 300 on Tolstoi Cliffs, St. Paul Island; April 27, 500 on Tolstoi Cliffs; May 4 and 9, abundant (Hanna).

It breeds on all the five islands of the group, most abundantly on St. George and St. Paul Islands, in large numbers on Otter Island, rather commonly at times on Walrus Island, and in small numbers even on Sea Lion Rock. Its single white egg, seemingly large for the bird, is usually laid beneath large bowlders or in practically inaccessible cavities in the cliffs; in some cases the egg is deposited in a burrow apparently excavated in the loose soil topping the volcanic cliffs. Dates for eggs follow: St. George Island, July 1, 1873; Walrus Island, June 13, 1890 (egg collection, U. S. Nat. Mus.); Otter Island, June 20, 23, 1884 (Lutz, 1889, p. 31); St. George Island, July 1, 1914 (Hanna); Pribilof Islands, June 8, July 7, July 16 (Bent, 1919, p. 120).

Autumn and winter dates follow: Elliott (1875, p. 205) states that they depart from the islands between August 20 and September 1, and this statement seems to be generally true. Later detailed observations are: St. Paul, 1910: August 30, specimen; August 31; September 7, one observed; October 2, several seen on way to Walrus Island; November 7, specimen (Hahn). St. George August 20, 1913, not seen later (Hanna). St. Paul, 1914: October 4, 4 observed; December 4, 20 seen; December 13, 200 seen, flocks abundant offshore, many dead on beach (Hanna). St. Paul, February 18, 1915, large flocks just off-shore, Northeast Point (Hanna). St. George, February 6, 1917, 2 killed (Hanna).

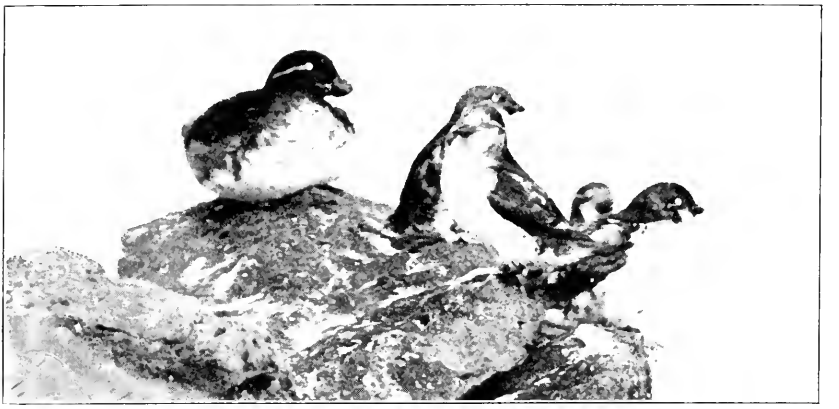


FIG. 1.—PAROQUET AUKLET (PHALERIS PSITTACULA) AND GROUP OF LEAST AUKLETS (AETHIA PUSILLA).

Many of the breeding birds associate closely. Photograph by G. Dallas Hanna, summer, 1920, on St. George Island.

FIG. 2.—HORNED PUFFIN (FRATERCULA CORNICULATA).

These interesting birds nest chiefly in clefts among the rocks. Photograph by G. Dallas Hanna, on St. George Island.

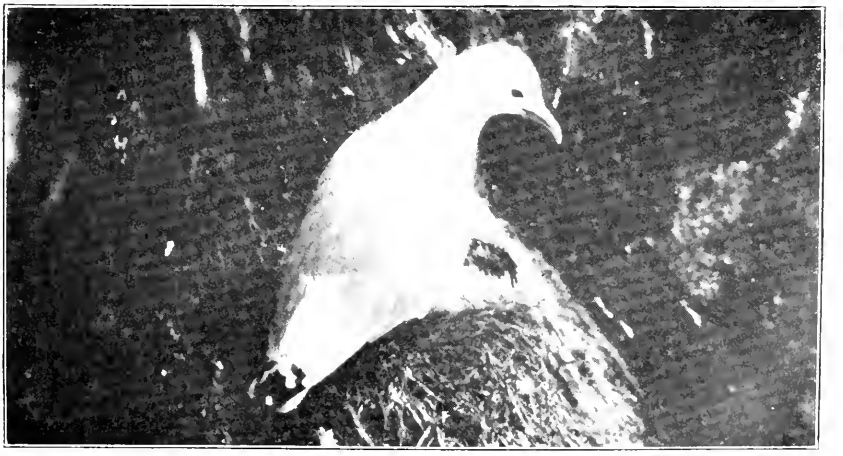


FIG. 3.—PACIFIC KITTIWAKE (RISSA TRIDACTYLA POLLICARIS) ON NESTING CLIFF.

This is the most abundant of the two species of kittiwakes. Photograph by G. Dallas Hanna, on St. George Island.

The species thus winters at sea in the vicinity of the islands, and thence southward to the latitude of Monterey Bay, Calif., and the Kurile Islands, Japan.

A female taken on St. Paul Island, May 20, 1911 (Hanna), measured in the flesh: Length, 10 inches, extent 21; the bill was blood orange in color; feet and tarsus, bluish in front, dusky behind. A male, taken April 30, 1912, measured: Length, 10⅜ inches, extent, 21; bill, coral red, rostral shield darker. A female, same place and date, length, 9⅞ inches, extent 20½; bill coral red.

Food.—H. W. Elliott stated (1874, unpaged, and 1875, p. 205) that the food of the paroquet auklet consists of amphipods and fish fry. He says further that "I have never seen one among the thousands that were around me when on the islands 'opening' the bivalve shells, such as mussels, etc., as stated by Professor Brandt." The suggestion of the latter author no doubt was a deduction from the shape of the bill of the paroquet auklet, but with little doubt is erroneous. The only stomach of this species available was collected at St. Matthews Island, July 12, 1916 (G. D. Hanna), and the content consisted entirely of remains of small Crustacea.

Aethia cristatella (Pallas). CRESTED AUKLET.

The crested auklet is a fairly common summer resident on the Pribilof Group, nesting on all the five islands excepting Sealion Rock. It usually comes on the cliffs in April or earlier, but this date is uncertain and difficult to determine, since large numbers pass the winter on the ocean in the vicinity and are likely to be seen in the surf at any time. It is called by the natives "Canooskie" (Little Captain). The species was first recorded from the islands by Veniaminof in 1840, under the name crested auk. (Trans. by Elliott, 1874, unpaged, and 1875, p. 242.)

Available spring records of occurrence later than February are as follows: St. Paul Island, April 5, 1901, a few brought in; St. Paul, April 10, 1906, some shot (notes taken from island log by W. L. Hahn); April 30, 1911, 5 or 6 shot by natives at Tolstoi Point, St. Paul (Hahn); St. Paul, March 12, 16, 18, 1912, specimens (Marsh); St. George, April 8, 1914, thousands observed (Hanna); St. Paul, 1915—April 15, hundreds; April 18, many near shore; April 24, 40 seen; April 27, 30 seen; May 6, abundant (Hanna).

This species usually nests about the high cliffs, the single white egg being deposited in a deep and usually inaccessible recess; occasionally the birds lay in the depths of the bowlder beaches. Eggs have been taken on the following dates: St. George Island, June 19, 20, and July 4, 1873; St. Paul Island, July 10, 1895 (collection U. S. Nat. Mus.); Otter Island, June 20, 22, 1884 (Lutz, 1889, p. 31); Walrus Island, June 16, 1910 (James Judge).

Notes on fall and winter occurrence follow: St. Paul Island, January 31, 1904, and December 6, 1909, numbers seen (notes from island log). St. George, vast numbers seen about end of November, 1905 (Chichester, 1908, p. 49). St. Paul, 1910—probably 5,000 seen at sea November 8, usually flying at great speed close to the water; many seen at sea November 9, 22, and 29, off St. Paul (Hahn). A great many flocks of hundreds each seen about 1 mile off St. George January 4, 1914 (Hanna). Hundreds of thousands seen off St. Paul December 13, 1914, and February 18 and March 5, 1915 (Hanna). Taken on St. George, October 18 and 29, 1915 (H. P. Adams). Abundant at edge of ice pack off St. George, January 25, 1917 (Hanna). Some killed at sea near St. Paul, February 8, 1918 (Hanna).

These flocks wintering at sea are observed well into the spring. Thus Hanna noted them off St. George Island March 21 and April 8, 1914.

On several occasions numbers of the birds have been found dead on the beaches, usually in the early summer. These may represent merely the normal mortality from the large flocks which winter in the vicinity.

G. Dallas Hanna, who has had exceptional opportunities for observing this species, thinks that great numbers of crested auklets move northward in winter from their principal breeding grounds south of Bering Sea, and that this accounts for the immense numbers sometimes seen at this season, when they are much more abundant than in summer. He states:

> This species evidently winters not far to the south of the Pribilof Islands, since after a severe storm from this quarter in winter the birds are almost always seen in small numbers and occasionally in enormous flocks, as in February, 1915, off St. Paul, and January, 1917, off St. George. At these times the birds gather on the water as closely as they can sit, and on both of the above occasions some flocks of the birds covered as much as 5 acres. This is a conservative statement, as applied to the larger flocks, as the areas were carefully estimated. At the same time there were many smaller flocks in the vicinity. The presence of drift ice does not prevent them from appearing after a blow; they then gather in the open spaces in their customary manner. (MS. notes, 1920.)

The flesh measurements of a number of specimens, recorded by M. C. Marsh, range as follows: Length, 9 to $10\frac{1}{4}$ inches; extent, $18\frac{5}{8}$ to $19\frac{11}{16}$. No appreciable sexual difference in size is apparent. A male (No. 104, M. C. Marsh) taken on St. Paul Island December 5, 1911, measured: Length, 10 inches; extent, 19. Notes on the colors of the soft parts follow: Iris with a ring of pale green within yellow, finally bordered by a black circle on the edge of sclerotic; legs and feet pale bluish, blackish behind, the web dusky in front; bill plain brown, lighter underneath.

A summer female (No. 349, Hanna) taken on St. George August 22, 1913, had the bill lead color at the tip, brown at base; iris white; feet and toes slate; webs, black.

Food.—Seven well-filled stomachs of crested auklets from the Pribilofs contained only amphipods, identified as *Parathemisto oblivia* in five cases and as *Socarnea vahli* in one. Another nearly empty stomach contained only two bits of kelp. Six of the stomachs holding amphipods were collected in midwinter, and the following note by G. Dallas Hanna is of interest as indicating the depth to which the birds must descend at that season to secure their staple food:

> On several occasions I have been on fishing parties out among these birds and twice we pulled up codfish which had in their stomachs in one case one, and in the other case two, birds of this species. As the cod is a bottom feeder it seems evident that the birds descend to 30 fathoms, the depth of the water at the localities concerned. I believe it is customary for most of the diving birds to feed on the bottom, because I have been unable to secure amphipods at intermediate depths in the winter time. In summer, however, the crustaceans come nearer the surface and are more easily secured.

Aethia pusilla (Pallas). LEAST AUKLET. Pl. VI, fig. 1.

The least auklet, the "Choochkie" of the natives, is excessively abundant on the Pribilofs during the breeding season, being present in countless thousands, probably millions. Palmer estimated their numbers as equaling the sum of all the other species. They breed on all the islands, but most abundantly on St. George, where an immense colony occupies the base and slopes of a high hill, Ulekiah, which rises near the center of the island. Elsewhere they nest in the cliffs and bowlder beaches throughout practically the entire coast line of the different islands. The species was first recorded from the islands by Coinde (1860, p. 403).

Apparently the birds resort to land only to breed. A few winter at sea about the Pribilofs, and these flocks are augmented in spring by the arrival of the myriads which have wintered to the southward. A few days after their appearance offshore they begin to alight on the cliffs and bowlder beaches, and soon become abundant on their breeding grounds.

Since these birds form an important and welcome addition to the spring food supply of the natives, their arrival is eagerly awaited, and many notes on spring arrival have been recorded. The following, referring to St. Paul Island, were taken from the island log by W. L. Hahn: April 30, 1886, arrival; April 25, 1889, arrival; April 18, 1899, arrival; April 28, 1900, small numbers; May 1 and 2, common; April 24, 1901, arrival; April 25, numerous; April 18, 1902, arrival; April 23, 1903, arrival; April 13, 1904, arrival; April 19, 1906, seen at sea; May 2, 1908, arrival; April 26, 1909, arrival; May 10, 1910, first seen flying over the land. Notes during recent years

are: St. Paul Island, 1911—April 18, arrival; April 27, about 100 seen; April 28, first seen flying over land; May 9, many thousands (Hahn). St. George Island, 1914—April 8, about 250 seen, first date when observed in numbers, though a few had been about all winter; April 14, upwards of 10,000 seen, small numbers flying over land and large flocks along beach (Hanna). St. Paul Island, 1915—March 30, flocks flew along nesting ground; April 15, flocks near shore; April 24, 27, thousands; May 6, abundant (Hanna). St. George, 1916—April 16, seen at sea; April 25, seen on land; 1917—April 17, offshore; April 23, on rocks (H. P. Adams). St. Paul, 1918—April 10, near shore; April 14, large flocks over bowlder beaches (Hanna).

Eggs are usually laid in June; dates of collection follow: Otter Island, June 14, 17, 1884 (Lutz, 1889, p. 31). St. George, May 28, 1890; St. Paul, June 5, 1890 (Palmer, 1899, p. 388). St. George, May 24, June 8, 1913, June 16, 1914 (eggs well incubated) (Hanna). St. Paul, July 2, 1914 (Preble). St. George, June 5, 1916, eggs secured (H. P. Adams).

After the close of the nesting season in July the species rapidly becomes scarce about the shores of the islands. Hahn's observations in 1910 show records as follows: August 30, about 300 seen; August 31, 50; September 1, 8; September 10, 1; September 11, 1; October 2, none seen on St. Paul for some time, but still numerous at sea. In 1913, on St. George Island, Hanna saw none about the land later than August 20. In 1914, on St. Paul, I noted them only in small numbers during August, observing a few, however, almost daily up to the time of my departure on August 30, these late lingerers being probably the late hatched birds. After my departure Hanna recorded 6 observed on October 4, 1,000 on December 4, and 500 on December 13. H. P. Adams, in 1916, saw the last about St. George on August 28, and observed it at sea March 26, 1917. Hanna saw one off St. George January 25, 1917.

Numerous specimens taken by Hahn and Marsh in 1911 and 1912 measured in the flesh: Length, $6\frac{3}{8}$ to $7\frac{1}{2}$ inches; extent, $12\frac{3}{4}$ to $13\frac{5}{16}$.

Food.—The only information we have on the food of the least auklet is H. W. Elliott's credible statement (1875, p. 209) that "they feed on water shrimps and sea fleas."

Synthliboramphus antiquus (Gmelin). Ancient Murrelet.

The ancient murrelet was first recorded from the Pribilofs by W. H. Dall (Dall and Bannister, 1869, p. 310), who recorded it as "common at St. George." No specimens were taken at that time, and no further particulars as to the basis of the record are available. The first specimen was taken by W. L. Hahn on St. Paul Island, November 7, 1910; this is now in the collection of the Biological Survey. It measured in the flesh: Length, 10 inches; extent, $16\frac{5}{8}$.

Hanna observed three at St. Paul on December 4, 1914, and took a specimen there on April 18, 1918; another specimen, a female, taken on St. George Island, May 12, 1916, was sent in by Dr. H. P. Adams. Both of these are now in the collection of the U. S. National Museum.

Food.—The stomach of the April specimen above mentioned contained remains of more than 800 amphipods (*Pontogeneia inermis*).

Brachyramphus marmoratus (Gmelin). MARBLED MURRELET.

The marbled murrelet was first recorded from the Pribilofs by Hanna (1919a, p. 176, and 1920a, p. 251), on the basis of a specimen taken by him on St. Paul Island January 13, 1918. It is now No. 255110 of the collection of the U. S. National Museum.

Food.—The stomach of this specimen was about half filled with ground-up amphipods. These constituted 100 per cent of the food, a bit of hydroid present being much less than 1 per cent.

Cepphus columba Pallas. PIGEON GUILLEMOT.

The pigeon guillemot was first recorded from the Pribilofs by Nelson, who states "they nest on the fur seal islands" (1887, p. 45). This statement was based on conjecture, from his having observed the birds under the cliffs of St. George Island. Palmer found the birds quite common, but very shy, on the ocean to the southward of Walrus Island, on June 13, 1890 (1899, p. 389).

Hanna has published the following note, based on his observation of the species (1916, p. 402):

> This is a common winter resident, and by April 18, 1915, some had the black summer plumage almost complete though still slightly speckled with white. It is strange that this bird should not breed on the Pribilofs, since it is so abundant on the neighboring Aleutians. The last one seen in 1915 was on May 26. In winter it feeds along the surf line, is very tame, and utters a low, shrill whistle when observed. A male and a female were taken on each island. The species has been previously recorded from the islands, but apparently no specimens were secured prior to my work there.

His detailed notes taken on St. Paul Island, follow: 1914—December 2, 8 seen; December 9, 1; December 4, 6, and 13, about 200 seen each day. 1915—February 18, 200 seen at Northeast Point; April 6, 1; April 18, 12; May 10, 2; May 18, 2; May 26, 1.

According to his field catalogue, M. C. Marsh collected a male of this species on St. Paul Island, January 6, 1912, and made the following notes: Length, 13 inches; extent, 23. Legs and feet orange red in front, somewhat darker behind; tarsus black behind; claws black; mouth vermilion; iris brown.

Hanna, during 1913 to 1915, observed the species on a number of occasions, as follows: St. George Island, 1913—December 19 and 30. St. Paul Island, 1914, December 2, 8 seen; December 9, 1; December

4, 6, and 13, about 200 seen each day; 1915—February 18, about 200 seen at Northeast Point. During the same spring the species was noted as follows: April 6, 1; April 18, 12; May 10, 2; May 18, 2; May 26, 1. Single specimens, now in the U. S. National Museum, were collected by Hanna on the following dates; St. George Island, December 19 and 30, 1913; St. Paul Island, December 6, 1914; April 18, 1915. The specimen last mentioned has nearly finished acquiring the summer plumage, though the underparts are still speckled with white. H. P. Adams noted the species on St. George, February 4, 1917, and Hanna on January 24, 1917.

Food.—Of the seven stomachs of the pigeon guillemot from the Pribilof Islands only five were well-filled, and these contained the following food items: Amphipods, 56.8 per cent; hermit and spider crabs, 20.8 per cent; isopods, 17.2 per cent; fish, 4 per cent; kelp, 1 per cent; and univalves, 0.2 per cent. The amphipods were identified as *Allorchestes malleolus* and the isopods as *Idothea ochotensis*. The spider crab was *Lithodes brevipes*, and the hermit crabs include two species—*Hapalogaster grebnitzkii* and *Dermaturus mandtii*. No fewer than 13 of the last-named species had been eaten by one bird. The fact that almost no univalve fragments were present in the stomachs of birds eating so many hermit crabs shows that the crabs are either pulled from the empty shells they use for homes or are caught while transferring from one shell to another, a thing they frequently do. The fish remains in the present series of stomachs were unidentified, and the miscellaneous items of small importance, mostly contained in a single nearly empty stomach, were remains of marine worms, a pycnogonid or sea spider, and bits of kelp.

Uria troille californica (H. Bryant). California Murre.

The California murre is the less abundant of the two species breeding on the Pribilofs, occurring in some numbers among the nesting colonies of the Pallas murre in practically all the sites on the islands, excepting Sealion Rock, and in some cases occupying extensive areas to the exclusion of the larger species. It was first recorded from the Pribilofs by Elliott (1874, unpaged, and 1875, p. 210).

It is difficult to fix even the approximate date of spring arrival on the Pribilofs, since most observers have failed to distinguish the two species, and the case is further complicated by the fact that both species occur in some numbers during the winter. The birds usually begin perching on the cliffs, probably indicating an awakening breeding interest, in late April or early May.

The bird breeds on all the islands of the group excepting Sealion Rock (Hanna, 1920b, p. 175). Mr. Hanna states that on St. Paul this species nests principally at Southwest Point, and on the high

cliffs on the western side of the island, among the colonies of the more numerous Pallas murre, but that it is not found among the extensive murre rookeries on Reef or Kitovi; this is in agreement with my own observations as far as they extend. It nests in great numbers on Walrus Island, usually apart from the other species. This circumstance has caused different visitors, judging from hurried observation covering only parts of the rock, to believe that the murre rookeries there consisted mainly of one or the other species. Palmer, however, in 1890, made two trips to the rock, and noted the Pallas murre exclusively on the western and northern parts of the island, and the present species on its southeastern part. During my own visit there on July 16, 1914, I noted that the breeding colonies on the higher central part of the island were principally of the present species. Further detailed observations are needed to show the proportionate numbers and the breeding areas of the two species on Walrus Island, and these may vary in different years.

The first eggs are laid in early June, and owing to various causes eggs still being incubated may be found until near the end of July; at the time of our visit there on July 16, 1914, young birds and eggs seemed about equally numerous. Eggs were taken on Otter Island, June 13, 1884 (Lutz, 1889, p. 31).

The birds leave the breeding rookeries in late August but continue about the islands during the autumn and winter, being by far the more common of the two species at that season, and being called the winter arrie by the natives, many of whom think it is found only at that season. Winter specimens in the collections of the Biological Survey and U. S. National Museum include the following: St. George Island, male, December 21, 1913; male, December 30, 1913; St. Paul Island, December 6, 1914. The species seems usually to be seen only in small companies during the winter. However, on February 18, 1915, Hanna observed upwards of 1,000 about St. Paul. He also found the birds abundant at the edge of the ice-pack off St. George, January 25, 1917.

Food.—Eighteen stomachs of the California murre from the Pribilofs, mostly taken in winter, have been examined. Of these only 12 were well filled and the contents of these were almost exclusively amphipods. The kind most frequently identified was *Pontogeneia* sp.; *Anonyx nugax*, *Allorchestes ochotensis*, *Hyale* sp., *Jassa* sp., and *Metopa* sp. occurring in smaller numbers. One of the well-filled murre's stomachs contained remains of 20 or more marine worms of the family Nereidae, and two of them held isopods (*Idothea ochotensis*). The nearly empty stomachs, which experience has shown do not as a rule fairly represent normal food habits, yielded remains of small sculpins (Cottidae), bits of barnacles, mollusks (in-

cluding *Aegobuccinum oregonense*), and hydroids; and the following vegetable matter: Algae, and glumes of grasses (*Phleum alpinum* and *Festuca ovina* var. *violacea*).

Uria lomvia arra (Pallas). PALLAS MURRE.

The Pallas murre is a very abundant species, the more numerous of the two murres, and nests on all the islands of the Pribilof group. It was apparently first definitely recorded by Dall (Dall and Bannister, 1869, p. 309), though Veniaminof (Trans. by Elliott, 1874, unpaged, and 1875, p. 242), in referring to "arries" as occurring, referred, of course, to this species as well as to the California murre.

Since the species winters in small numbers about the Pribilofs it is impossible to give definitely its usual date of arrival or departure, especially since the two species are difficult to distinguish at a little distance. The following notes taken by Hanna in 1915 on St. Paul Island evidently refer to spring arrival of this species on the nesting cliffs: April 15, 150 killed by natives, hundreds reported on the cliffs at Southwest Point; April 26, 100 killed in same place; May 6, fairly common. On St. George, in 1917, Hanna noted the first of the season on April 20.

The Pallas murre is the more numerous of the two species on all the nesting rookeries. Egg laying begins in early June. James Judge (MS. report) states that two arrie eggs were found on Walrus Island on June 1, 1889, and that the birds had not begun to lay at the same place on June 8, 1904; on June 16, 1910, 932 fresh eggs were found at the same place; on June 21, 1909 (St. Paul Island log) about 6,000 eggs were obtained by the natives at the same place. (These notes may refer in part to the California murre.) Definitely identified eggs of the present species were taken as follows: St. George, June 27, July 1, 1873; St. Paul, July 31, 1890 (Catalogue eggs, U. S. Nat. Mus.); Otter Island, June 13, 30, 1884 (Lutz, 1889, p. 31); Walrus Island, June 13, 1890 (Palmer, 1889, p. 391); St. George, July 1, 1914 (18 eggs in collection U. S. Nat. Mus. selected from 100, to show variation in color, by G. Dallas Hanna).

By the end of August most of the birds have left the breeding rookeries; at this time many late-hatched young are deserted and soon perish, the desire of the mother to accompany the departing flocks evidently being stronger than the parental instinct. Hanna states that on August 31, 1913, most of the murres had gone, and that many young ones were falling from the cliffs.

A few are observed about the island during the autumn and winter; Hanna's notes for 1914 record 2 observed on October 4, 3 on December 4, and 3 dead ones seen December 13. As is the case with several others of the more abundant species, dead ones are frequently observed in large numbers. Notes taken from the St. Paul Island

log by W. L. Hahn include the following entries in the autumn of 1900: October 25, hundreds of sick young ones; November 2, hundreds of dead birds; November 10, at least 5,000 dead on the shores of the lagoon; November 24, both sides of Northeast Point covered with dead ones.

A female specimen taken by M. C. Marsh, February 5, 1912, measured in the flesh: Length, 15½ inches; extent, 28½; bill jet-black, excepting the border of light yellow at base of the upper mandible and the pale tip; legs and feet black posteriorly, dusky and dark yellow anteriorly.

Food.—If the relatively small number of stomachs available can be taken as a criterion, the food of the Pallas murre in the Pribilof region differs markedly from that of the California murre. Of six stomachs examined, four were well-filled, and the food in them consisted of fish remains, 48.75 per cent; flesh and mandibles of squids, 26.25 per cent; and crustaceans, 25 per cent. The nearly empty stomachs also contained fish and squid remains. The crustaceans which completely filled one stomach were shrimps identified as *Spirontocaris polaris.*

Family STERCORARIIDAE.

Coprotheres pomarinus (Temminck).[4] Pomarine Jaeger.

The Pomarine jaeger is a somewhat rare visitor. It was first obtained by Elliott, who took a specimen on the uplands between Kaminista Lake and Polovina, on St. Paul (Elliott, 1874, unpaged, and 1875, p. 196). This is No. 62522, female adult, U. S. National Museum, June 23, 1872. Another specimen (No. 106857, male, June 16, 1885) was obtained and reported by C. H. Townsend (1887, p 98).

Palmer (1899, p. 393) states: "During the summer of 1890 two were seen on St. George eating the carcass of a fur seal. One of these was killed and preserved by Mr. Ed. Lavender." The final disposition of this specimen is not known. Two specimens, a male and a female, were taken by H. J. Christoffers on St. Paul Island, June 10, 1916. These are now in the collection of the U. S. National Museum.

Stercorarius parasiticus (Linnaeus). Parasitic Jaeger.

The parasitic jaeger was first added to the fauna of the islands by Elliott, who mentions seeing four or five individuals (1874, unpaged, and 1875, p. 197). A specimen taken by him, a female in the dark phase of coloration, collected June 15, 1872, is No. 62524, of the bird collection of the U. S. National Museum. This constituted

[4] *Stercorarius pomarinus* of the A. O. U. check list, 1910.

the only record until 1914, when G. D. Hanna on September 24 took a dark male bird on St. Paul Island, now No. 237495, U. S. National Museum. Hanna observed another individual, also a dark-colored one, on June 14, 1915, on the same island.

Food.—The stomach of the September specimen taken by Hanna was filled with finely ground remains of small fishes. The grinding material it contained was three lumps of an old bryozoan colony.

Stercorarius longicaudus Vieillot. LONG-TAILED JAEGER.

Judging by the records the long-tailed jaeger is the most frequently observed of the three jaegers, and we may perhaps credit Veniaminof (Trans. by Elliott, 1874 unpaged, and 1875, p. 242) with first having observed it, since he records "jaegers" as one of the species occurring on the Pribilof Islands. Elliott took one June 13, 1872, which has been several times recorded, and is still in the collection of the U. S. National Museum. Though thus early noted, the species appears not to have been afterwards observed until recent years. Hanna shot one on St. George, May 23, 1914. This was a male which had a string about the right foot, showing previous capture. Later in the same summer Mr. Hanna and the writer observed a number on both islands. We saw it daily on St. George, July 12, 13, and 14, noting as many as 7 on the two latter dates, and taking a specimen on the 14th; I noted one near Kaminista Lake, St. Paul, on July 29. The next year, on May 27, Hanna took a specimen on St. Paul.

None of the jaegers are known to have bred on the Pribilofs nor to have remained through the breeding season, although the conditions there would seem to be favorable for nesting.

Food.—Five stomachs of the long-tailed jaeger collected on the Pribilof Islands are at hand, of which four are well filled, three of them with insects, and one with the remains of eggshell and an unhatched young of a deep-water duck (Fuligulinae). One of the stomachs containing insects held more than 90 individuals of 4 species. The most numerous species was the large gold and green ground beetle *Carabus truncaticollis*, of which one stomach contained 58, including one larva. Other ground beetles eaten were *Pterostichus pinguidineus*, *Pterostichus* sp., and *Amara brunnipennis*. One stomach contained 3 of the rather large yellow and brown moths (*Hyphoraia subnebulosa*), one a crane-fly (*Tipula* sp.) with eggs, one two flesh-flies (*Cynomyia hirta*) and 16 larvae of this or an allied species, and another a small parasitic wasp (*Amblyteles* sp.). A bit of fish bone was in one of the well-filled stomachs and a nearly empty stomach contained a single sawfly (*Amauronematus*, probably of the species *whitneyi*, described from material in the present collections).

Elliott (1874, unpaged, and 1875, p. 198) states that two individuals seen by him on July 29, 1872, [on St. Paul] were apparently feeding upon insects, and upon a small black berry (*Empetrum nigrum*).

Family LARIDAE.

Pagophila alba (Gunnerus). IVORY GULL.

An ivory gull obtained by True and Prentiss in 1895 was first recorded by Palmer (1899, p. 395). Concerning it, Prentiss (1902, p. 99) says: "One was killed by the natives on St. Paul in February or March, 1895, and prepared by Mrs. Judge, from whom I obtained it. It was not previously known from the Islands." Other specimens were taken on St. George Island by A. H. Proctor on February 18, 1916, and by G. Dallas Hanna on March 27, 1917. All these specimens are in the collection of the U. S. National Museum.

Rissa tridactyla pollicaris Ridgway. PACIFIC KITTIWAKE. Pl. VI. fig. 3.

Rissa tridactylus pollicaris Ridgway, Water Birds North Amer., vol. 2, p. 202, 1884. (Type from St. George Island.)

The Pacific, or western black-legged, kittiwake is very abundant on the Pribilofs, nesting on the cliffs of all five islands of the group, and remaining in small numbers during the autumn and early winter. The species was first recorded from the islands by Coinde (1860, p. 401), and has been observed by all later students of the avifauna. It is eaten in large numbers by the natives.

The following notes on spring arrival are the only definite ones at hand: St. Paul Island, 1909, first reported April 20; hundreds May 1 (St. Paul Island log, fide Hahn). St. Paul Island, 1911, 2 seen, April 24; many shot, April 30 (Hahn). St. George Island, 1914, 2 seen April 8; 10 seen April 22 (Hanna). St. Paul Island, 1915, May 18, 40 killed at Northeast Point; May 28, abundant (Hanna). St. George, April 16, 1917 (Hanna).

The nests are built of grass and moss, with some mud, and are placed on small platforms on the faces of cliffs. The following dates will show the period of nesting: St. Paul, July 3, 1879; St. George, June 24, 1873 (catalogue eggs, U. S. Nat. Mus.). Otter Island, June 21, 1884, eggs taken (Lutz, 1889, p. 31). Palmer (1899, p. 396) gives the following pertinent data: St. George, May 28, 1890, a few nests, but no eggs; Walrus Island, June 8, 1889, two eggs collected by C. H. Townsend; St. Paul Island, August 2, 1890, most nests with young, but a few had a young one and an egg, or sometimes two or three eggs. In 1914, on St. George Island, Hanna noted that on July 1 the nests were being completed, and a few had eggs. During the same season, the writer found a few nests with eggs on Sealion Rock, on June 29, and saw many nests on Walrus Island on July 16,

and on Otter Island, July 27. Bent (1921, p. 49) gives 13 records for eggs on the Pribilofs from June 10 to July 7; of these, 7 records fell between June 25 and July 3.

Hahn recorded this species as common on St. Paul Island during September and October, 1910, and saw quite a number in November. He saw 12 on December 8, and noted it as numerous December 21 of the same year, and saw 6 individuals on January 4, 1911. Hanna, on St. Paul Island, during the autumn of 1914, observed the species as follows: September 14, 40; September 16, 10; September 20, 2; September 22, 100; October 4, 25; October 12, 3.

A female specimen taken by W. L. Hahn, August 31, 1910, measured in the flesh: Length, 15⅞ inches; extent, 39.

Food.—Three stomachs of St. Paul specimens of the Pacific kittiwake (taken in July and August) have been examined but yield meager data on the food habits of the species. One, very well filled, contained fish flesh, with no bones, and therefore not identifiable, another held fragments of Crustacea, also unidentifiable, and the third only vegetable débris, evidently algae. A more valuable stomach content collected at St. Matthews Island, July 12, 1916, by G. Dallas Hanna, contained Crustacea exclusively: A spider crab, Lithodidae, 50 per cent; and isopods, including *Idothea ochotensis*, 50 per cent.

Regarding the kittiwakes Mr. Hanna says:

> They both occasionally eat small fishes which come near the surface of the sea. At such times they dive down like a tern for their prey. They also eat the refuse from freshly cleaned fish which may be thrown into the sea, but I have never seen one eat carrion.

However, the record above of fish flesh without bones is very suggestive that carrion sometimes is eaten.

Rissa brevirostris (Bruch). Red-legged Kittiwake.

The red-legged kittiwake, an exceedingly beautiful species, the "Goverooskie" of the natives, is much less abundant than its congener, but is nevertheless found in large numbers. It breeds on all the islands excepting Sealion Rock, and appears to leave the neighborhood of the Pribilofs in September, to remain until April. It is a favorite article of food of the natives, being more esteemed than the black-legged species. It was first credited to the islands by Coinde, who supposed it to be an undescribed species, and named it *Larus warnecki* (1860, p. 401).

Hahn noted that many were shot on St. Paul Island on April 30, 1911. All the rest of the available notes on spring arrival are by Hanna. On St. George Island, in 1914, he observed 4 on April 8, 50 on April 22, and upwards of 1,000 on May 6. His notes for 1915, on St. Paul Island, are as follows: April 18, 20 individuals observed; April

24, 6; April 26, 81 killed by natives at Southwest Point; May 4, 30 observed, abundant at Southwest Point; May 18, 100 observed at Northeast Point; May 28, abundant. In 1917, on St. George, he noted the first on April 22.

The red-legged kittiwake nests among the colonies of its more numerous relative. Prentiss (1902, p. 99) makes the following statement regarding its detailed distribution on St. Paul Island, from observations made in the summer of 1895:

> The distribution of the red-leg on the island of St. Paul differs from that of the black-leg. Around the village and the southeast portion of the island the red-leg is comparatively rare, while at Half-way Point on the east side of the island, there is a marked increase in numbers. At the southwestern portion they form nearly one-half of the kittiwakes. * * * On the north side of St. Paul they were numerous, and also on the beach at Zapadnie.

Palmer (1899, p. 398) gives the measurements of eggs taken on St. George Island, by Elliott, June 25, 1872. Lutz (1889, p. 31) records an egg taken on Otter Island, June 29, 1884. The catalog of eggs in the U. S. National Museum notes eggs taken on St. Paul, July 15, 1895. Hanna took eggs on St. George Island, July 3, 1914. On August 31, he observed young still in the nest; on September 11, the young were all on the wing. This apparently was the signal for the departure of the species. On September 14, he records seeing 12 individuals; on the 16th, 4, and on the 22d, 10. These were the last seen that season. I find no winter records.

Food.—Fifteen stomachs of the red-legged kittiwake from St. George Island have been examined, eight of them being half or more full and seven nearly empty. Of the food in the former, 25 per cent consisted of squid remains, 37.5 per cent of fish, and 37.5 per cent of Crustacea. The Crustacea were small shrimplike forms, chiefly of the genus *Thysanöessa*, and were present to the number of several hundred in each of two stomachs. All of the nearly empty stomachs contained squid mandibles.

Larus hyperboreus hyperboreus Gunnerus. GLAUCOUS GULL.

The glaucous gull breeds in small numbers on the grassy summit of Walrus Island, among a large colony of glaucous-winged gulls, and during the summer season may occasionally be observed on the other larger islands. It is found in larger numbers during the fall, and Hanna (1917, p. 407) states that in winter it is the only large gull found on the Pribilofs, having replaced entirely the glaucous-winged gull with which it has been associated.

The species was first recorded by Palmer (1899, p. 395) under the name *Larus barrovianus*. A specimen taken by him there on June 13, 1890, has recently been referred by Oberholser, as a result of a critical study of the group, to the typical form (1918, p. 471).

On the occasion of my visit to Walrus Island on July 16, 1914, a few glaucous gulls, about 15 pairs, were found to be nesting on the extreme grassy summit of the island. At this time most of the nests contained well-grown young. No specimens were collected, and owing to the brief time we could stay on the island, no detailed study could be made of this or any particular species.

Hanna observed the glaucous gull on St. Paul Island, as follows: 1914, September 14, 1; September 16, 5; September 20, 1; October 12, 1; October 25, 20; November 27, 10; December 13, 4. 1915: February 18, 25; March 5, 2; March 18, 300; April 2, 1; April 24, 10; May 4, 30; May 28, 15.

The species evidently was common about St. George Island in the spring of 1917, since Hanna sent in the stomachs of nine birds taken on April 12.

Food.—Nine stomachs of glaucous gulls from St. George Island and one from St. Matthew Island, all well filled, were available for the present study. They reveal that this species shares the well-known propensity of gulls to feed largely on carrion. Fifty-eight per cent of the total food of these birds was fishes, the indications being that most if not all of them were found dead. Ten per cent of the food consisted of a large egg, perhaps of a duck, found in one stomach, another 10 per cent, approximately, of squid remains, a slightly larger amount of invertebrates including hydroids, mollusks, marine worms, and a crab, and a similar proportion of algae. The mollusks identified were the common blue mussel (*Mytilus edulis*), a sea slug (*Chiton* (?) *submarmorea*), and the crab was a hermit (*Dermaturus mandtii*).

Larus hyperboreus barrovianus Ridgway. POINT BARROW GULL.

A gull taken on St. Paul Island on June 21, 1890, has been referred by H. C. Oberholser (1918, p. 473) to this form, which is characterized as smaller, and having a darker mantle, than typical *L. hyperboreaus*. This bird must have been a nonbreeding bird or a wanderer from some breeding colony. It was taken by William Palmer, but for some reason was not mentioned in his account of the birds of the Pribilofs. The specimen is still in the collection of the U. S. National Museum.

Larus glaucescens Naumann. GLAUCOUS-WINGED GULL.

The glaucous-winged gull is an abundant summer resident, breeding on Walrus Island, St. George Island, and Sealion Rock, and is also observed in winter, sometimes in considerable numbers. First recorded from the Pribilofs by Veniaminof in 1840 (Trans. by Elliott, 1874, unpaged, and 1875, p. 242), under the name of "chickee" (the native name), and noted by all subsequent observers.

Because of its wintering to some extent, the date of spring arrival is somewhat uncertain. The following dates of observation later than late March are available: St. George Island, 1914: March 28, 25 seen; May 6, 30 seen; April 14, 40 about stranded whale; April 22, 20. St. Paul Island, 1915: April 24, about 3,000 seen, appeared in numbers during the last few days; May 4, 20 seen; May 28, abundant.

The birds breed principally on Walrus Island, the foxes apparently preventing them from nesting on St. Paul Island and Otter Island, and on St. George except in a few places, as the birds prefer flat turfy situations for nesting. A few pairs breed on the summit of Sealion Rock, a small islet close to St. Paul. All through the breeding season the birds are common on St. Paul Island, feeding about the shores and numerous ponds, and apparently securing most of their nesting material there. On Walrus Island, in 1872, Elliott considered that 500 or 600 were nesting; in 1914 I estimated about 100 pairs. The eggs, usually 2 or 3 in number, are laid mainly in June. James Judge reported finding 359 eggs, all fresh, on Walrus Island, June 16, 1910. Palmer (1899, p. 394) on June 13, 1890, found some fresh eggs and many well incubated, while a few were already hatched. At the same place on July 16, 1914, I found many young, but only a few eggs, and those usually about to hatch.

A few fall and winter dates of observation follow: St. Paul Island, 1910, abundant during September and October; less so in November. December 8, 12 seen; December 21 numerous at sea; 1911, January 4, 3 seen; January 30, 6 (Hahn). St. George: 1913, September 4, 8 seen; September 15, about 20; October 9, 4; October 18, 50; November 11, a few along beach all the time; 1917, January 25, abundant (Hanna). M. C. March made the following notes on fresh specimens collected by him: St. Paul Island, October 16, 1911, female, length, 23¾ inches; extent, 53; basal half of bill whitish, scarcely tinged with flesh color; terminal part, black, excepting pale tip; legs and feet outwardly dirty brownish, paler on inner surface. Another female specimen, same place and date, measured: Length, 24 inches; extent, 52; iris purplish-silvery mottled; edges of eyelids pinkish; bill whitish and yellow, with a blotch of orange at angle; lower mandible yellow, deepest on curves; upper mandible lighter along straight edges of commissure and above nostrils; legs and feet faded pinkish.

Food.—William Palmer in his report on Pribilof birds (1899, p. 395) noted that the glaucous-winged gull feeds "on pretty much everything in the way of offal. Even the dead seals are devoured by them, and they vie with the foxes in their ability to search out and dispose of all animal matter." Results obtained in the present

investigation bear out this bird's reputation as a scavenger. Three of the four well-filled stomachs contained fish bones and flesh and eggs, undoubtedly carrion, which amounted to 41.25 per cent of the total food. A rib of a fur seal was the principal food taken by one bird; the bone was 6 inches long and extended from the throat to the stomach, where the lower end was undergoing digestion. One full and one nearly empty stomach contained exclusively remains of eggs and young of a bird of the auklet family. Miscellaneous contents were remains of univalve, sea urchin, crab, and algae.

Larus schistisagus Stejneger. SLATY-BACKED GULL.

The slaty-backed gull was included among the birds of the Pribilofs by Palmer, whose account (1899, p. 394) may be quoted in full:

> Several of the natives informed me that a large black-backed gull, different from the following, bred sparingly on the cliffs of Otter Island, and that they rarely visited St. Paul. Daniel Webster, an old experienced sealer who had then spent 22 years on the islands, also told me that a large dark-backed gull was to be found in small numbers on the cliffs of St. George. On June 11, on St. Paul I saw three, and on June 12, another, which came in over the Reef from the direction of Otter Island. Several evenings after August 11 I noticed some large gulls flying slowly in from the Reef (on one evening I counted seven). The mantle was much darker than in *glaucescens*. They were probably this species, the status of which is very uncertain on the American side of Bering Sea.

Gulls observed by Hanna on two occasions were apparently of this species. On December 21, 1913, he saw about 25 large white-tailed gulls with slate-colored backs, off St. George Island; and on October 15, 1919, saw two dark-backed gulls, with black-tipped wings, and slightly smaller than the glaucous-winged gull, about the ship's anchorage off St. Paul Island. He has no evidence of the breeding of the species on Otter Island.

Rhodostethia rosea (Macgillivray). ROSY GULL.

A specimen of the beautiful rosy gull was shot by a native on a fresh-water lake on St. George Island May 25, 1911, and was preserved by A. H. Proctor. The specimen, which is now in the collection of the Biological Survey, was recorded by Evermann (1913, p. 17). A second specimen, a female, taken on St. George March 24, 1917, is now in the U. S. National Museum.

Xema sabinii (J. Sabine). SABINE GULL.

The Sabine gull appears to be of regular occurrence in early summer and in the autumn. It was first credited to the islands by Palmer (1899, p. 398), who mentions one seen on St. Paul Island by H. W. Elliott June 4, 1890, and one (perhaps the same individual) seen later about the lagoon by himself. He also lists a specimen

taken June 26, 1890, and refers to others taken during the summer of 1896, and one on St. George Island by D. W. Prentiss. Prentiss, referring to observations made in 1895, says (1902, p. 100): "I saw them occasionally on both St. Paul and St. George, and secured several."

W. L. Hahn, during the autumn of 1910, observed the species as follows on St. Paul Island: August 31, 1; September 1, 7; September 7, 2; September 8, 20; September 11, 20; October 2, 1. A specimen taken by him on September 8 measured in the flesh: Length, 13⅛ inches; extent, 30¾.

G. Dallas Hanna, on St. George Island, observed two individuals, collecting one, May 19, 1914, and on June 16 saw three. In the year following, on St. Paul Island, he saw one on May 26. Two specimens, an adult and an immature female, were collected by him on St. Paul Island, August 30, 1916. They are now in the collection of the U. S. National Museum.

Food.—One well-filled stomach and crop of the Sabine gull taken May 19, 1914, on St. George, gives evidence that this bird feeds upon insects on the wing and is skillful in the pursuit. The food contained in this stomach included the remains of 6 gold and green ground beetles (*Carabus truncaticollis*), 2 other ground beetles (*Pterostichus* sp.), and 1 water beetle, together 4 per cent; a great many caddisflies, 16 per cent; and numerous two-winged flies (37 *Borborus annulatus*, 5 *Leria fraterna*, 3 *Scatophaga dasythrix*, 1 *Hydrophorus innotatus*, and 27 or more others), 80 per cent. A nearly empty stomach taken at the same time contained remains of amphipods, and marine worms (Nereidae).

Sterna paradisaea Brunnich. ARCTIC TERN.

The arctic tern is apparently of regular occurrence about the Pribilofs during migration. It was first recorded from the group by Palmer (1899, p. 398) on the authority of F. A. Lucas, who saw two on St. Paul Island July 26, 1890, and of Daniel Webster, an old sealer, who described a tern claimed to be found every fall about St. George. Later observations have added to the records. Hahn observed eight on St. Paul Island August 30, 1910, and one on September 24. Hanna saw four feeding in the surf off St. George Island May 19, 1914, and collected one. During the following spring, on St. Paul, he observed the species as follows: May 9, two; May 11, four; May 15, one; May 26, one; June 30, one. Two female specimens, an adult and an immature, now in the collection of the U. S. National Museum, were taken by Hanna on St. Paul Island on August 28 and 30, 1916. He also took a specimen on St. George, August 5, 1920.

Food.—Only two stomachs of the arctic tern from the Pribilofs (May 19, 1914, and August 5, 1920) have been examined; one of them was practically filled with remains of small sculpins, the other with amphipods (46 or more *Pontogeneia* sp.). Both stomachs contained traces of univalves, in each case less than 1 per cent.

Family DIOMEDEIDAE.

Diomedea albatrus Pallas. SHORT-TAILED ALBATROSS.

The short-tailed albatross used to be of common occurrence about the Pribilof Islands according to the testimony of the natives. Veniaminof, writing in 1840 (Trans. by Elliott, 1874 unpaged, and 1875, p. 242) stated that the albatross "is frequently to be seen about the beaches." Elliott took a specimen August 12, 1873, and was informed by the natives that 20 years earlier the birds had been very abundant but had disappeared with the whalers. Palmer (1899, p. 381) obtained an immature bird on St. Paul on August 4, 1890, and observed five others on August 10, off the reefs of the same island.

I have no recent records, excepting that of a sternum picked up on the beach at St. Paul by Hanna.

Family PROCELLARIIDAE.

Fulmarus glacialis rodgersi Cassin. RODGERS FULMAR.

The Rodgers fulmar is a rather common summer resident, but the greater number apparently leave the islands as soon as breeding is over. A few are seen during the autumn, but they are very rare later. The species lays its single egg on narrow shelves on steep cliffs on St. Paul, Otter, and St. George, by far the greater number on the last. It was first recorded from the Pribilofs by Dall, who procured a specimen on St. George (1869, p. 323).

The birds usually arrive in March or April; I have few definite dates. On St. George Island in 1914 Hanna, on March 21, recorded having seen large numbers during the two preceding days, "the first since January, when one was seen"; April 3, numbers reported at Zapadni; April 8, 30 observed; April 22, 20. In 1917 it was first seen at Zapadni on March 8. Hanna's notes for St. Paul are as follows: 1915—May 2, 200 reported at Southwest Point; May 4, hundreds; May 10, abundant. 1918—February 8, killed at sea near island; large numbers on high cliffs.

The following dates refer to nesting: Otter Island, June 10, 1872, St. George, June 10, 1873, eggs in U. S. National Museum, collected by Elliott. Otter Island, June 14, 1885, eggs taken by C. H. Townsend (Palmer, 1899, p. 382). St. George Island, July 1, 1914, eggs taken by Hanna. On August 4, 1914, we found nests with well grown

young on the cliffs near Zapadni, St. George. H. P. Adams secured eggs on St. George, June 4, 1916.

Hahn found fulmars common at sea between Walrus Island and St. Paul, October 2, 1910. Hanna saw a few on St. George Island, September 11, 1913, and two on September 28. On St. Paul, in 1915, he noted two on October 4.

A considerable number of birds in the sooty phase of plumage occur in the breeding colonies. Hanna thinks that on St. George Island about one-fifth are dark birds. He has preserved two specimens of the dark phase of this species, and states (1920a, p. 249): "These birds are often seen in the large colonies which breed on the Pribilofs. They seem to mate indiscriminately with light colored birds and in one case a slate-colored downy young was seen which had light-colored parents." On July 12, 1914, in a breeding colony near the village of St. George, I saw a light and a dark bird, apparently mates, presiding over a nest containing a young one.

Food.—Of 19 stomachs of the Rodgers fulmar collected on St. George Island, 18 were nearly empty, but whether empty or well-filled the entire food remains present were those of squids. In one case mandibles representing at least 13 squids were present. G. Dallas Hanna also recognized the importance of squids in the dietary of this bird and gives the following interesting account of another food habit of the species:

> Some species of squid is eaten extensively and the eyes, which resemble pearls, are found in the stomachs and the beaks have also been secured. But the huge brown-rayed jellyfish found in Bering Sea also is eaten. In the tide rips and eddies about the Pribilofs this jellyfish is often brought to the surface of the water. Fulmars attack it voraciously when an opportunity is presented and if possible tear it to pieces. The birds then gather around in large numbers to enjoy the feast. It seems that the attacks of the birds finding the jellyfish are chiefly an endeavor to so injure the animal that it will be unable to dive to safety. I have seen as many as 50 birds in one small circle eating these jellyfish, and I have never seen anything else being captured or eaten although in the course of a day's fishing many thousands of the birds are seen cruising over the ocean.

Puffinus tenuirostris (Temminck). SLENDER-BILLED SHEARWATER.

Hanna (1919a, p. 176, and 1920a, p. 251) added the slender-billed shearwater to the Pribilof fauna, and writes as follows:

> A female slender-billed shearwater was picked up on the beach of St. Paul Island on June 4, 1918. Another bird was seen shortly after, flying about 2 miles out at sea. Mr. C. E. Crompton told me that numerous individuals were in the vicinity of St. George Island at about the same time. (l. c., p. 251.)

This specimen is now No. 255111 of the bird collection of the U. S. National Museum.

Oceanodroma furcata (Gmelin). Fork-tailed Petrel.

The fork-tailed petrel has been observed on a number of occasions about the Pribilofs during the summer, but is not known to breed. It was first recorded from the islands by Palmer (1899, p. 383) on the strength of an individual picked up on the beach of St. Paul by True and Prentiss in 1895, and another similarly taken by D'Arcy Thompson in August, 1897.

M. C. Marsh next observed the species, collecting specimens on St. Paul Island on March 6 and April 28, 1912. Hanna saw a gray petrel, which was probably this species, on St. George Island June 16, 1914, and on July 15 of the same year, while crossing from St. George to St. Paul, the writer observed a few individuals at sea. Hanna took a specimen, now in the U. S. National Museum, at Northeast Point, St. Paul Island, on April 24, 1915; it was the only one seen at the time. He observed another off St. George, May 4, 1917.

Marsh made the following notes from the fresh specimens: Male, St. Paul Island, March 6, 1912, length, $9\frac{1}{4}$ inches; extent, $18\frac{5}{16}$; bill, legs, and feet, black. St. Paul (sex not determined), April 28, 1912, length, $8\frac{13}{16}$ inches; extent, $18\frac{1}{2}$.

Food.—A single stomach of the forked-tailed petrel from the Pribilofs (St. Paul, April 24, 1915) has been examined and it was practically empty, containing only traces of fish bones.

Family PHALACROCORACIDAE.

Phalacrocorax pelagicus robustus Ridgway. Violet-green Cormorant.

The violet-green cormorant seems to have been first authoritatively credited to the Pribilofs by Baird, Brewer, and Ridgway (1884, vol. 2, p. 161), who say: "It is also said to be abundant at St. George's Island, in Behring's Sea, where Captain Smith obtained several examples." Although the bird was thus early recorded, its regular presence has been generally ignored by observers, and it remained for G. Dallas Hanna to discover that the bird is rather common and breeds in a number of places. He states (1916, p. 402) that it is common about the Pribilof Islands in winter, and that it is recognized as differing from the red-faced cormorant by the natives, who call it "sea shag."

We found it nesting on Sealion Rock in 1914 and at a number of places on both St. Paul and St. George Islands, and it is believed also to breed on Otter Island.

Hanna has collected a number of specimens which are in the U. S. National Museum (one is No. 255123, St. George, May 2, 1917) and has furnished the writer with the following dates of occurrence on

St. Paul Island: 1914—September 22, 2 observed; December 6, 3; December 8, 18 killed at Northeast Point by natives; December 13, 10. 1915—February 18, 10; March 5, 2; March 15, 25; March 18, 30; March 24, 3; May 6, 4 seen on Reef Cliffs; May 9, 4 seen on Southwest Point Cliffs; May 18, 2 seen at Northeast Point; these May records in all probability indicate birds settled on their nesting cliffs. Hanna also reports the species killed at sea near the island February 8, 1918.

Food.—This cormorant, like all its race, is a great lover of fish food, but investigation discloses it is by no means exclusively piscivorous. The contents of 21 well-filled stomachs from the Pribilofs were: Fishes, nearly 74 per cent, and Crustacea, about 26 per cent. The fishes were chiefly sculpins taken by 17 birds; the species identified were *Myoxocephalus* sp., *M. polyacanthocephalus*, and *Megalocottus laticeps*. Three of these violet-green cormorants had captured rock eels (*Pholis fasciatus*), in one case to the number of 20, which in bulk were equal to about three-quarters of a pint. All but three of the stomachs examined contained remains of shrimps of the genus *Spirontocaris*, and no fewer than 30 individual shrimps were taken from a single stomach. Both *Spirontocaris polaris* and *S. groenlandica* were identified, and specimens of the latter species 3½ inches in length had been eaten. Four of the birds also had devoured hermit crabs, which were identified as *Dermaturus mandtii*, *Pagurus undosus*, and *Hapalogaster grebnitzkii*. Ten of the latter were present in a single stomach. The nearly empty stomachs also contained crustaceans and fish remains, and one well-filled stomach yielded a bit of sea lettuce, no doubt accidentally taken.

Phalacrocorax urile (Gmelin). RED-FACED CORMORANT.

The red-faced cormorant is a rather common breeder, nesting on all the islands of the group excepting Sealion Rock. It was probably first noted from the Pribilofs by Coinde (1860, p. 401). Owing to this bird having been confused with *P. p. robustus* in many cases there are numerous notes of occurrence at various seasons which can not with safety be used for either. In the present account, therefore, all doubtful notes have been ignored.

Apparently the bird does not winter unless in very small numbers. It usually arrives in late April or early May. Hanna's spring notes for 1915 on St. Paul Island are as follows: April 15, only one *P. urile* among 25 cormorants shot by the natives for food; April 24, 30 observed; May 9, 8 observed at Southwest Point; May 18, 6 seen; May 28, 8 seen at Northeast Point.

The bird is an early breeder. Eggs were found on Otter Island May 22, and on Walrus Island on May 23, 1875 (notes from island log). Other dates for eggs include: Walrus Island, June 1, 1872,

eggs well incubated taken by Elliott; Walrus Island, June 13, 1890, eggs more or less advanced in incubation taken by Palmer (1899, p. 377). On the occasion of our own visit to Walrus Island on July 16, 1914, young about one-fourth grown were found.

The birds remain about the islands in small numbers throughout the autumn. Hanna's notes for 1914 on St. Paul Island are as follows: September 20, 2 observed; September 22, 1; October 4, 4; October 25, 2; November 16, 5; November 27, 6.

Palmer (1899, p. 373) has given a very full account of the species, especially of the nesting and the feather structure.

Food.—Five well-filled and one nearly empty stomach of the red-faced cormorant are at hand; the latter may be dismissed at once with the statement that it contained one mandible of a squid, the only trace of this type of animal in the series. The food in the other 5 stomachs consisted of fishes, 57.8 per cent; crustaceans, 41.4 per cent; and algae and hydroids, 0.8 per cent. The fishes included sculpins (*Gymnocanthus pistilliger*), rock eels (*Pholis* sp.), and an unidentified kind. The crustaceans were chiefly shrimps of the genus *Spirontocaris;* both *S. groenlandicus* and *S. polaris* were identified. No fewer than 66 of the latter species were present in one stomach. Hermit crabs (*Hapalogaster grebnitzkii*) were eaten also by one bird, and a spider crab (*Oregonia gracilis*) by another. Hydroids (*Abietinaria* sp.), sea lettuce, and plume algae (*Ptilota asplenoides, and Ptilota* sp.) were each found in a single stomach.

Family ANATIDAE.

Mergus merganser americanus Cassin. American Merganser.

The earliest record of the American merganser is that of Dall (1873, p. 31), who stated that the bird winters on the Pribilofs. Palmer gives it as undoubtedly occurring during migrations and in winter, but gives no definite notes beyond referring to Dall's account. The first known specimen from the islands seems to have been taken on St. George Island, October 13, 1916, by Dr. H. P. Adams, and is now No. 253784, female, of the bird collection of the U. S. National Museum.

Mergus serrator Linnaeus. Red-breasted Merganser.

The red-breasted merganser has been detected only a few times on the Pribilofs. It was first recorded from the group by Evermann (1913, p. 17), who listed a female specimen taken on St. Paul Island, December 16, 1910. Hahn, who prepared and sent in the specimen, states that it was shot on the lagoon by Doctor Morgan. It measured in the flesh: Length, 19½ inches; extent, 29.

Hanna states that he examined a specimen of this species which was shot by a native on St. George Island in the autumn of 1913.

Anas platyrhyncha platyrhyncha Linnaeus. MALLARD.

The mallard is a regular spring and autumn migrant on the Pribilofs. A few remain during the summer, and it has occasionally been known to breed. It was first added to the avifauna of the islands by Elliott, who recorded it from both islands (1874, unpaged, and 1875, p. 190).

Palmer observed a few during the summer of 1890 (1899, p. 380). The following notes on occurrence in spring, taken from the St. Paul Island log by W. L. Hahn, are of interest: May 9, 1888, 1 shot; about April 10, 1903, 2 shot; May 15, 1905, observed; May 7, 1908, 2 killed (first for season); May 1, 1909, several seen. Hahn himself reported it in 1911 as follows: April 22, 3 seen; April 24, 2 seen; April 29, 4 seen; April 30, many reported.

On St. George Island, in 1914, Hanna noted the mallard as follows: April 22, 9 seen; May 19, 6 seen. On St. Paul Island, in 1915, he recorded the following observations: April 30, 5 seen; May 2, 8; May 4, 15; May 6, 4; May 9, 20; May 17, 4 (paired); May 27, 2. During more recent years he has a record of 4 seen on St. George April 14, 1917, and 7 on St. Paul May 16, 1919. H. P. Adams noted the bird on St. George September 26 and 27, 1915; April 16 and 19, 1916; and April 26, 1917. The following are all the data regarding breeding that I have secured. Elliott (1875, p. 190) states that a pair bred at Polovina, St. Paul Island, in 1872. Hanna furnishes the following notes: In 1917 a pair nested in a pond at Little Polovina, St. Paul. In 1918 a brood of 8 young was hatched in the pool above Ice-house Lake, St. Paul. These were killed, with the parents, before they were half grown. Hanna was told by W. C. Allis, who has wide experience on the islands, that it was formerly not a rare occurrence to see flocks of young mallards in the various ponds on the road to Northeast Point, and that they were eagerly hunted by the natives. While on the Pribilofs in the summer of 1914, I observed the mallard only once, recording a male seen at Kaminista Lake, St. Paul Island, on August 17.

The following dates of occurrence in autumn are available: St. Paul Island, several shot October 9, 11, and 15, 1902 (island log notes transcribed by Hahn). Hahn himself thus recorded the bird on St. Paul in the autumn of 1910: October 9, several shot at Northeast Point; October 11, 1 seen; October 14, 5; October 15, 20 seen in two flocks of 6 and 14, flying in direction of St. George Island, in evening; October 16, 3; October 19, 5; October 20, 4; October 23, 1; November 9, 3. On St. George Island, in 1913, Hanna saw 1 on September 28, and 10 on October 18; on St. Paul, in 1914, he saw 4 on November 20, and 2 on November 21. In 1916, on St. George, Hanna noted it as follows: October 26, still abundant; No-

vember 5, 5 seen; December 24, 1 killed. He also found it abundant there on April 28, 1917.

The only winter record is of a female taken by M. C. Marsh on St. Paul Island, January 1, 1912. The following notes are from the fresh specimen: Length, 21 inches; extent, 35½; legs and feet, orange-red; bill, yellow, blotched with black; nail, black. A male taken by Hahn on St. Paul, November 9, 1910, measured: Length, 22½ inches; extent, 35¼. A female taken at the same time measured: Length, 20½ inches; extent, 33¾.

Food.—Univalves (*Littorina atkana*) constituted three-fourths of the food of two mallards collected in a salt lagoon on St. Paul Island, November 20, 1914, and unidentified vegetable matter, the other fourth. G. Dallas Hanna notes that they usually feed in fresh-water ponds and that they prey extensively on the larvae of blowflies. W. L. Hahn examined a gullet which was filled with larvae of Diptera and of caddisflies.

Chaulelasmus streperus (Linnaeus). GADWALL.

The gadwall has been taken on the Pribilofs on only two occasions. It was first added to the list by Evermann (1913, p. 17), who recorded a female specimen taken by M. C. Marsh on St. Paul Island, November 13, 1911. The following notes, taken by Marsh from the bird in the flesh, are from his field catalogue: Length, 18⅞ inches; extent, 33⅝; iris, brown; lower mandible, light yellow, tip, dark; upper mandible, darker yellow along sides, black at tip, and along culmen, shading into yellow on the sides; legs and toes, light yellow, dark at the joints; web, and toes below, black.

A second specimen, also a female, taken from a flock of three at Halfway Point, St. Paul Island, May 20, 1919, has been recorded by Hanna (1920b, p. 174).

Mareca penelope (Linnaeus). EUROPEAN WIDGEON.

The European widgeon was first ascribed to the Pribilofs by Coues (in Elliott 1874, unpaged, and 1875, p. 190) on the strength of an adult male specimen taken on St. Paul Island, May 27, 1872, by Elliott, who also reported seeing a few others. A second specimen, also a male, taken by W. L. Hahn on St. Paul, April 30, 1911, was recorded by Evermann (1913, p. 17). Hahn's catalogue gives the flesh measurements of this bird as follows: Length, 19¼ inches; extent, 32. A third specimen, male, No. 242691, preserved by A. G. Whitney, is in the collection of the Biological Survey. It was taken by a native on Ice-house Lake, St. Paul, May 9, 1913. The following notes were made from the fresh specimen: Length, 17.7 inches; tip of upper mandible for one-half inch black, this color extending farther back on the edges; remainder of upper mandible slaty-blue,

lighter between nostrils; lower mandible black; feet and legs grayish, webs blackish. Parasites taken from this specimen proved to be *Trinoton luridum*, previously recorded from the same host.

Another, represented only by the head and feet, was taken by G. Dallas Hanna on St. Paul, May 1, 1918, and is now No. 255133 of the bird collection of the U. S. National Museum.

By the capture of this bird on the Pribilofs, the species was added to the North American fauna. It breeds in Eurasia from Scandinavia to Kamchatka, migrating southward in winter.

Eunetta falcata (Georgi). Falcated Teal.

The falcated teal, a beautiful crested species, was added to the avifauna of the Pribilofs by Hanna, who has recorded (1919a, p. 176, and 1920a, p. 250) a specimen secured by him on St. George Island, April 18, 1917. This specimen, which is a male in high plumage, is now No. 255131 of the bird collection of the U. S. National Museum. The species ranges normally in Asia east to Kamchatka, Korea, and Japan. The specimen mentioned is the first secured in North America.

Food.—The stomach of this rare straggler was about half filled with sea lettuce.

Nettion crecca (Linnaeus). European Teal.

A male and female of the European teal, taken on St. Paul Island May 4, 1918, and recorded by G. Dallas Hanna (1919a, p. 176, and 1920a, p. 252), formed the first record for the Pribilofs. These are now Nos. 255127 and 255128 of the bird collection of the U. S. National Museum. Another specimen, a male, was taken on the same island September 20, 1919, and has also been put on record by Mr. Hanna (1920b, p. 174). It is in the collection of the California Academy of Sciences.

The species is of general distribution in northern Eurasia, and breeds regularly eastward to the eastern Aleutians, where it had been detected many years before its capture on the Pribilofs.

Nettion carolinense (Gmelin). Green-winged Teal.

The exact status of the green-winged teal on the Pribilofs is uncertain owing to the great difficulty of distinguishing the female and young of this species from those of the European teal (*Nettion crecca*), even with the birds in hand. Teals were definitely ascertained to breed at Antone Lake, St. Paul Island, by Mr. Hanna and myself in the summer of 1914, and an adult female and her unfledged young one were taken. We failed to take or even see a male on this occasion, however, and the specimens we secured can not be certainly identified. Teals of one or both species also occur quite frequently in migration.

The present species was recorded from the Pribilofs by Palmer (1909, p. 380), who saw one on a pond on St. George Island, May 28, 1890. It was later killed by some one but was not secured for a specimen. The following notes on the occurrence of teal are given with the understanding that they may not be referable in all cases to the American species: St. Paul Island: May 15, 1905, seen on Polovina Lake (island log, note transcribed by Hahn); February 27, 1911, 1 killed on Lagoon Reef by a native, preserved by Hahn (now No. 270533, male, collection Biological Survey); May 21, 1911, 1 killed (reported to Hahn); July 29, 1914, 1 seen on Polovina Lake (Preble); August 22 (4), and 25 (1), 1914, (Preble and Hanna); October 17, 1914, 3 seen (Hanna); May 18, 1915, 1, Halfway Point (Hanna).

On St. George Island Hanna observed 3 teals on September 4, 1913, and 1 on May 19, 1914, and collected a fine male of the American form there on May 10, 1917. Another male was taken by him on St. Paul, May 26, 1919 (1920b, p. 174). These two last-mentioned specimens are in the collections of the U. S. National Museum, and of the California Academy of Sciences, respectively.

Food.—Two teals from Antone Lake, St. Paul (August 31, 1914, G. D. Hanna), identified as the green-winged, had been feeding on seeds and foliage of white water crowfoot (*Batrachium trichophyllum*) and a pondweed (*Potamogeton filiformis*), together with a few small Diptera.

Two other teals, not certainly identified as to species, collected at the same lake in the same month (August 22, 25, 1914) had taken the same things in somewhat different proportions, together with certain additional items. Water crowfoot made the bulk of the food of one of these birds, but a few seeds of pondweed and a sedge (*Carex* sp.) were present. The bird had eaten also beetles, flies, bivalved crustaceans (Ostracoda), and mollusks. The preponderant article of food of the second teal was rat-tailed larvae of a flower fly (Eristalinae), of which at least 16 had been taken. This bird had eaten also lesser quantities of beetles and Hymenoptera and of the seeds of sedge and water crowfoot.

Spatula clypeata (Linnaeus). SHOVELER.

The shoveler was added to the Pribilof list by Evermann (1913, p. 17), who recorded a male specimen taken by W. L. Hahn on St. Paul Island, May 24, 1911. The following notes are from Hahn's catalogue: Length, 19½ inches; extent, 30; legs and feet, pinkish-orange; bill, glossy black, except for slight yellow mottling below. This specimen is now in the Biological Survey collection.

The only other record seems to be that of a male bird observed by the writer near Northeast Point, St. Paul Island, June 27, 1914.

Dafila acuta tzitzihoa (Vieillot). PINTAIL.

Two male specimens of the pintail taken by M. C. Marsh on St. Paul Island, May 24, 1912, were recorded by Evermann (1913, p. 17). Marsh in his field catalogue gives the following notes from the fresh specimens: No. 178, male, length, 25½ inches, extent, 35½; iris, brown; bill, blue, with a broad black stripe down the middle and a narrow black stripe at base; upper mandible, black, edged forward; feet, gray above, webs darker. No. 179, male, length, 24$\frac{13}{16}$ inches; extent, 34¾; colors of soft parts same as No. 178.

Hanna observed 9 individuals at Webster Lake, August 17, 1914, and obtained 1 (No. 237499, U. S. Nat. Mus.). He also noted 2 on St. Paul Island, May 27, and 2 on May 31, 1915. On St. George, in 1916, he noted it as still common on October 26. He considers that the bird is a common migrant.

Food.—The Pribilof Islands evidently do not afford the vegetable food which is most relished by the pintail in its continental range, for the six stomachs of this species collected there were filled entirely with animal food. Five of them contained only midge (Chironomidae) larvae and the other one caddis (Trichoptera) larvae and their cases. Mr. Hanna says that this species—

> has never been seen feeding anywhere except in fresh-water ponds. They eat the larvae of blowflies from the seal carcasses extensively. These larvae wander from the decaying meat when the time comes for them to pupate and many of them are drowned in the fresh-water ponds.

Aristonetta valisineria (Wilson).[5] CANVASBACK.

The famous canvasback was added to the Pribilof list by G. Dallas Hanna (1919a, p. 176, and 1920a, p. 252) on the strength of a fine adult male taken on St. George Island, May 18, 1917. It is now in the collection of the U. S. National Museum, No. 255149.

Food.—The stomach of this specimen contained only caddis larvae and cases.

Fulix marila (Linnaeus).[6] SCAUP DUCK.

A male scaup duck taken by M. C. Marsh on St. Paul Island, April 27, 1912, was recorded by Evermann (1913, p. 17). Marsh in his field catalogue gives the following notes: Length, 18 inches; extent, 31⅜; bill, pale blue; nail, black; iris, yellow. The species seems not to have been otherwise observed.

Fuligula fuligula (Linnaeus). TUFTED DUCK.

A female tufted duck collected on St. Paul Island, May 9, 1911, by W. L. Hahn, proved to be the first record for the Pribilofs, and

[5] *Marila valisineria* of the A. O. U. check list, 1910.
[6] *Marila marila* of the A. O. U. Check List, 1910.

also for North America. It was formally recorded by Evermann (1913, p. 17). The bird was accompanied by a male, which escaped. The species breeds regularly in northern Eurasia east to Kamchatka, and migrates to northern Africa, India, China, and Japan.

Food.—Evermann (l. c.) quotes from Hahn's field notes as follows: "the stomach was full of grass, cress (?), small seeds, and a few larvae."

Aithyia ferina (Linnaeus). European Pochard.

The European pochard was added to the avifauna of the Pribilofs and North America by Evermann (1913, p. 17), on the basis of a male specimen taken by M. C. Marsh on St. Paul Island, May 4, 1912. His catalogue records the following notes made from the fresh specimen: Length, 18 inches; extent, 30½; iris, yellowish-red; base of bill, brownish-black, middle pale bluish, terminal band of jet black sharply demarcated from the bluish; legs and toes, pale, with much grayish, webs black. The specimen is now No. 239123 of the collection of the Biological Survey. The pochard breeds in northern Eurasia east to Lake Baikal, and in migration and in winter wanders eastward to China and Japan.

Glaucionetta clangula clangula (Linnaeus). European Goldeneye.

A female goldeneye (No. 237500, U. S. Nat. Mus.), taken by G. Dallas Hanna on St. Paul Island November 27, 1914, from a flock of four, proved to be the typical form, and hence constitutes a new record for North America. It was so reported by Mr. Hanna (1916, p. 400). The specimen was determined by Dr. H. C. Oberholser. This form breeds generally throughout northern Eurasia.

Other goldeneyes, assumed to belong to the present form, were observed by Mr. Hanna on St. Paul Island, some in the possession of native hunters, as follows: October 12, 1914, 4; October 25, 4; April 12, 1915, 5.

Food.—Three stomachs from St. Paul (October 12, 1914) have been examined and their contents were amphipods, 55 per cent; fish remains, 10 per cent; marine worms (Nereidae), 3.3 per cent; and seeds of pondweed (*Potamogeton* sp.), 31.7 per cent.

Glaucionetta clangula americana (Bonaparte). American Goldeneye.

During recent years this goldeneye has been taken on both St. Paul and St. George Islands by G. Dallas Hanna, who has put the captures on record. He took a male specimen on St. George Island, May 6, 1917, and a female on St. Paul, January 31, 1918 (1919a, p. 176, and 1910a, p. 252).

Food.—The stomach of the specimen last mentioned was practically empty; however, the slight remains of food represented three

distinct phyla of animals, namely, Mollusca (*Modiolaria verrucosa*), barnacles, and sea urchins.

Charitonetta albeola (Linnaeus). BUFFLEHEAD.

The beautiful little bufflehead was first taken on the Pribilofs by G. Dallas Hanna, and was recorded by him (1916, p. 401). He observed it first on St. George Island, taking male specimens November 19, 1913, and May 19, 1914. In the spring of 1915 he observed others on St. Paul Island as follows: May 19, 2 seen at Halfway Point; May 26, 1 Northeast Point; May 28, 8 (paired) on Webster Lake.

Food.—Only animal food was present in the two bufflehead gizzards collected by Mr. Hanna on St. Paul, May 19, 1914, and January 29, 1918. One of the stomachs held only caddis larvae and cases, while the other contained ground-up amphipods, 80 per cent; 7 or more small bivalves (*Modiolaria verrucosa*), 18 per cent; and a bit of barnacle, 2 per cent.

Clangula hyemalis (Linnaeus). OLD-SQUAW.

The old-squaw is resident about the Pribilofs, being, however, much more abundant in winter than in summer. It breeds only on St. Paul, nesting about most of the shallow fresh-water ponds which are scattered over the island. It was first recorded from the group by Elliott (1874, unpaged, and 1875, p. 191).

Since the species is abundant during the winter and spring, no dates of arrival can be cited; Hanna records the birds as pairing April 18, 1915, about which date they begin acquiring the summer plumage, and as being observed in pairs at various dates in May. Eggs were found June 12 and 17, 1890, by Palmer (1899, p. 378). The egg-laying period is long, since downy young not over two days old were taken August 17, 1897, by Snodgrass and Greely (Grinnell, 1901, p. 19), and the writer saw downy young on Antone Lake, August 25, 1914.

Many fall and winter dates are at hand, but in the case of so common a bird it seems unnecessary to give them in detail. They seem to indicate a gradual gain in numbers until the species is seen by hundreds or thousands during the winter and early spring.

A male, St. Paul Island, January 7, 1912, M. C. Marsh, measured: Length, 16½ inches; extent, 28⅝. Another male, St. Paul Island, February 5, 1912, M. C. Marsh: Length, 16 inches; extent, 28¾; iris brown; bill black with band of rose. Another male, St. Paul, March 27, 1912, M. C. Marsh: Length, 19 inches; extent, 28½; iris brown, basal half of bill jet-black, rest rose-pink except black nail; lower mandible same relative colors; legs and feet pale bluish, webs black. A female specimen, St. Paul Island, February 5, 1912, M. C. Marsh,

measured: Length, 15½ inches; extent, 27; iris brown; feet pale bluish, darkly reticulated. Another female, same place and collector, February 23, 1912, measured: Length, 15½ inches; extent, 27⅜; bill dusky bluish except black nail, and black bordering the feathers at base of upper mandible and the nostrils; iris light brown; legs and toes in front very pale-bluish, black behind; webs black.

Food.—Fifteen well-filled and fourteen nearly empty stomachs of the old-squaw are available to illustrate its food habits at the Pribilof Islands. From the nature of the food it is evident that most of it was obtained in salt water, and in this connection a note on the habits of the species by Mr. Hanna is of interest. He says the old-squaw is—

> much more abundant in winter than in summer. It breeds in the lowland fresh-water lakes where several sets of eggs have been collected. Parent birds have been seen flying from the sea to the nesting site which might indicate that food is secured in salt water at all seasons. In winter they feed just outside the surf lines, in the open spaces between the ice cakes, and in the Salt Lagoon when this is open.

The food composing the 15 normal stomach contents studied consisted of amphipods, 74.1 per cent; hermit crabs, 11.2 per cent; caddis larvae (the only fresh-water animals in the lot), 6.4 per cent; mollusks, 3 per cent; vegetable matter, 1.6 per cent; and numerous items of lesser importance. In 12 cases amphipods constituted the bulk of the food and were represented by very numerous individuals. The species identified were *Anonyx nugax*, *Bathymedon* (?) *obtusifrons*, *Caprella kincaidi*, *Gammarus pribilofensis*, *Hippomedon* sp., *Orchomenella minuta*, *Pontoporeia affinis*, and *Tmetonyx* sp. Other crustaceans eaten were the hermit crabs *Dermaturus mandtii* and *Hapalogaster grebnitzkii*, remains of 8 or more of the former and 6 or more of the latter were found (together) in one stomach. Barnacles had been eaten by 9 of the well-fed birds, and compose 1.2 per cent of the total food; only one species, *Balanus balanus*, was identified. Mollusks composing 3 per cent of the diet included both bivalves and univalves. Of the former the common blue mussel (*Mytilus edulis*) was found in 6 stomachs, *Saxicava arctica* in 3, *Modiolaria verrucosa* in 2, and *Musculus* sp. in 1. The univalves identified were *Margarites helicina*, *Littorina atkana*, and *Borcotrophon* sp. Remains of a sea slug (*Chiton*) occurred in one stomach. Among the other items of animal food were Foraminifera, hydroids (*Abietinaria* sp.), Bryozoa, nereid and tubicolous worms, sand dollars (*Echinarachnius parma*), and other sea urchins.

The vegetable food taken by these 15 old squaws comprised rootstocks and foliage of grass and sedge, seeds of sedge (*Carex* sp.) and lupine (*Lupinus nootkatensis*), and algae. The latter included kelp, plume algae (Ceramiaceae), and a filamentous alga (*Chaetomorpha melagonium*).

The 14 nearly empty stomachs contained chiefly the same items as the better-filled ones, those of most frequent occurrence being amphipods, barnacles, and mollusks. One additional item, namely starfish remains, was obtained from this series.

Histrionicus histrionicus pacificus Brooks. HARLEQUIN DUCK.

The harlequin is resident the entire year on the Pribilofs, being most common in spring and fall, fairly common in winter except when the pack ice is present, and found in small flocks throughout the summer. No absolute evidence of its breeding on the islands is at hand. It was first definitely recorded from the Pribilofs by Elliott (1874, unpaged, and 1875, p. 199).

Being abundant during all or most of the winter, it can not be said to arrive in spring. Hanna gives many instances of occurrence in spring and summer, from which the following may be given: St. Paul Island, 1915—March 5, 25; March 18, 6; April 24, 200; April 27, 50; May 4, 40; May 28, 10; July 19, several individuals seen which were molting and could not fly; have been abundant all summer. While on the islands in 1914 the writer saw flocks on the surf-washed rocks almost daily, both on St. Paul and St. George. The notes most nearly giving evidence of breeding that I have been able to find are these of Palmer, who says (1899, p. 379): "I was told that some young were killed on St. George during the summer [of 1890]." Hahn observed two pairs mating on St. Paul Island, April 24, 1911; these, however, may have bred elsewhere.

Numbers of specimens of both sexes are in the collection of the U. S. National Museum. The following notes from selected specimens from St. Paul Island are from the collectors' field catalogues: Male, November 18, 1910, W. L. Hahn; length, 18 inches; extent, 25½; bill plumbeous at base, tipped with pale horn color; feet dusky. Male, December 7, 1911, M. C. Marsh; length, 16½ inches; extent 24½; bill dark olive, lighter underneath; tip of lower mandible rosy; tarsus and toes pale greenish, joints dark, webs black, obscure streaks of rose along inner surface of tarsus and middle and inner toes; hallux lobe black on outer surface. Male, February 23, 1911, M. C. Marsh; length, 17 inches; extent, 27¾; iris dark brown; bill pale bluish, darkened at base; nail lighter, legs and feet dark brown, webs black. Male, March 8, 1912, Marsh: Length, 16⅛ inches; extent, 26⅜; iris brown, bill dark leaden, rami below pale blue, membrane between black; legs and feet with slight pale bluish cast, darker at joints, webs black. Female, October 20, 1911, Marsh: Length, 14$\frac{9}{16}$ inches; extent, 23; iris brown; bill leaden, lighter underneath; tarsus very pale yellowish in front, dark behind; toes pale yellow, the joints dark, web brownish black.

Food.—Mr. Hanna notes that harlequin ducks feed in the kelp beds and rest on the surf-washed rocks the year round, and it is evident from the contents of the 11 well-filled and 8 nearly empty stomachs of the species collected about the Pribilofs that the birds take full advantage of the great variety of invertebrate life to be found in these rich marine pastures. The bulk of their food is amphipods (51.4 per cent of the total contents of 11 stomachs), hermit crabs 25.1 per cent, and mollusks 19 per cent. Other items, though numerous, in every case fall short of 1 per cent of the total food. Amphipods, the greatest staple, are taken in large numbers, and a variety of species are captured. Identifications are: *Anonyx nugax*, *Gammarus pribilofensis*, *Hyale* sp., *Jassa marmorata*, *Metopa* sp., and *Orchomenella minuta*. The hermit crabs in all cases were *Dermaturus mandtii*, and 16 of these were represented in the stomach of one duck. Isopod crustaceans were found in one gizzard and barnacles in five. The mollusks included widely diverse members of the group, as sea slugs (*Chiton* sp., *Schizoplax* sp.), limpets, sea snails, and mussels. The univalves identified were *Littorina atkana*, *Margarites helicina*, and *Trichotropis insignis*, and the bivalves *Modiolaria verrucosa*, *Mytilus edulis*, and *Saxicava arctica*.

Among the animal food items of lesser importance are Foraminifera, hydroids (*Abietinaria* sp.), tubicolous and other (nereid) marine worms, sea spiders or pycnogonids (*Ammothea pribilofensis*), sea urchins, and sand dollars (*Echinarachnius parma*). Vegetable matter composed less than 1 per cent of the food of the harlequins here reported upon and all of it may have been taken accidentally. It included kelp, plume algae (*Ptilota pectinata*, and *P. asplenoides*), and other algae (*Pterosiphonia bipinnata*).

Scraps of food in the 8 nearly empty stomachs of harlequins were chiefly of the same items mentioned above, amphipods and barnacles (in part *Balanus balanus*) being of most frequent occurrence. Additional foods from these stomachs were bryozoans, the amphipod *Pontoporeia affinis*, and fish. W. L. Hahn examined a bird that had fed more extensively on isopods than any of those here reported upon, there being 45 of these animals entire in the gullet and stomach besides many fragments.

Polysticta stelleri (Pallas). STELLER EIDER.

The beautiful Steller eider is apparently a regular migrant, and early summer visitor, though the records are somewhat scattered and meager. Elliott shot 2 in June, 1872, from the Village Hill on St. Paul, and speaks of others shot off East Point, St. George, in the same year (1874, unpaged, and 1875, p. 192). Palmer saw several in company with harlequin ducks, from the Village Hill, St. Paul, and on June 14 shot 3 males from a flock of 4 in St. Paul Harbor.

Later he saw many others. The species was next detected by Marsh, who prepared 2 males which were shot by P. R. E. Hatton on the Lagoon, St. Paul Island, on April 23, 1912, and took another on May 9. These are in the collection of the Biological Survey. Hanna was the next observer to record it, taking a female specimen on St. Paul, October 25, 1914, and a male on March 21, 1915. He also observed 4 on St. Paul, April 18, 1915.

Individuals of this species, represented by stomachs sent in for examination, were later taken as follows: St. George, February 4 and April 12, 1917; St. Paul, December 6, 1918. The specimen taken February 4 is now No. 255125 of the U. S. National Museum collection.

Notes from Marsh's field catalogue, taken from the fresh specimens, are as follows: Male, St. Paul Island, April 23, 1912, length, 18⅛ inches; extent, 29$\frac{9}{16}$; iris dark brown; bill pale blue; legs and feet grayish brown. Another male, same place and date, measured: Length, 17⅛ inches; extent, 28. Notes on soft parts same as preceding. The specimen taken May 9, 1912, measured: Length, 17¼ inches; extent, 28⅝.

Food.—The food of the Steller duck in the Pribilof region is known from the examination of two well-filled stomachs and one other. The content of the well-filled stomachs was some 60 per cent amphipods and the remainder chiefly mollusks. Amphipods identified were *Allorchestes* sp., and *Pontoporeia affinis*. The mollusks were chiefly univalves, *Neverita recluziana* (25 or more in one stomach), *Melanella* sp., and *Cardium ciliatum* being identified. Minor items of food were a bit of a bivalved mollusk, and remains of marine worms (Nereidae), barnacle, sea urchin, and algae.

Arctonetta fischeri (Brandt). SPECTACLED EIDER.

The spectacled eider was added to the Pribilof list by the capture of three female birds on January 13, 1918. These were taken by native hunters and secured by G. Dallas Hanna, who has put their capture on record (1919a, p. 176, and 1920a, p. 252). These specimens, two of which were preserved as skins and the other in formalin for anatomical study, are now in the collection of the U. S. National Museum.

Food.—Two stomach contents of the spectacled eider have been examined and were found to be composed of amphipods, about 90 per cent; mollusks, about 5 per cent; and various minor items. One species of amphipod was determined, namely, *Bathymedon obtusifrons*, and 4 of mollusks. The latter included the common blue mussel (*Mytilus edulis*); *Modiolaria verrucosa* and *Rochefortia* sp., bivalves; and *Lora* sp., univalve. Other articles of food in these two stomachs were: Foraminifera, Bryozoa, sea urchin, sand-dollar

(*Echinarachnius parma*), starfish, crab (*Erimacrus isenbeckii*), bones of a sculpin, and bits of kelp.

Somateria v-nigra Gray. PACIFIC EIDER.

The Pacific eider was first credited to the Pribilofs by Palmer (1899, p. 380), who gives it as a winter visitant, usually seen offshore. The first actual specimen seems to have been taken by Hahn (male, St. Paul Island, May 17, 1911). Marsh later collected female specimens at the same place on December 23, 1911, and January 8, 1912.

Hanna states that many are shot by the natives when the ice is around the islands. He notes eiders, probably the present species, on St. George Island, November 11, 1913, when 20 were seen about 100 feet offshore. Six others were seen at the same place March 28, 1914. Later notes, referring to birds certainly identified, are as follows: St. Paul Island, December 4, 1914, 10 observed; December 13, 10; January 10, about 100; February 18, about 5,000; March 5, about 300; April 15, 60; April 18, 20; April 24, 200; April 27, 50. H. P. Adams noted the species about St. George on February 10, 1916; and January 13, February 4, and March 25, 1917.

Notes from field catalogues follow: St. Paul Island, male, May 17, 1911, W. L. Hahn: Bill, deep orange; feet, orange. St. Paul Island, male, January 1, 1912, Marsh: Length, 24¾ inches; extent, 42⅜; bill, orange, paler terminally; legs and feet, yellow. St. Paul Island, female, January 8, 1912, Marsh: Length, 23⅝; extent, 39; iris, brown; basal portion of bill, gray; terminal, pale yellow; legs and feet, dusky yellowish; webs, darker.

Food.—Information obtained by examination of a collection of 44 well-filled and 3 other stomachs of the Pacific eider from the Pribilofs is sufficient to give a very good idea of the food of the species in that region during the months in which they were collected; namely, January, February, and March. A wide variety of organisms inhabiting the sea is represented in the food, ranging from algae and Foraminifera through the principal group of marine invertebrates to the Chordata, or backboned animals, as ascidians and fishes. Many of the articles of diet are not fed upon to any great extent, and the favorites seem to be mollusks and crustaceans, according to the following schedule of the principal items: Mollusks, 41.2 per cent; crustaceans, 28.2 per cent; sea urchins, 9.45 per cent; starfishes, 7.34 per cent; and algae, 7.47 per cent. The mollusks included limpets, sea snails, mussels, and sea slugs. The kinds most frequently taken were common blue mussels (*Mytilus edulis*), found in 15 stomachs, and another species of bivalve (*Modiolaria verrucosa*), found in 11; in two cases hundreds of the latter shellfish had been eaten. Besides these, identifications made of mollusks of the

various groups were: *Acmaea* sp.; *Amphissa reticulata*, *Borcotrophon* (?) *multicostatus*, *Buccinum plectrum*, *Haloconcha* (?) *minor*, *H. reflexa*, *Littorina atkana*, *L. grandis*, *Margarites helicina*, *Natica clausa*, *Neverita recluziana*, *Nucella lima*, *Plicifusus spitzbergensis*, *Trichotropis insignis*, *Volutharpa ampullacea*, *Cardium ciliatum*, *Pecten islandicus*, *Saxicava arctica*, *Chiton marmoreus*, and *Chiton* sp.

The crustaceans eaten by Pacific eiders consisted of crabs, 13.06 per cent; amphipods, 12.4 per cent; shrimps, 1.5 per cent; and isopods, 1.3 per cent. The crabs captured were principally hermit crabs, and one species, *Dermaturus mandtii*, was found in 17 stomachs and to the number of 11 specimens in one of them. The other hermit crabs eaten were *Hapalogaster grebnitzkii*, *Pagurus dalli*, and *P. trigonocheirus*. Spider crabs (*Oregonia gracilis*) were found in two stomachs, and remains of crabs of the family Xanthidae, a group not hitherto reported from the region, in one. The amphipods identified belonged to a number of species, among which *Gammarus pribilofensis* occurred most frequently, namely 5 times. The other forms determined were: *Allorchestes malleolus*, *Allorchestes* sp., *Amphithöe rubricata*, *Anonyx nugax*, *Atylus* sp., Calliopiidae, *Caprella kincaidi*, *Ischyrocerus* sp., *Metopa* sp., *Nebalia* sp., *Neopleustes assimilis*, *Neopleustes* sp., and *Pleustes panoplus*. The isopods eaten by Pacific eiders belong to the family Idotheidae, of which *Idothea ochotensis* was specifically identified. Thirty shrimps (*Spirontocaris polaris*) were found in one stomach and a few minute bivalved crustaceans (Ostracoda) in another.

Among birds thus far studied as to food habits, preying upon sea urchins and starfishes is unusual, but Pacific eiders in the Pribilof region form an exception to the rule in that more than a sixth of their food is made up of these animals. The sea urchins most frequently taken were the sand-dollars (*Echniarachnius parma*), but spheroidal urchins (*Strongylocentrus drobachiensis*) of the more ordinary type were not neglected. Sea urchins (9.45 per cent) were found in 19 stomachs, and starfishes (7.34 per cent) in 14; the latter in 5 cases were identified as *Leptasterias* sp.

Other articles of animal food forming more than 1 per cent of the diet were barnacles and worms. The former had been eaten by 14 birds, and only one species (*Balanus balanus*) was identified; the worms were of the family Nereidae in 8 cases, and tubicolous forms in two. While amounting to less than 1 per cent, other animals eaten by the Pacific eiders are of considerable interest because they are preyed upon by so few birds. Such are the hydroids, bryozoans, sea spiders, and ascidians. Hydroids not further identified were found in 9 stomachs, *Abietinaria* sp. in 8, *Sertularella* sp. in 4, and

Thuiaria sp. in 1. Bryozoans not further determined were observed in 10 gizzards, *Crisia* sp. in 3, *Cellepora surcularis* in 2, and *Menipea pribilofi* in 1. All of the sea spiders, found in 3 stomachs, belonged to a single species, *Ammothea pribilofensis*, and the ascidians or sea squirts, found in two gizzards, were identical; they were found to be *Boltenia ovifera*. Foraminifera, the only representatives of the Protozoa, or simplest animals identified, were obtained from 5 gizzards.

The percentage (7.47) of marine algae in the stomach contents of Pacific eiders is so high as to suggest that these plants are in part sought for, not all incidentally taken, as some of them, growing on hermit crabs and their shelly homes, undoubtedly are. Algae chiefly with this latter habit were plume algae (Ceramiaceae), identified as *Ptilota pectinata* in 6 cases, *P. asplenoides* in 4, and *Ptilota* sp. in 12. Coralline algae were found in one stomach, and a single seed of the rye grass (*Elymus villosissimus*) in another.

Somateria spectabilis (Linnaeus). KING EIDER.

The beautiful king eider, although it appears to be of regular occurrence nearly throughout the year, and is usually more or less abundant in winter, has only recently been included in the list, having been recorded by Evermann (1913, p. 17) from specimens taken by M. C. Marsh on St. Paul Island on February 4, and March 9, 1912. The species is present in small numbers throughout the summer, but has not been known to breed. In 1914 it was observed by the writer on several occasions as follows: St. Paul Island, July 19, 10 seen at Northeast Point; August 17, 1 at Northeast Point; August 24, 1. St. George Island, August 4, 1 seen at Zapadni. Hanna sent in for examination the stomachs of three shot on St. George Island, May 3, 1917.

I have no dates of occurrence in early fall; Hanna's notes for St. Paul Island, fall of 1914, follow: November 27, 2 seen; December 4, 75; December 13, 50.

The species is sometimes, perhaps usually, common about the islands in winter, especially when pack ice is present. On March 29, 1911, Hahn noted that between 150 and 200 eiders, nearly all of which were male king eiders, were shot on St. Paul. In 1915, on St. Paul, Hanna recorded the bird as follows: January 10, 15 seen; February 18, abundant; March 5, about 100 in the ice pack; April 6, 1; April 15, 40; April 18, 6 (near shore); April 24, 15; May 10, 14. H. P. Adams, on St. George, noted the bird on January 13, February 4, and March 23, 1917.

There are numerous specimens from St. Paul Island in the collection of the Biological Survey, mainly taken by W. L. Hahn and M. C. Marsh. From their catalogues the following data have been cop-

ied: Male, March 30, 1911, Hahn: length, 22 inches; extent, 34; bill reddish at base, shading to pale horn color at tip; caruncle deep lemon; toes pale lemon, webs blackish. Male, January 7, 1912, Marsh: Length, 22¼ inches; extent, 38½; iris dark brown, processes of bill yellow, shading into yellow-red of bill, which is pale at tip; legs and feet yellow, dark at joints, webs blackish. Immature male, February 4, 1912, Marsh: Length, 21⅝ inches, extent, 36¾; iris dark brown, processes of bill light yellow; bill mostly drab, nail darker; feet dingy yellowish, webs dark. Female, February 1, 1912, Marsh: Length, 19¾ inches, extent, 36; iris dark brown; bill dusky, pale below and about nail; feet dusky reticulated, on yellowish ground. Female, February 4, 1912, Marsh: Iris dark brown; processes of bill black, pale band back of nail, above and below; feet yellowish, dusky reticulated.

Food.—To illustrate the food habits of the king eider in the Pribilof area we have had for examination about the same number of stomachs as of the Pacific eider, namely, 44 well-filled ones and 9 others. The nature of the food also proves to be very similar, the principal items and their proportions being: Mollusks, 34.36 per cent; crustaceans, 28.2 per cent; sea urchins, 9.54 per cent; starfishes, 2.59 per cent; and algae, 9.88 per cent. The king eider takes fewer mollusks and a much lower percentage of starfishes than the Pacific eider, but makes up for these in part by greater consumption of barnacles and fishes. Mr. Hanna notes that this species can descend to the bottom in 30 fathoms of water, as evidenced by the fact that a bird killed just after coming to the surface of water of this depth had freshly swallowed mollusks in its gullet.

Like its congener, this eider draws its shellfish fare from diverse branches of the molluscan kingdom. Of the bivalves eaten the favorite was the common blue mussel (*Mytilus edulis*), which occurred in 21 stomachs, and next in preference was *Modiolaria verrucosa*, taken by 12 birds. Other bivalves eaten included the scallop (*Pecten islandicus*) and *Cardium ciliatum*, *Musculus* sp., *Mya intermedia*, *Rochefortia* sp., and *Saxicava arctica*. A single limpet (*Acmaea mitra*) was identified in the food, as also were numerous sea snails, of which *Plicifusus spitzbergensis*, found in 7 stomachs, was of most frequent occurrence. The others identified are: *Astyris* sp., *Borcotrophon* (?) *multicostatus*, *Buccinum fischerianum*, *Buccinum* sp., *Cerithiopsis* sp., *Littorina atkana*, *L. grandis*, *L. grönlandica*, *Littorina* sp., *Machaeroplax cinereus*, *Margarites helicina*, *Natica clausa*, *N. operculina*, *Neverita recluziana*, *Nucella lima*, *Trichotropis insignis*, and *T. nucellatus*. Sea slugs, as the creeping mollusks with segmented dorsal mail may be called, also were taken by the king eiders, and the following forms were identified: *Chiton marmoreus*, *Chiton* sp., and *Schizoplax brandtii*.

The crustaceans eaten by the king eiders studied consisted rather more of crabs and less of amphipods than in the case of the Pacific eider. Crabs were slightly more than a fifth of the total food, most of them being hermits. One species of this group, *Dermaturus mandtii*, was found in no fewer than 33 of the stomachs, 7 individuals being counted in one of them. Other hermit crabs identified were *Hapalogaster grebnitzkii*, *Pagurus trigonocheirus*, and *Pagurus* sp. Other crabs eaten were the spider crab (*Hyas coarctatus*), the mud crab (*Telmessus cheiragonus*), and crabs of the family Xanthidae. Amphipods were much less prominent in number and variety in stomachs of the king eider than in those of its relative, and only 3 forms were identified, namely, *Gammarus pribilofensis*, *Hyale* sp., and *Orchomenella minuta*. A few isopods were eaten, among which one species, *Synidotea nebulosa*, was determined; and also a few shrimps (*Spirontocaris polaris*).

Sea urchins, in this species, as well as in the Pacific eider, are a prominent element of the food. The kinds eaten are the same and they occurred in the following numbers of stomachs: Sea urchins not further identified, 19; *Echinarachnius parma*, 9; and *Strongylocentrus drobachiensis*, 2. Starfishes, for some reason comparatively neglected by this eider, were found in 6 stomachs and only in one case were identified as to genus (*Leptasterias*).

Of the lesser items of animal food, fishes and barnacles are the most important. The only fish remains at all classifiable were some sculpin bones. Three batches of eggs, not absolutely known to be those of fishes, were added to the undoubted fish remains, and make a percentage of the total food of 3.84 per cent. Barnacles (2.34 per cent) are next in importance, being found in 18 stomachs; a single species, *Balanus rostratus*, was identified.

Both tubicolous and nereid marine worms were eaten, the latter occurring in 20 stomachs; the percentage of worms in the food was 1.7 per cent. While some of them occurred in numerous gizzards, the remaining articles of animal food in no case amounted to as much as 1 per cent of the total subsistence. Hydroids not further identified were found in 13 stomachs, and also the following genera of this group, in the number of gizzards indicated: *Abietinaria* 8, *Sertularella* 4, and *Thuiaria* 3. Bryozoa similarly not further named, occurred in 16 gizzards; those identified were *Cellepora surcularis* in 2, and *Menipea pribilofi* and *Myriozoum subgracile* in 1 each, Sea spiders (*Pycnogonida*), found in 2 stomachs, a sea squirt (*Boltenia ovifera*) in 1, and Foraminifera in 5, complete the list of animal foods.

The vegetable food (9.88 per cent) consisted exclusively of algae. That not further identified, chiefly kelp or laminar algae, was found

in 19 stomachs. Plume algae (*Ptilota pectinata* in 17 stomachs, *P. asplenoides* in 15, and *Ptilota* sp. in 8) were a prominent article of diet, and two kinds of coralline algae (*Corallina* probably *aculeata* and *Amphiroa cretacea*) were each found in a single stomach.

Oidemia deglandi dixoni Brooks. PACIFIC WHITE-WINGED SCOTER.

During the past few years the Pacific white-winged scoter has come to be recognized as a more or less regular migrant and winter visitor. G. Dallas Hanna has put the species on record (1919a, p. 176), and later (1920a, p. 252) writes as follows:

> Four specimens of the western white-winged scoter have been taken on the Pribilofs during the last three years. All were females but this is merely an accidental circumstance because males have been seen. The first specimen was secured on October 30, 1916, at St. George Island by the writer. The next was taken on November 15, 1916, at the same island by Dr. H. P. Adams, formerly physician of the U. S. Bureau of Fisheries. Another was secured at St. George Island on February 4, 1917, and one at St. Paul Island, February 8, 1918, both by the writer.

Hanna also noted the bird as abundant at the margin of the ice pack off St. George on January 25, 1917.

The species is of regular occurrence about the islands in winter. It has been seen on several occasions before any specimens were secured but was not recorded because positive specific identification could not be made.

The specimens above mentioned are all in the collection of the U. S. National Museum.

Food.—The stomachs of 2 white-winged scoters, 1 collected on St. George Island, February 4, 1917, and the other on St. Paul, February 8, 1918, have been examined and the food proved to be about equally divided between amphipods and bivalves. None of the former were identified, and the mussels were *Saxicava arctica* principally, with a trace of *Mytilus edulis*. Other items of food sparingly represented were sea urchin, bryozoan, and hydroid.

Chen hyperborea hyperborea Pallas. SNOW GOOSE.

The snow goose was added to the Pribilof list by G. Dallas Hanna (1919a, p. 176, and 1920a, p. 251), who obtained an individual shot by a native at Northeast Point, St. Paul Island, September 16, 1916. "Another bird was killed the following year on the same island but since it belonged clearly to the same species and time did not permit of its preparation it was not preserved" (l. c., p. 251).

The specimen from Northeast Point is now in the collection of the U. S. National Museum, and the head of one shot on St. George by Mr. Hanna is in the Biological Survey collection.

Anser albifrons albifrons (Scopoli). WHITE-FRONTED GOOSE.

The white-fronted goose was first noted from the islands by Palmer, who saw 2 on a small pond near the village on St. Paul Island, June 11, 1890. Two others were seen by him later (1899, p. 380). The only other records seem to be those of G. Dallas Hanna, who saw 1 individual at Garden Cove, St. George Island, September 28, 1913, and 2 individuals at Halfway Point, St. Paul Island, on May 18, 1915.

Food.—The contents of two stomachs of the white-fronted goose collected on St. George Island in May have been studied and found to consist of leaves of grass, 99 per cent; and those of saxifrage and chickweed, 1 per cent.

Branta canadensis hutchinsi (Richardson). HUTCHINS GOOSE.

So far as known to the writer the Hutchins goose has been detected only once on the Pribilofs, by G. Dallas Hanna. He has reported the occurrence (1919a, p. 176, and 1920a, p. 251):

> A female of this subspecies was shot and preserved on St. Paul Island, May 12, 1918. It is considerably larger than the cackling goose which ordinarily comes to the islands each spring and fall, and unlike the latter form there is no sharp demarcation in the coloration of the under parts (p. 251).

The specimen above mentioned is now No. 255152 of the bird collection of the U. S. National Museum.

Branta canadensis minima Ridgway. CACKLING GOOSE.

Elliott secured a specimen of the cackling goose (62526, male adult, U. S. Nat. Mus.) on St. Paul Island, May 14, 1872. This specimen was listed by Palmer, who also (1899, p. 381) records individuals observed on St. Paul on June 25 and June 28, 1890. Palmer (l. c.) and Hanna (1919b, p. 106) consider the bird a regular migrant.

Hahn reported geese of this type, assumed to be referable to the present race, on St. Paul Island, as follows: September 15, 1910, 5; September 24, 1; October 2, 8; May 30, 1911, 1. Hanna reported this race as follows: St. Paul, 1915: May 14, 8 flew over village; May 16, 4 observed; May 18, 6 in pairs, 2 killed, Halfway Point.

Branta nigricans (Lawrence). BLACK BRANT.

The black brant was first recorded from the Pribilofs by Dall (1874, p. 275), who says, in connection with the occurrence of the bird on the western Aleutians: "It has also been reported as a casual visitor at the Pribiloff Islands."

Specimens were first collected by Hanna, and recorded by him (1916, p. 401). His first one, a male, was taken at Bear Lake, St. George Island, September 28, 1913, and is now No. 242535 of the U. S. National Museum collection. Another individual was seen

at this time. He states (l. c.) that small flocks and single birds seem to occur each spring and fall, and he considers that this species is more common than any other goose excepting the emperor. During the following year, on St. Paul Island, Hanna observed the species, as follows: September 17, 5 seen, 1 secured; September 20, 2 seen; October 8, 2; October 25, 4 at Northeast Point.

Notes taken from the St. Paul Island log by W. L. Hahn, referring to black geese, undoubtedly relate to this species. These notes record 5 individuals shot from a flock on October 7, 1902; and 10 shot April 18, 1905.

Food.—The contents of a single stomach of the black brant collected at St. Paul Island on September 17, 1914, consisted exclusively of a filamentous alga (*Chaetomorpha cannaban*).

Philacte canagica (Sevastianoff). EMPEROR GOOSE.

The beautiful emperor goose seems to be of regular occurrence in spring and fall on both the larger islands. It was first recorded by Elliott, who witnessed the capture of an entire flock, which landed so exhausted that the natives were able to take them by hand (1874, unpaged, and 1875, p. 189).

Townsend (1887, p. 99) speaks of 3 or 4 seen on St. Paul Island in September [1885]; Palmer records 1 killed on St. George Island, July 16, 1890. Hahn found notes in the St. Paul log recording the shooting of 1 on November 29, 1904, and 2 on September 24, 1908; and Hahn himself reports 2 seen on St. Paul Island May 10, 1911.

Hanna has made the most extensive observations, as follows: St. George Island, 1913, December 21, 4 seen; 1914, April 8, 3 seen; April 22, 8; May 19, 8 seen, 2 shot, not skinned owing to scarcity of food among the natives, head and feet saved; 1917, May 10, 2 shot. St. Paul Island, 1914, September 14, 6; September 16, 20; September 20, 2; September 22, 2; October 31, 15; November 4, 1 (specimen); November 26, 3; 1915, March 20, 5; May 18 (2, in village cove); June 14, 7 pairs; June 16, 4 pairs. H. P. Adams, on St. George, noted the bird on September 22 and 26, 1915, and April 26 and 28, 1917.

Food.—H. W. Elliott has reported the food of the emperor goose to consist of *Mytilus edulis* and other shellfish (1874, unpaged, and 1875, p. 190). Such food habits would be a radical departure from the standard vegetarianism of geese in general, and there is no direct evidence that they exist. Reliable evidence points to the emperor goose sharing the plant-feeding proclivities of its allies as the entire food of 5 birds of this species collected on the Pribilofs was marine algae of the type known as sea lettuce, identified in one case as *Dilsea integra*.

Olor columbianus (Ord). WHISTLING SWAN.

The whistling swan was first recorded by Palmer, who says (1899, p. 381):

Several were seen on St. George in the fall of 1889 and three rested on the shore at Halfway Point, on St. Paul, during the same autumn.

Hahn took the following from the St. Paul Island log: October 9, 1888, 1 killed; May 15, 1903, 1 shot; October, 1909, 2 shot; weight, 8½ and 9 pounds, respectively. Hahn himself recorded 1 seen by a native, October 2, 1910; and 2 reported May 7, 1911.

Hanna (1916, p. 402) has recorded 1 shot by a native on a high hill on St. George Island, October 10, 1913. Its measurements, reduced to millimeters, were as follows: Length, 1,151 mm.; extent, 1,780 mm. The head and foot of this one were saved as a specimen. H. P. Adams records the bird on St. George as follows: October 16, 1915, noted; October 17, 1915, 1 killed.

Family GRUIDAE.

Megalornis canadensis (Linnaeus.)[8] LITTLE BROWN CRANE.

The little brown crane, which has several times been observed in early summer, was added to the Pribilof list by Townsend (1887, p. 99). He says:

While at St. Paul Island [summer, 1885] some natives came to me and reported having seen a large long-legged bird wading in a shallow pond near the village, and gave me a large feather which the bird dropped in its flight.

Palmer's original notes follow:

Jake, a well-known Aleut sealer, told me on June 28 [1890], that he had seen 3 cranes that morning north of Kaminista Lake. Going there, I found 5, but they were very wild. They remained in the neighborhood until after August 1, as I saw them frequently picking up insects on the tundra. One was caught in a trap near the village in June, 1888 (1899, p. 398).

According to the St. Paul Island log (notes transcribed by Hahn), two "blue cranes" were seen on the tundra September 13 and 14, 1908. These birds were almost certainly the present species.

Hanna observed 3 cranes at Big Lake, St. Paul Island, on May 12, 1915, and 1 on the tundra near Rocky Point Lake on June 26. In May, 1919, he took the first specimens, which he recorded as follows (1920b, p. 174):

Two little brown cranes (*Grus canadensis*) were collected on St. Paul Island in May, 1919. This species occurs in small numbers regularly during migrations but the birds are rarely shot. The previous record was based on a single feather picked up on the tundra.

Food.—William Palmer stated (1899, p. 398) that he saw little brown cranes picking up insects on the tundra of the Pribilofs, and

[8] *Grus canadensis* of the A. O. U. Check List, 1910.

G. Dallas Hanna notes that the two specimens collected by him on St. Paul Island had their crops filled almost to the bursting point with blowfly larvae from the seal-killing fields.

Family PHALAROPODIDAE.

Phalaropus fulicarius (Linnaeus). RED PHALAROPE.

The red phalarope is an abundant northward migrant in early summer and again appears on its return late in summer. It is occasionally seen in midsummer, but has not been found breeding on the islands.

The earliest spring dates are from specimens taken by M. C. Marsh on St. Paul Island, May 16 and 31, 1912, and by Hanna on St. George May 19 and 23, 1914, and the latter's note of May 26, 1915, when he saw large flocks crossing between St. Paul and Otter Islands. Palmer collected several about Polovina, St. Paul Island, between June 10 and July 17, 1890, but thought that they did not breed. Hanna observed 2 at Halfway Point, St. Paul, June 20, 1915, and a pair each on St. Paul and St. George throughout the summer of 1919, but found no evidence of nesting.

Fall migrants begin to appear in mid-July. Palmer noted the first fall arrivals on July 17, 1890, I saw the first one on St. George July 14, 1914, and on July 16 found hundreds on the water about Walrus Island. These were largely still in breeding plumage. From that date until we left the Pribilofs, the last of August, I frequently observed the birds, usually in small numbers but sometimes in large flocks.

During the autumn the birds continue to be observed until quite late. Hahn's notes for St. Paul for 1910 follow: August 30, about 100 seen; a few to September 7; September 8, about 1,000; September 9, about 200; September 11, about 200; September 12, about 50; September 15 to 19, a few; October 2, many seen on way to Walrus Island; October 15, 1; October 19, 3; October 20, 2. On January 18, 1911, Hahn saw one on the water off Tolstoi Point, St. Paul. Hanna on St. George records the following observations in 1913: September 5, 4; September 15, 25; October 9, about 100, some in surf but mostly in fresh-water ponds; October 18, 12. His notes for St. Paul, 1914, follow: September 20, 1; October 25, 1 taken at Webster Lake; November 4, 1 in surf at village landing. Specimens taken on St. Paul by Hahn and Marsh, in 1910, 1911, and 1912, measured in the flesh as follows: Males, length $7\frac{3}{4}$ to $8\frac{1}{2}$ inches; extent, $15\frac{3}{16}$ to $15\frac{7}{8}$. Females, length, 9 to $9\frac{1}{8}$; extent, $16\frac{1}{4}$ to 17.

Food.—The red phalarope, one of the swimming snipe, is represented in the present collection by 53 well-filled and 2 nearly empty stomachs. While the phalaropes habitually alight and feed in water, it is evident from analyses of the contents of these stomachs that they

feed also on land, where they must obtain most of the flies and beetles they eat. The principal food items found in the 53 stomachs were: Crustaceans, 38.29 per cent; flies, 21.69 per cent; fishes, 18.18 per cent; caddisflies, 10.15 per cent; and beetles, 9.86 per cent.

Of the crustaceans eaten, 30.45 per cent of the total of 38.29 per cent were identified as amphipods and probably part of the unidentified belonged to the same group. Amphipods were found in 22 stomachs, but could be determined to the species in only 2 cases, these being *Gammarus pribilofensis* and *Pontogeneia inermis*. Another group of crustaceans, while contributing only a trace to the food of the red phalarope, is of considerable interest as an item of avian diet, because its members are so small, bordering on microscopic size. These are the water fleas (Daphniidae), which, as ordinarily seen by human observers, appear like dancing motes in waters pierced by the sunbeams in which they love to gather. The contribution of these little animals to the food of the phalarope is their egg cases (ephippia), each a twin sac inclosing the two relatively large black eggs. These were found in 6 stomachs, no fewer than 50 of them being taken from one stomach, and in this single instance they amounted to 5 per cent of the contents.

Two-winged flies (Diptera) and their larvae and pupae were found in more than half of the gizzards examined and constituted 21.69 per cent of the total food. The kinds most frequently taken were members of the dung-fly family (Scatophagidae) and the adults and larvae of midges (Chironomidae). Seventy of these larvae were found in a single stomach. The determinations of flies, other than as just mentioned, were: Anthomyiidae, blowflies (Muscidae), dung-flies (*Scatophaga crinita*, *S. dasythrix*, and *Scatophaga* sp.), soldier-flies (Stratiomyidae), and crane-flies (Tipulidae).

Fishes were the next most important element of the food of the red phalarope, being found in 15 stomachs and composing 18.18 per cent of the total subsistence. All taken were small sculpins (Cottidae). Caddisflies and their larvae were taken by 14 birds and formed 10.15 per cent of the food. These live in fresh water and the larvae construct cases of a variety of materials in which they pass the immature stages.

The only remaining item of any importance in the diet of this species is beetles (9.86 per cent). Ground beetles of the genus *Pterostichus* were taken more frequently than any other kind, occurring in 11 stomachs. Another beetle (*Amara* sp.) of the same family was identified, and in addition the following: Rove beetles, including *Atheta* sp., *Hadrotes* sp., and *Olophrum fuscum;* diving water beetles, including *Ilybius angustior;* and *Aegialites californi-*

cus, a beetle of a peculiar family having a few species along our western coast.

Hymenoptera, mostly small parasitic wasps (*Plesignathus* sp.), the only other insects eaten, were found in 5 stomachs and spiders in 1. Mollusks were taken by two birds and marine worms (Nereidae) by one.

Vegetable matter constituted less than half of 1 per cent of the contents of the 53 stomachs of red phalaropes examined, and is to be considered as an accidental rather than genuine article of food. It consisted entirely of seeds, of which those of violet (*Viola* sp.) were found in 5 stomachs, sedge (*Carex* sp.) in 2, and the following in 1 each: Crowberry (*Empetrum nigrum*), lousewort (*Pedicularis sp.*), and bog bean (*Menyanthes trifoliata*).

Lobipes lobatus (Linnaeus). NORTHERN PHALAROPE.

The northern phalarope is apparently a fairly abundant migrant on the Pribilofs, although I have no definite information on this point. It breeds in small numbers on both St. George and St. Paul.

Elliott first recorded the bird (1874, unpaged, and 1875, p. 181) and took downy young on St. George in 1873. Palmer found the birds nesting near Rocky Point, St. Paul, July 2, 1890, also collecting newly hatched young. I observed several, apparently nesting, near the latter locality on June 27, 1914. Hanna saw four pairs near the same place on June 14, 1915. The earliest spring date is of a specimen taken by Hanna on St. George, May 23, 1914. The latest dates are also represented by specimens: August 15, 1914, St. Paul, Hanna; and August 17, 1897, St. Paul, Greely and Snodgrass.

A female specimen collected by Marsh on St. Paul Island, June 1, 1912, measured in the flesh: Length, $7\frac{3}{4}$ inches; extent, $14\frac{1}{8}$.

Family SCOLOPACIDAE.

Limnocryptes gallinula (Linnaeus). EUROPEAN JACKSNIPE.

The only record of the European jacksnipe as an inhabitant of the Pribilofs is based on a specimen taken by G. Dallas Hanna and recorded by him (1920b, p. 173) as follows:

> Some time during the spring of 1919, probably in April, a native on St. Paul Island secured one of these birds and very kindly kept the skin for me until my arrival. The identification was made by Mr. Joseph Mailliard, of the California Academy of Sciences. This is a new record for the Pribilof Islands and for North America.

The specimen is deposited in the collection of the California Academy of Sciences. The species breeds generally in northern Eurasia east to the Kolyma River, and occurs in migration and in winter south to India and Burma, and occasionally to Japan and Formosa.

Limnodromus griseus scolopaceus (Say).[9] Long-billed Dowitcher.

A female specimen of the long-billed dowitcher taken on St. Paul Island, September 18, 1919, by G. Dallas Hanna, and recorded by him (1920b, p. 173) constitutes the first record for the Pribilofs.

Later Mr. Hanna took 2 additional specimens, a male and a female, at Northeast Point, St. Paul Island, August 29, 1920. These are recorded by Mailliard and Hanna (1921, p. 95). All these specimens are in the collection of the California Academy of Sciences.

Food.—Two stomachs, of the two specimens last mentioned from St. Paul Island, have been examined and their contents were almost exclusively the larvae of midges (Chironomidae), of which there were more than 75 in one gizzard and more than 100 in the other. Vegetable débris, amounting to 3 per cent by bulk of the stomach contents, also was present, and it probably was picked up incidentally with the midge larvae. Included in the vegetable matter were seeds of bottle brush (*Hippuris vulgaris*), sedge (*Carex* sp.), and water chickweed (*Montia fontana*).

Arquatella maritima couesi Ridgway. Aleutian Sandpiper.

The Aleutian sandpiper, which breeds mainly on the Alaska Peninsula, visits the Pribilofs in the autumn and lingers in small parties about the icy shores until winter. It has also been observed early in spring, sometimes about the pack ice. It was first ascribed to the islands by Seale (1898, p. 139), from specimens taken on St. Paul Island in the late summer of 1897 by R. E. Snodgrass and A. W. Greely. There is reason to believe, however, that this record is based on mis-identified specimens. These are now supposed to be in the collection of Leland Stanford University. At the request of the writer, Dr. Walter K. Fisher kindly attempted to look up the pertinent specimens but was able to find only one which could reasonably be supposed to be in part the basis of the record. This specimen (No. 3498, an immature female, labeled *T. couesi*, taken July 25, 1897) he kindly forwarded for examination. This proved to be an undoubted example of the breeding species *A. m. ptilocnemis*, and is in the usual plumage of the immature bird at this season. It is possible that later research will bring to light other specimens of the Snodgrass-Greely collection which are actually referable to *A. m. couesi*, but the writer is rather inclined to the belief that they will all prove to be the breeding form, which gathers abundantly on the beaches in late summer, and includes many small specimens which, without close examination, might be considered to be the Aleutian form.

However this may be, the species has been definitely added to the list by Hanna, who took specimens on St. Paul Island in the autumn

[9] *Macrorhamphus g. scolopaceus* of the A. O. U. check list, 1910.

of 1914 and in the spring following. His notes of occurrence are as follows: 1914, September 16, 4 observed (1 taken now in the collection of the Biological Survey); October 17, 1 taken (female No. 237527, U. S. Nat. Mus.); October 25, 4 seen at Northeast Point; November 16, 8 seen; November 27, 4 seen at Lukanin beach, 2 taken (males, Nos. 237525 and 237526, U. S. Nat. Mus.). 1915, March 5, 1 seen in pack ice; April 24, 1 taken at Northeast Point (No. 237524, U. S. Nat. Mus.). This last specimen has begun to acquire the reddish summer feathering on the back and the sides of the breast.

Mailliard and Hanna (1921, p. 94) have recently recorded a specimen, not sexed, taken on St. George Island, February 12, 1917. This is in the collection of the California Academy of Sciences.

Arquatella maritima ptilocnemis (Coues). PRIBILOF SANDPIPER.

Tringa ptilocnemis Coues, in Elliott, Report Seal Islands, Alaska, 1874, unpaged; 1875, reprint, p. 182 (type from St. George Island).

The Pribilof sandpiper breeds in some numbers on both St. Paul and St. George. It is absent from the Pribilofs during the colder months, leaving in October, and returning in middle or late April.

Veniaminof in 1840 (Trans. by Elliott, 1874 unpaged, and 1875, p. 242) listed "a few kinds of *Tringa*" as occurring on the Pribilofs, and may reasonably be supposed to have observed the only species of the group which breeds; the species, however, was first definitely recorded by Dall, who obtained a specimen on St. George and listed it under the name *Tringa maritima* (1869, p. 291). Later both Dall and Coues listed the species as *Tringa crassirostris*, but Coues, assured of its novelty, in a footnote (in Elliott, 1874, not paged, p. 182 of 1875 reprint) gave it the specific name it now bears. About the same time, Harting (1874, p. 243) bestowed upon it another name, *Tringa gracilis*.

Hanna in 1914 saw seven individuals at Zapadni, St. George Island, on April 14. His records of observations on St. Paul in the spring of 1915 are as follows: April 24, about 50 seen in flocks; a male taken on this date had nearly finished acquiring the breeding plumage, but still retained a few traces of the winter feathering; April 26, about 50 (in flocks); May 2, about 30 (pairing); May 4, 18 (about all paired); May 9, 20 (about all paired); May 18, 12 (in pairs); May 28, 8 (in pairs).

This sandpiper nests on the higher lichen-covered parts of both St. George and St. Paul, and as far as known, on only one other group—St. Matthew. The first eggs known, a set of 4, were taken by H. W. Elliott and G. R. Adams on St. George, June 19, 1873. Another set of 4 was taken by True and Prentiss on St. Paul, July 6, 1895. More recently a number of sets have been taken on St.

George Island by G. Dallas Hanna and others, and Mr. Hanna (1921a, pp. 50–57) has published a very full and interesting account of the nesting of the species, with description and measurements of the eggs, and the present place of depository of the 23 sets of which he has knowledge.

The experience of the writer is limited to a few observations made on the two main islands of the group in the summer of 1914. A few pairs attending young were found on the breeding grounds near the Polovina Lakes, St. Paul, on June 28, and adults and downy young were collected. Both sexes had been brooding as shown by the bare spots on the sides of the abdomen. They were still lingering about their breeding grounds here on July 20, and perhaps later. About August 9 the birds began to be common about the beaches, the flocks there apparently being in excess of the number breeding on the islands, and in all probability, therefore, comprised in part of migrants from other breeding stations. They continued to be abundant until my departure the last of August. A young female bird taken August 28 still retained some of the down of the juvenal plumage on the postauricular region. During our brief visits in mid-July and early August to St. George Island, where the bird breeds more abundantly, many were observed, on the former occasion near their breeding grounds, and in early August mainly about the beaches.

About the middle of July, when the earlier nesting birds are freed from family cares, they begin to resort to the beaches to feed, and at night gather in flocks to roost on some favorite rocky point. Later the young join the adults and the flocks increase in size through August.

The majority of the birds leave by mid-September. Hahn in 1910 observed a few on St. Paul during September and early October; his latest date is October 20. Hanna in 1913 noted the species on St. George as follows: August 30, 20 seen; September 4, 20; September 11, 500; September 15, about 75; September 28, 4. Hanna's notes for St. Paul, autumn of 1914, are as follows: September 14, large flocks going south; September 16, about 500 individuals seen, the majority have gone; September 20, about 200; September 22, about 30; October 4, 20; October 17, 10.

The species winters as far as known on the mainland of southeastern Alaska and has not been observed on the Pribilofs later than the dates above noted, being replaced at that season, in a measure, by the Aleutian sandpiper, as detailed in the account of that species.

Males taken by Hahn and Marsh measured in the flesh: Length, 8 to 9¼ inches; extent, 16 to 16$\frac{3}{16}$; females, length, 9⅝ to 10⅛; extent, 16¾ to 17⅛. A female taken on St. Paul, October 19, 1910, by Hahn,

had the bill horn color at base, dusky at tip; feet dusky greenish, tarsus horn color.

Food.—More stomachs of the Pribilof sandpiper have been available for examination than of any other species, the total being 198, of which 6 were nearly empty (and consequently excluded from computations, the results of which are here cited). The articles of food composing more than 1 per cent of the total were: Mollusks, 32.63 per cent; crustaceans, 29.15 per cent; flies (Diptera), 23.49 per cent; beetles, 10.29 per cent; marine worms, 1.27 per cent; and vegetable matter, chiefly algae, 1.21 per cent.

The molluscan food, although the largest single item, was little varied, consisting chiefly of univalves, and these mostly of the genus *Littorina*. Unidentified species of this genus were found in 33 stomachs, and *L. sitchana* in 53. Several stomachs held large numbers of this species, the maximum count being 205. One other univalve (*Neritina sitchana*) was determined among the food, and 3 kinds of bivalves, namely, *Pisidium hannai* in 1 stomach, blue mussels (*Mytilus edulis*) in 14, and *Modiolus modiolus* in 7. One of these stomachs yielded 40 of the last-named species.

Like the molluscan food of the Pribilof sandpiper, the crustacean also was very uniform, being almost entirely amphipods. Unidentified amphipods were found in 43 stomachs, *Gammarus pribilofensis* in 20, *Gammarus* sp. in 9, and *Orchestia* sp. in 1. Isopods, named as *Idothea* (?) *ochotensis*, occurred in 2 gizzards, and eggs of water fleas (Daphniidae) in 1.

The third item in rank among the food staples of this sandpiper, two-winged flies (Diptera, 23.49 per cent), includes larvae, pupae, and adults of a variety of forms. Crane-flies (Tipulidae, *Tipula* sp.), either the larvae or adults, the latter often with eggs, were most frequently identified, and various members of the dung-fly family (Scatophagidae) next. Flies of the latter group determined were: *Scatophaga crinita*, *S. furcata*, *Leria fraterna*, and *L. leucostoma*. Blowflies, so numerous on the Pribilofs when large numbers of rotting seal carcasses are present, were eaten by 12 of the birds. As many as 23 of one of these flies (*Calliphora vomitoria*) were found in a single stomach, and no fewer than 112 larvae of blowflies in another. Kelp-flies (*Coelopa eximia*, *Coelopa* sp., and *Fucellia* sp.) occurred in 10 stomachs.

Beetles, last of the major elements of the Pribilof sandpipers' food, 10.29 per cent in all, were a varied lot. Ground beetles were distinctly the favorites, those of the genus *Pterostichus* being found in 33 stomachs, and in numbers as great as 21, 25, and 31 in three instances. Larvae as well as adult beetles of this family were eaten, and the following forms in addition to the genus already mentioned

were determined: *Amara brunnipennis*, *Amara* sp., and *Patrobus septentrionis*. A small species of the burying beetle family (Silphidae), by name *Lyrosoma opaca*, was eaten by 3 birds, unidentified rove beetles (Staphylinidae) by 7, and others of the latter family as follows: *Atheta* sp., 1; *Tachinus apterus*, 1; *Tachinus* sp., 8; and *Olophrum fuscum*, 2. One of the moss beetles (*Byrrhus fasciatus*) was found in 3 stomachs, a click beetle (*Hypnoidus musculus*) in 2, a leaf beetle (*Chrysomela subsulcata*) in 2, the beach beetle (*Aegialites californicus*) in 3, and a weevil (*Lophalophus inquinatus*) in 3.

Of the remaining insects in the dietary of this bird, caddis larvae were found in 4 stomachs, a plant bug (*Irbisia sericans*) in 1, a moth in 1, caterpillars in 2, and Hymenoptera in several. Identified forms of the last group were all parasitic wasps, representing the following genera: *Gelis*, *Seleucus*, *Bathymetis*, *Stiboscopus*, *Phygadeuon*, and *Amblyteles*.

Mites were found in 1 stomach examined and spiders in 5. Marine worms, chiefly of the family Nereidae, composed 1.27 per cent of the food, and as many as 38 individuals were represented in a single stomach. A sculpin (*Myoxocephalus* sp.) was eaten by 1 of the birds studied. It is of interest to note that material, no doubt taken for grinding purposes, included in a few cases bits of bone, and in one instance a molar tooth of the lemming (*Lemmus nigripes*).

Vegetable matter, 1.21 per cent of the total food of the species, consisted chiefly of algae, including kelp and plume algae (*Ptilota* sp.). Bits of moss also were eaten and a few seeds of the following plants: Grass, lupine (*Lupinus nootkatensis*), violet (*Viola langsdorfii*, crowberry (*Empetrum nigrum*), and bottle brush (*Hippuris vulgaris*).

Pisobia acuminata (Horsfield). Sharp-tailed Sandpiper.

The sharp-tailed sandpiper was first recorded from the Pribilofs by Seale (1898, p. 139) on the basis of a specimen taken by R. E. Snodgrass and A. W. Greely on St. Paul Island August 19, 1897. (Grinnell (1901, p. 20) gives the date of what is apparently the same specimen as August 17.) Bishop, touching at St. George on October 3, 1899, saw about a dozen and took 3 (1900, p. 66). The bird has since been found to be a regular fall migrant and is sometimes abundant. Hahn recorded it in small numbers on September 7 and 24, October 11 and 20, and November 9, 1910. A male taken by Hahn on St. Paul on October 8 is in the collection of the Biological Survey.

Hanna, in 1913, took specimens on St. George on August 30, September 5 and 6, and October 18. In 1914, on St. Paul, he observed a few on August 29, September 14 and 20, and 1 on Octo-

ber 12. The same observer noted the species in large flocks, together with the pectoral sandpiper, on the seal-killing fields of St. Paul during the early autumn of 1919.

Two males taken by Marsh October 11, 1911, measured, respectively: Length, 9⅛ and 8¾ inches; extent, 17½ and 17. Females taken by Hahn measured as follows: Length, 8 inches; extent, 14¾ and 15¼.

Food.—Eight well-filled and 1 nearly empty stomach of the sharp-tailed sandpiper are available to illustrate the food habits. This number is too small to furnish reliable results, and too great dependence must not be placed in data as to the relative ranks of food items as here stated. The percentages found for the limited material, then, are flies (Diptera), 39.1 per cent; crustaceans, 18.1 per cent; mollusks, 14.2 per cent; caddisflies, 11.8 per cent; beetles, 8.8 per cent; Hymenoptera, 1.8 per cent; and vegetable matter, 3.9 per cent.

Mr. Hanna notes that flocks of this species frequent the seal-killing fields feeding on fly maggots, a statement receiving confirmation from stomach analysis. Blowflies (*Calliphora vomitoria*) were found in two stomachs and larvae of this or an allied species in another. Thirty-three rat-tailed larvae of flower flies (Syrphidae; Eristalinae), and those of crane flies (Tipulidae), and midges (Chironomidae) in 1 each.

Both caddis larvae and adults were eaten, and of the latter *Chilostigma praeteritum* was identified. Among the beetles, ground beetles are well represented by *Pterostichus* in 2 stomachs and the large gold and green beetle (*Carabus truncaticollis*) in 1. Other species of beetles eaten, each by 1 bird, except a weevil (*Lophalophus inquinatus*) by 2, were: A predacious diving beetle (*Hydroporus* sp.), rove beetle (*Tachinus* sp.), moss beetle (*Byrrhus fasciatus*), click beetle (*Hypnoidus musculus*), stores beetle (*Ptinus fur*), and a leaf beetle (*Chrysomela subsulcata*).

The few remaining insects found in stomachs of the sharp-tailed sandpiper were parasitic wasps (*Gelis* sp., and *Polyrhembia* sp.) and a plant bug (*Irbisia sericans*). Spiders were found in 1 stomach and amphipods in 2, these comprising the bulk of the crustaceans eaten. The vegetable matter in the stomachs consisted of plant fibers, further unidentified, which were probably taken accidentally.

Pisobia maculata (Vieillot). PECTORAL SANDPIPER.

The pectoral sandpiper is a migrant on the Pribilofs, evidently occurring mainly in early autumn, though the first record relates to June specimens. Palmer (1899, p. 404) obtained 2 specimens on St. Paul, June 12, 1890. The next instance of its capture seems to have been recorded by Bishop (1900, p. 66), who mentions a specimen shot on St. George Island by W. H. Osgood, October 3, 1899. Hahn took

specimens on St. Paul on September 11 and October 8, 1910; and Marsh collected the species on the same island on October 11, 1911, and May 30, 1912.

While on St. Paul Island in the summer of 1914 the writer first noted this species on August 17, when four were observed at Northeast Point; subsequent records, made near the village, follow: August 23, 7 observed; August 24, 30; August 25, 6; August 28, common; August 29, abundant. Following my departure on August 30, G. Dallas Hanna noted it: September 14, 18; September 16, 12; September 20, about 50.

Notes taken from the field catalogues follow: Male, St. Paul Island, October 8, 1910, W. L. Hahn: length, $8\frac{3}{4}$ inches; extent, $16\frac{1}{4}$; bill, horn color at base, dusky on terminal half; feet, greenish-yellow. Female, St. Paul Island, September 11, 1910, Hahn: length, $8\frac{7}{8}$ inches; extent, 17. Male, St. Paul, May 30, 1912, M. C. Marsh: length, $9\frac{3}{8}$ inches; extent, $17\frac{3}{8}$; legs and feet, yellowish-red; bill, black.

Food.—Included in the present study are 23 stomachs of this species, of which 2 collected long ago were imperfectly examined and are not available for reexamination. The food proportions here given, therefore, are based on the contents of 21 well-filled gizzards. The principal elements of the food are: Flies (Diptera), 54.5 per cent; amphipods, 22.3 per cent; vegetable matter, chiefly algae, 10.5 per cent; beetles, 8 per cent; Hymenoptera, 2.1 per cent; and bugs (Hemiptera), 1.3 per cent.

The Diptera eaten were almost exclusively larvae of crane-flies (Tipulidae; *Tipula* sp.), of which no fewer than 123 were in a single stomach among the 16 in which such larvae occurred. Kelp-flies (*Coelopa* sp.) were found in 2 stomachs. The beetles eaten were mostly ground beetles and their larvae, of which the following kinds were identified: *Amara brunnipennis*, *A. glacialis*, *Amara* sp., and *Pterostichus* sp. Other beetles eaten included a predacious diving beetle (*Hydroporus* sp.), rove beetles (*Quedius hyperboreus*, and *Hadrotes* sp.), and weevils (*Lophalophus inquinatus*). The Hymenoptera consumed were small parasitic wasps (*Amblyteles* sp. and *Campoplex* sp.), and the Hemiptera, the plant bug (*Irbisia sericans*). The only other insects eaten were caddis larvae. Mites and spiders were found in 3 stomachs each, and amphipods, the only crustaceans eaten, in 5.

The vegetable food, while largely algae, included also a few seeds of grass, lupine (*Lupinus nootkatensis*), and violet (*Viola langsdorfii*).

Pisobia bairdi (Coues). Baird Sandpiper.

The Baird sandpiper was added to the Pribilof list by Hanna (1916, p. 401), who took 3 specimens at Kaminista Lake, St. Paul

Island, August 31, 1914. Mailliard and Hanna (1921, p. 95) have recently put on record 2 specimens taken at Northeast Point, St. Paul Island, August 12, 1920.

Food.—The food secured by Baird sandpipers on the Pribilofs is known only from the contents of three stomachs taken August 31, 1914. They contained amphipods (partly *Gammarus* sp.), 73.6 per cent; algae, 11.6 per cent; beetles, 10.3 per cent; and a fly larva, 1 per cent. The beetles were ground beetles (*Pterostichus* sp. and *Patrobus septentrionis*), and a weevil (*Lophalophus inquinatus*).

Pisobia minutilla (Vieillot). LEAST SANDPIPER.

The first specimen of the least sandpiper known to have been taken on the Pribilofs was a female shot by Wilfred H. Osgood, at Kaminista Lake, St. Paul Island, August 29, 1914. It is now in the collection of the Biological Survey, and has been recorded by G. Dallas Hanna (1916, p. 401). Hanna also observed 2 on September 14 of the same year, and 1 on July 13, 1915, also on St. Paul. A second specimen, taken by Hanna at Northeast Point on St. Paul Island, August 27, 1920, has been recorded by Mailliard and Hanna (1921, p. 95).

Food.—The stomachs of the 2 specimens above mentioned were examined. One of them contained amphipods exclusively, and the other the following items: 23 seeds of bottle brush (*Hippuris vulgaris*), 50 per cent; bits of hydroid stems, 40 per cent; and chitin from the blue mussel (*Mytilus edulis*), 10 per cent.

Pisobia subminuta (Middendorff).[10] LONG-TOED STINT.

The specimen of the long-toed stint taken by Townsend in 1885, which added a new species to the North American list, still remains the only record for the Pribilofs. The occurrence was first put on record by Ridgway (1886, p. 275). Concerning the taking of the bird, Townsend says (1887, p. 100):

> By the capture of this Asiatic bird on Otter Island, Alaska, where I shot an adult female, in breeding plumage, on June 8, 1885, a species is added to the fauna of North America. It was feeding in a shallow salt-water pond, with other *Tringae*, which I supposed to be *Actodromas*.

The long-toed stint breeds in Kamchatka and other parts of eastern Siberia, including the Commander and Kurile Islands. In winter it occurs as far south as Australia and the Philippines.

Pelidna alpina sakhalina (Vieillot). RED-BACKED SANDPIPER.

The American dunlin was first observed on the Pribilofs by L. B. Bishop October 3, 1899, when during a short visit to St. George Island be observed a few (1900, p. 67). The first specimen, a male,

[10] *Pisobia damacensis* of the A. O. U. Check List, 1910.

was taken by Hahn October 30, 1910, and recorded by Evermann (1913, p. 17). It measured: Length, 7½ inches; extent, 14. It is now in the collection of the Biological Survey.

A second specimen, shot by Doctor Hunter on St. Paul Island, September 3, 1914, was preserved by Hanna, and is now in the U. S. National Museum collection. The reddish brown of the scapulars and tertials is nearly replaced by the gray of the winter plumage; sides of breast with small rounded black blotches. Another individual was observed at the same time.

Food.—The single available stomach of the red-backed sandpiper (St. Paul, September 3, 1914) was entirely filled with amphipods.

Ereunetes pusillus (Linnaeus). Semipalmated Sandpiper.

A female semipalmated sandpiper taken by Palmer on St. Paul Island, June 12, 1890, remains the only record for the Pribilofs. This specimen, which was recorded by Palmer (1899, p. 405), was in company with two pectoral sandpipers, evidently just arrived from the south.

Food.—The stomach of this specimen was found to contain remains of the beach beetle (*Aegialites californicus*), 10 per cent; fragments of small flies (Diptera), 85 per cent; and two seeds (not identified), 5 per cent.

Limosa lapponica baueri (Naumann). Pacific Godwit.

The Pacific godwit seems to be of regular occurrence in spring and fall. It was first recorded by Elliott who observed it in flocks of a dozen to 50 (1874 unpaged, and 1875, p. 187). Subsequent records of occurrence are few. Palmer took specimens on Walrus Island, June 13, and on St. Paul, July 7, 1890. Marsh collected a male on St. Paul, June 12, 1912; it measured: Length, 15½ inches; extent, 27¾. Hanna collected an adult female on St. George, September 7, 1913. In 1915, on St. Paul, he observed the bird as follows: May 20, 4 seen, 1 taken; May 26, 14; May 27, 30; May 28, 50 seen at Northeast Point.

Food.—Six stomachs of Pacific godwits collected on St. Paul and Walrus Islands by William Palmer in 1890 have been reexamined. Dr. S. D. Judd's analysis of their contents was published by Palmer (1899, pp. 405, 406), but the present report is an improvement in some respects over the original. The items of the food in rank by bulk, are flies (Diptera), 76.6 per cent; beetles, 17 per cent; mollusks, 3.6 per cent; marine worms (Nereidae), 1.3 per cent; and vegetable matter, 1 per cent. The fly remains were very largely midge (chironomid) larvae, but included also a few dung-flies (*Scatophaga* sp.). The beetles included as the principal item 450 or more beach beetles (*Aegialites californicus*), which made up 85 per cent of the contents of one stomach; and as lesser items, ground beetles

(*Pterostichus* sp. and *Amara brunnipennis*), rove beetle (*Tachinus* sp.), and a weevil (*Lophalophus inquinatus*). A caddisfly was the only other insect eaten. The mention of tiger beetles by Judd must be set down as a misidentification, based no doubt on the jaws of marine worms (Nereidae) which one of the stomachs contained. All of the mollusks eaten by the godwits were of a single species of univalve, *Littorina sitchana*.

The vegetable matter consisted of unidentified fibers and a few leguminous seeds, probably accidentally taken.

Totanus melanoleucus (Gmelin). GREATER YELLOW-LEGS.

A greater yellow-legs taken at Kaminista Lake, St. Paul Island, in 1897, by R. E. Snodgrass and A. W. Greely, was at last accounts in the collection of Leland Stanford University. Alvin Seale, who first recorded it (1898, p. 139), gives the date as August 23. Grinnell, reporting on the same collection (1901, p. 20), gives the date as August 17. However, Walter K. Fisher, in response to my request, kindly looked up the specimen and tells me that the label bears the date August 29, 1897. These details are given lest it be supposed that there are several specimens; there is apparently only one involved.

Hanna reports seeing one at close range on St. George on May 28, 1917, and another on St. Paul, June 10, 1919.

Totanus flavipes (Gmelin). LESSER YELLOW-LEGS.

Palmer saw a lesser yellow-legs among a flock of godwits, June 11, 1890, but failed to secure it (1899, p. 407). Hanna took a female specimen, now in the collection of the U. S. National Museum, on St. George Island, October 18, 1913, and has recorded it (1916, p. 402). These seem to be the only records.

Rhyacophilus glareola (Linnaeus). WOOD SANDPIPER.

A specimen of the wood sandpiper was taken on St. George Island May 19, 1914, by G. Dallas Hanna. This specimen, which was partially demolished by a blue fox and now consists only of the wings and one foot, is now in the collection of the Biological Survey, and has been recorded by Mr. Hanna (1916, p. 401).

The wood sandpiper breeds in northern Eurasia east to Kamchatka and Bering Island, and winters in northern Africa, southern Asia, Japan, and the Philippines. It had been taken once in Alaska previous to its capture on the Pribilofs.

Heteroscelus incanus incanus (Gmelin).[11] WANDERING TATTLER.

The wandering tattler is a rather common migrant in early and late summer, the outward spring and return fall movements being

[11] *Heteractitis incanus* of the A. O. U. Check List, 1910.

separated by only a short interval. The species was first recorded from the islands by Elliott (1874, unpaged, and 1875, p. 187). The available dates of occurrence, divided as nearly as may be into spring and fall records, are as follows: St. Paul Island, May 27, 1872, specimen (Elliott). Otter Island, June 8, 1885, specimen (Townsend). St. Paul Island, May 22, 1911, 1 seen; May 29, 1 seen; May 30, 2 seen (Hahn). St. Paul Island, May 31, 1915, 1 seen (Hanna). The earliest record marking the return movement is that of Hanna, who saw one on St. Paul Island, July 7, 1915. Palmer observed it on St. Paul July 10, 1890, and took specimens there on July 29 and 31. Hahn did not begin his observations on St. Paul in 1910 until about the 1st of September; his notes on this species are as follows: September 2, 2; September 4, 2; September 7, 3; September 8, 6; September 9, 3; September 11, 10; September 18, 3; October 4, 1. Hanna, on St. George, observed 4 singly on August 24, 1913, and collected 1.

During the late summer of 1914 the writer did not observe this species until July 27, when one was seen on Otter Island. On St. Paul a few were seen between Northeast Point and the village on July 29, and subsequently as follows: August 15, 1; August 16, 1; August 23, 2; August 25, 1; August 28, 4; August 29, 3. One was also observed on St. George on August 5. Following my departure from the Pribilofs G. Dallas Hanna recorded the species on St. Paul on the following dates: September 14, 8; September 16, 10; September 20, 3; September 22, 2. Hanna informs me he took specimens on St. Paul Island on August 18 and 27, 1920.

Food.—The six stomachs of wandering tattlers examined yielded quite a variety of food items of which those in excess of 1 per cent of the total, are: Flies (Diptera), 46.1 per cent; caddisflies, 30.6 per cent; amphipods, 16 per cent; mollusks, 3.6 per cent; and beetles, 1.1 per cent. One stomach was filled with blowflies (*Calliphora vomitoria*), another nearly so with dung-flies (*Scatophaga crinita*), and a third in like measure with kelp-flies (*Coelopa frigida*), and crane-fly larvae. Two of the stomachs were nearly full of caddisfly larvae. Amphipods (including *Gammarus* sp.) occurred in three of the gizzards but in quantity only in one. The mollusks eaten by two birds were univalves of the genus *Littorina*, 23 in one of the stomachs being *L. sitchana*. The only beetle was the large gold and green ground beetle (*Carabus truncaticollis*) and the only other insects were small parasitic wasps (*Polyrhembia* sp.). Concluding the enumeration of food items, one stomach contained a few bones of a small fish and another a little vegetable débris.

Heteroscelus incanus brevipes (Vieillot). POLYNESIAN TATTLER.

The Polynesian tattler has been taken on three occasions on the Pribilofs, the only North American locality. G. Dallas Hanna

first recorded it (1919a, p. 176, and 1920a, p. 250) and (l. c., p. 250) elaborates the circumstances as follows:

The history of the Polynesian tattler in North America dates back to October 4, 1911, when a female was secured on St. Paul Island by Mr. M. C. Marsh, then the naturalist of the fur-seal service. The specimen was placed in the National Museum collection without being detected as differing from the wandering tattler. It was discovered by Dr. H. C. Oberholser while he was verifying the identification of a second specimen of the same species, a female collected on St. Paul Island, September 2, 1917, by the writer. Owing to the difficulty of distinguishing the tattlers it may be that the Asiatic form comes across Bering Sea more frequently than the records would indicate.

A third specimen was taken later by Mr. Hanna, and is referred to as follows (1920b, p. 174):

A female Polynesian tattler (*Heteractitis brevipes*) was secured on St. Paul Island on September 17, 1919, near Kitovi Rookery. It makes the third specimen taken in North America. I had an opportunity to observe this bird for a while with two wandering tattlers in view at the time. The actions of the two species were practically the same. They feed very close to the sea on rocky shores and when disturbed fly lazily rarely more than 100 yards. The wandering tattlers on this occasion appeared perceptibly larger than the Polynesian, and the notes of the two were different. The latter uttered an irregular screech not of the same intensity or pitch, whereas the former gave its usual call, a series of 6 to 10 individual notes uttered in the same pitch and rapid succession but each of shortening duration.

The Polynesian tattler breeds in eastern Siberia, including Kamchatka, and moves southward in winter to China, Japan, the Malay Peninsula, and Australia. It has also been taken on Bering Island in the spring migration.

Philomachus pugnax (Linnaeus).[12] RUFF.

An immature female ruff taken by W. L. Hahn on St. Paul Island, September 7, 1910, formed the basis for Evermann's account, crediting the species to the Pribilofs (1913, p. 18). This specimen, which is now No. 239169 of the collection of the Biological Survey, is the first one taken on the western coast of North America. Hahn's field catalogue shows that it measured in the flesh: Length, 11⅜ inches; extent, 23¼.

The ruff is of wide distribution in central Eurasia, occurring eastward rarely to Japan and China, and in winter moving southward to Africa and India.

Numenius hudsonicus Latham. HUDSONIAN CURLEW.

The Hudsonian curlew has been recorded a few times from the islands on what appears to be excellent authority, but no specimens have been taken. It was first added to the list by Palmer, who recorded one seen at close range on St. Paul Island by F. A. Lucas,

[12] *Machetes pugnax* of the A. O. U. Check List, 1910.

July 16, 1897. The St. Paul Island log, under date of May 27, 1903, refers to "curlew" as having been "here last few days" (notes taken by Hahn). Hahn himself noted the bird as follows: August 29, 1910, 1 seen; September 2, 1 seen flying over pond; September 25, 1 seen flying over lagoon.

While on St. Paul Island in 1914 the writer saw 2 curlews, which seemed to be of this species, flying over the shallow ponds near the village of St. Paul. On May 18, 1915, G. Dallas Hanna observed 6 individuals on St. Paul.

Numenius borealis (J. R. Forster). ESKIMO CURLEW.

The Eskimo curlew was first recorded by Coues (in Elliott, 1874, unpaged; 1875, p. 189). He says:

> A single specimen only of the Esquimaux curlew was taken by Mr. Elliott on St. Paul's Island, June, 1872. None other than this one was seen by him.

Palmer lists the specimen as No. 62448, adult male, May 26, 1872. This specimen is still, and will probably remain, the only record for the Pribilofs.

Numenius tahitiensis (Gmelin). BRISTLE-THIGHED CURLEW.

The bristle-thighed curlew, which had previously been taken on the mainland of northern Alaska, was added to the Pribilof list by G. Dallas Hanna, a specimen having been taken by him on St. George Island, May 26, 1917, and recorded by the collector (1919a, p. 176, and 1920a, p. 252). This specimen is now No. 255154 of the bird collection of the U. S. National Museum. The species winters on Hawaii and other islands of the south Pacific.

Family CHARADRIIDAE.

Pluvialis dominica fulva (Gmelin).[13] PACIFIC GOLDEN PLOVER.

The western race of the golden plover visits the Pribilofs regularly in spring and fall, still in fair numbers, although it is probably much less common than formerly. It was first recorded from the group by Coinde (1860, p. 400), who considered it identical with European specimens. Elliott (1874, unpaged, and 1875, p. 180) observed it as a spring and fall migrant, and the single specimen preserved by him was identified by Coues as *Charadrius fulvus*.

Coinde's specimens taken by Warneck seem to have been unusually early visitors; they were taken on St. Paul April 18 and 20, 1852. Elliott's specimen was collected on St. Paul May 1, 1873. Palmer (1899, p. 408) took a single specimen, the only one he saw, on St. Paul June 12, 1890. Hahn took 1 on May 7, 1911. Hanna's earliest date for 1915 is May 9, when the natives reported seeing 12 at Halfway Point, St. Paul; he noted 8 on May 17, and 1 on May 28. These are all the spring dates available to the writer.

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[13] *Charadrius dominicus fulvus* of the A. O. U. Check List, 1910.

Dates of arrival in the autumn are more common. From the St. Paul Island log Hahn extracted the following notes: October 10, 1897, several killed; October 19, 1901, many came. Hahn himself, in 1910, observed the species on St. Paul as follows: September 3, 6; September 4, 1; September 7, 3; September 11, 5; October 3, 1; October 11, 4; October 18, 2; October 19, 6; October 20, 6; October 23, 2; October 24, 2. Hanna, on St. George, noted the species in the autumn of 1913 as follows: September 4, 2 seen; September 7, 15 seen on high tundra, 1 taken; September 28, 4; October 9, 4; October 18, 8 on uplands. He also noted 4 on St. George on November 5, 1916.

My own dates for St. Paul Island in 1914 seem to be the earliest fall records available: August 7, 1 observed; August 10, small flock; August 15, 3; August 17, 4 at Northeast Point; August 24, 2. Continuing observations after my departure, Hanna noted the bird as follows: September 3, 4 seen, 1 with black belly; September 14, 6; September 20, 30; October 4, 3; October 25, 2 at Northeast Point.

Food.—Elliott and Hanna both note that Pacific golden plovers frequent the seal-killing grounds on the Pribilofs and feed extensively upon the blowfly maggots there. However, in the two stomachs available for examination (St. Paul, June 12, 1890, Palmer; and September 3, 1914, Hanna) none of these larvae were found, their food contents consisting of beetles, 72.5 per cent; flies, 22.5 per cent; Hymenoptera, 4 per cent; and seeds of crowberry (*Empetrum nigrum*), 1 per cent. The beetles were chiefly ground beetles (*Pterostichus* sp., *Amara* sp., and *Carabus truncaticollis*), but rove beetles (Staphylinidae) and leaf beetles (*Chrysomela subsulcata*) also were eaten. The flies devoured were chiefly crane-fly larvae (Tipulidae), and the Hymenoptera were partly a new species of parasitic wasp (*Amblyteles alpestriformis*) and partly unidentified. Hahn noted several chrysomelid beetles and some dry grass blades in a stomach examined by him.

Charadrius semipalmatus Bonaparte. SEMIPALMATED PLOVER.

The semipalmated plover is known only from a specimen taken from a small flock at Northeast Point, St. Paul Island, July 6, 1895, by D. W. Prentiss, jr., and first published by Palmer (1889, p. 408). Prentiss later (1902, p. 102) gives the following details regarding its capture:

> Saw a number on the sands at Northeast Point, on July 6, and as I only had my beanshooter, I failed to get more than one, which was a poor specimen. This is an addition to the avifauna of the Islands.

The specimen is now No. 153543, adult female, of the bird collection of the U. S. National Museum.

Arenaria interpres interpres (Linnaeus). PACIFIC TURNSTONE.

The Pacific race of the turnstone, first recorded from the Pribilofs by Coinde (1860, p. 400), occurs only as a migrant, mainly in fall, when it stops for rest and food before starting on its long journey to its wintering grounds.

I have only two dates of occurrence which may be classed as spring migration. Hahn took a specimen May 24, 1911. It measured in the flesh: Length, 9½ inches; extent, 19¼. The other, taken by M. C. Marsh May 30, 1912, measured: Length, 9⅛ inches; extent, 18 3/16; the legs and feet were orange red. These specimens are in the collection of the Biological Survey.

The first fall arrivals come some time in July; the earliest date I find is July 2, 1895 (Prentiss, 1902, p. 102). Hahn, reaching St. Paul in late August, 1910, found the bird abundant. His notes for the remainder of the autumn follow: September 1 to 15, still common, flock seen leaving September 10; September 15 to 30, less common, flock seen on September 24; October 2, some on Walrus Island; October 3, 7; October 4, 9; October 5, 3; October 6, 2; October 18, 5; October 19, 1; October 20, 2 (single ones). Hanna, making observations on St. George in 1913, noted the species as follows: August 30, 4 seen; September 4, 2; September 5, 4; September 15, 15.

My notes for St. Paul in 1914, are the most complete available; they follow: July 11, first observed, abundant, and remained so until the 17th; common July 18, 19, 20, 21, 24, 25; abundant July 28 to 30; common August 3, 4, 7; abundant August 9, and from August 21 to 30. Continuing observations after my departure, Hanna noted the bird as follows: September 14, large flocks; September 16, about 500 observed; September 20, about 50; September 22, 5; October 12, 2; October 4, 6; October 17, 8; October 25, 3 at Northeast Point; October 24, 6 (all with sore feet).

Food.—As in the case of the Pacific golden plover, Elliott and Hanna both assert that turnstones feed almost exclusively on maggots in the seal-killing fields during their stay on the Pribilof Islands.[14] The 12 well-filled stomachs of the bird from the islands do not bear out such far-reaching statements, but these larvae did compose most of the contents of one stomach. The food items of the 12 birds collected were found to be two-winged flies (Diptera), 50.83 per cent; caddis larvae, 16.25 per cent; beetles, 12.5 per cent; amphipods, 11.66 per cent; mollusks, 8.33 per cent; and seeds of crowberry (*Empetrum nigrum*), a few in one stomach, amounting to less than 1 per cent of the total food. Besides the blowfly larvae

[14] Mr. Hanna attributes (1921, p. 57) the same habit to phalaropes, and pectoral and sharp-tailed sandpipers also.

previously mentioned, the dipterous food included larvae of crane flies (numbering 82 and 110 in two instances), remains of dung flies (Scatophagidae), and other fly larvae and pupae. The beetles consumed were chiefly ground beetles, those identified being *Pterostichus* sp., *Amara brunnipennis*, *Amara* sp., and *Carabus truncaticollis*. A rove beetle (*Tachinus* sp.) and a click beetle also were found in the stomachs. The remains of mollusks in the diet were especially interesting, consisting of more than 400 operculi of univalves, apparently of a single species, which completely filled one gizzard. These objects, each of which forms a door closely fitting the aperture of the shell when the snail withdraws into its retreat, were chitinous in the present instance, and evidently had strongly resisted digestion; it is probable they would have been ejected in mass had the bird lived. Alvin G. Whitney in a field note states that turnstones searched over the whole mud bottom of a large pond for the ruby-red midge (chironomid) larvae, which were abundant there.

Family HAEMATOPODIDAE.

Haematopus bachmani Audubon. BLACK OYSTER-CATCHER.

A specimen of the black oyster-catcher was taken on St. George Island January 12, 1917, and was preserved and recorded by G. Dallas Hanna (1919a, p. 176, and 1920a, p. 253). It constitutes the first record for the Pribilofs and is now No. 255153 of the bird collection of the Biological Survey. Hanna comments as follows:

> There is good reason to suspect that this species has been shot on St. George Island before. One native told me he had given a bird like it to a Doctor Mills several years earlier but that it had spoiled before being prepared as a specimen (l. c., p. 253).

However, a specimen (No. 241645) taken by H. C. Mills on St. George Island, in the spring of 1913, is in the Biological Survey collection.

Family ACCIPITRIDAE.

Archibuteo lagopus sancti-johannis (Gmelin). AMERICAN ROUGH-LEGGED HAWK.

The American race of the rough-legged hawk was added to the Pribilof list by G. Dallas Hanna (1919a, p. 176, and 1920a, p. 253). His account (l. c., p. 253), in part, follows:

> One specimen, unsexed, was secured on St. George Island in the fall of 1917 by Mr. C. E. Crompton, of the U. S. Bureau of Fisheries. He has kindly consented to the record being included in this list.

This specimen is now No. 255159 of the bird collection of the U. S. National Museum.

Thallasoaetus pelagicus (Pallas). KAMCHATKAN SEA EAGLE.

G. Dallas Hanna has put on record the capture of a Kamchatkan sea eagle on St. Paul, thereby adding it to the Pribilof and to the North American list (1919a, p. 176, and 1920a, p. 250). His account (l. c., p. 250), in part, follows:

> A bird of this species was shot and wounded on St. Paul Island, December 15, 1917, but fell into the sea. Five days later it was picked up on the beach in badly decomposed condition. Enough of the specimen could be saved, however, to enable the identification to be made in the National Museum.

The incomplete skeleton is in the collection of the above institution. The species breeds in Kamchatka, and has been taken on Bering Island.

Haliaeetus leucocephalus alascanus C. H. Townsend. NORTHERN BALD EAGLE.

The status of the bald eagle in the Pribilof avifauna is somewhat doubtful, since no specimens have been taken. Palmer first recorded it, having exhibited an Unalaska specimen, which was recognized by the St. Paul natives as being occasionally seen about the islands.

According to the St. Paul Island log (notes extracted by Hahn) eagles were seen on April 29, 1907, and October 16, 1908. A large bird, evidently an eagle, was reported to Hanna as having been seen on St. George, December 21, 1913. These notes probably, though of course not certainly, refer to the common Alaska species.

Family FALCONIDAE.

Hierofalco rusticolus sacer (J. R. Forster). AMERICAN GYRFALCON.

The gyrfalcon is a more or less regular visitor to the Pribilofs. It was first credited to the group by Coues (in Elliott, 1874, unpaged, and 1875, p. 179) from a specimen in the collection from St. Paul Island, taken in March, 1873. The same specimen was referred to by Elliott in his subsequent accounts of the ornithology of the group. On September 24, 1880, a female specimen was taken while trying to alight on a Coast Survey vessel in Bering Sea, 60 miles east southeast of St. George Island. This was recorded by Bean (1882, p. 161). The two specimens above noted formed the sole basis for Palmer's account of the bird on the Pribilofs (1899, p. 418).

No other gyrfalcons seem to have been taken on the Pribilofs until the autumn of 1913, when G. Dallas Hanna took a female specimen on St. George Island, November 29. It had been noted on the cliffs along the shore for about a month. During the autumn of 1914, on St. Paul, he observed a few others, as follows: September 14, 1; September 20, 1; October 14, 1 (taken); October 25, 3; November 20, 1. Another individual was shot on St. George Island during the winter of 1915–16. During the following winter, 1916–17, St. George

Island was visited by so many gyrfalcons that the local wren (*Nannus alascensis*) and the rosy finch (*Leucosticte griseoucha*) were nearly extirpated. On November 30, 6 were seen, 3 of which were killed.

By offering a reward Hanna was able to secure a series of 13 specimens altogether. Six of these, taken during December, 1916, and January and February, 1917, are in the U. S. National Museum. These are mainly immature birds, but at least one in adult plumage is included in the series. Mr. Hanna was told that the birds were also unusually common on St. Paul Island during the same winter, but their destructive habits seem not to have resulted so disastrously to the smaller resident birds of St. Paul as was the case on St. George. Although all the available Pribilof specimens have been examined by the writer, his studies have not progressed far enough to permit a decision as to the form represented there. These birds are all, of course, migrants from some other region, but whether from North America or from Asia can not be determined without a more exhaustive study than is justified in the present connection. The subspecific designation above used is therefore employed only tentatively. It is believed, however, that only one form inhabits northwestern North America, to which the name *Falco sacer* (Forster, Phil. Trans., vol. 62, pp. 383, 423, 1772) appears to be applicable.

Food.—G. Dallas Hanna states in field notes that the stomach of the bird killed on St. George Island, November 29, 1913, contained feathers of a rosy finch (*Leucosticte griseonucha*), and that three birds shot there on November 30, 1916, had eaten snow buntings and rosy finches.

Falco peregrinus anatum Bonaparte. DUCK HAWK.

Palmer added the duck hawk to the Pribilof list (1899, p. 419). In the summer of 1890, on St. Paul, he "dug the remains of one from a sand dune; it had been killed the previous December." Hahn found a note on this species in the St. Paul Island log under date of December 14, 1904: "One shot but lost." The writer saw a duck hawk about the cliffs on Tolstoi, St. Paul, June 26, 1914; it was not identifiable subspecifically.

Falco peregrinus pealei Ridgway. PEALE FALCON.

This form of the duck hawk was added to the Pribilof list by Hanna, who took a female specimen on St. George Island, March 12, 1914, and has put the capture on record (1916, p. 401). The specimen is now No. 242571 of the Biological Survey collection. According to a manuscript report in the Biological Survey, H. P. Adams noted one on St. George Island, January 13, 1917.

Family STRIGIDAE.

Asio flammeus Pontoppidan. SHORT-EARED OWL.

The short-eared owl was added to the Pribilof list by Palmer (1899, p. 419) on the basis of one seen by him near the village of St. Paul, June 17, 1890. The natives reported seeing the species every winter.

W. L. Hahn took a specimen on St. Paul Island, November 8, 1910, which is now in the collection of the Biological Survey. It measured in the flesh: Length, 14 inches; extent, 39¾. A second specimen, also in the Survey collection, was taken by Hanna on St. George, February 28, 1914.

Food.—William Palmer noted that the bird under observation by him "often visited the same place during the night or early in the morning to feed upon the least auklets which were breeding in the vicinity" and, he adds:

> I often found on the moss a round patch of feathers which showed the fate of a Choochkie. A few are seen every winter by the natives, but they all agree that hawks and owls are more abundant on St. George, owing to the presence of numerous lemmings, which are entirely absent from St. Paul.

W. L. Hahn reports that the stomach of the specimen collected by him contained three shrews (*Sorex pribilofensis*).

Cryptoglaux funerea magna Buturlin. BUTURLIN HAWK OWL.

A female hawk owl taken by W. L. Hahn, on St. Paul Island, January 26, 1911, was recorded by Evermann (1913, p. 18) under the name *Cryptoglaux funerea funerea* and was considered a new record for the Pribilofs and for North America. The specimen, which is in the collection of the Biological Survey, has recently been examined by Dr. H. C. Oberholser, in the light of additional material, and found to be referable to *C. f. magna*, described by Buturlin from the Kolyma River, Siberia, and has been recorded by him (1922, p. 73). *C. f. magna* thus replaces *C. f. funerea* as a Pribilof and a North American bird.

According to Hahn's field catalogue this specimen measured in the flesh: Length, 10¼ inches; extent, 23½. Its stomach was empty save for a few hairs.

Cryptoglaux funerea richardsoni Bonaparte. RICHARDSON OWL.

Evermann added the Richardson owl to the Pribilof list on the basis of a male specimen taken by M. C. Marsh on St. Paul Island, February 2, 1912 (1913, p. 18). The field catalogues give the following notes taken from the fresh specimen: Length, 9¾ inches; extent, 22; iris, yellow; cere, blackish behind, pale forwards; bill, pale along culmen and gonys, the rest black; soles, light yellowish; claws, black.

Notes taken from the St. Paul Island log by Hahn record the capture of an owl, which from the detailed description could be no other than this species, on March 20, 1905; another was shot on May 22, and one was seen on May 23, of the same year.

Food.—The stomach of the specimen collected by Marsh, February 2, 1912, contained bones and fur of the house mouse.

Nyctea nyctea (Linnaeus). Snowy Owl.

The boreal snowy owl is rather frequently observed on both St. Paul and St. George during the fall and winter months. On a few occasions it has been observed in summer, but it has never been found to breed. It was first recorded from the Pribilofs by Elliott (1881, p. 136), who states that it was occasionally taken on either island, but that he saw none.

The following are the definite records of occurrence that have come to the attention of the writer: Palmer took 1 on St. Paul on June 13, 1890, and states that 1 was shot on St. George on June 10 of the same year. He is also authority for the statement that 7 individuals were shot by one of the Treasury agents during the winter of 1884–85 (island not stated), and that F. A. Lucas saw 3 during the summer of 1896. W. L. Hahn found records in the St. Paul Island log to the effect that 2 were seen December 4, 1904, and that 1 was shot March 5, 1905. Hahn himself noted the species on St. Paul as follows: November 5, 1910, 1 taken near Cove salthouse; November 8, 1 seen near Polovina; November 9, 2 seen, 1 shot; January 18, 1911, 1 seen at Black Bluffs. M. C. Marsh took specimens on the same island on November 20 and December 10, 1911. Hanna, collecting on St. George in the fall of 1913, noted the birds as follows: September 4, 1 seen; September 28, 1 seen at Garden Cove; October 9, 1 seen; December 21, 1 seen; he saw another on St. George, July 20, 1914. On St. Paul, in 1915, Hanna took a specimen, now in the U. S. National Museum, on February 7, and later observed the species as follows: April 4, 1; April 16, 1 (pursuing crested auklets); May 18, 2 seen on Hutchinson Hill. On St. George, he saw 1 on November 5, 1916.

The field catalogues show the following measurements of specimens taken on St. Paul: Female, November 5, 1910, Hahn, length, 25 inches, extent, 63¼; male, November 20, 1911, Marsh, length, 23, extent, 57; male, December 10, 1911, length, 21½; extent, 55¼.

Food.—G. Dallas Hanna states in a field note that an owl of this species has been known to snatch from the water an old-squaw duck which had been shot by a hunter. Usually, however, these owls remain on the highlands and apparently feed on the birds found there. No evidence has been seen that they feed on the St. George lem-

mings. Two stomachs of the snowy owl, both from St. Paul (June 13, 1890, Palmer; and February 7, 1915, Hanna) have been examined, one of which contained remains of the least auklet (*Aethia pusilla*) and the other a Pribilof shrew (*Sorex pribilofensis*).

W. L. Hahn examined one stomach which contained feathers of the burgomaster gull; and Marsh, two, each of which held three house mice (*Mus musculus*).

Family CUCULIDAE.

Cuculus canorus telephonus Heine. KAMCHATKAN CUCKOO.

A Kamchatkan cuckoo taken by William Palmer at Northeast Point, St. Paul Island, July 4, 1890, the capture of which is detailed by him (1899, p. 419), was the first taken in North America and remains the only record for the Pribilofs. It breeds in Kamchatka, Manchuria, Japan, and China.

Food.—Palmer states (l. c. p. 420) that the stomach of this bird, which was examined by Dr. S. D. Judd, contained more than 100 crane flies, many of them females full of eggs.

Family PICIDAE.

Colaptes auratus luteus Bangs. NORTHERN FLICKER.

A specimen of the northern flicker, obtained by James Judge on St. George Island in the autumn of 1904 (a short time previous to October 5), was sent to the United States National Museum. It was recorded by A. H. Clark (1910, p. 60) and is catalogued as No. 191769 of the bird collection.

Family MICROPODIDAE.

Micropus pacificus (Latham). JAPANESE SWIFT.

A female specimen of the Japanese swift was taken by G. Dallas Hanna on St. George Island August 1, 1920. It was flying about over the tundra and along the cliffs. The occurrence has been recorded by Mailliard and Hanna (1921, p. 93), and the specimen is deposited in the Museum of the California Academy of Sciences.

The Japanese swift breeds over a considerable part of eastern Asia, including Kamchatka, Japan, and northern China and has been reported from the Commander Islands.

Food.—The stomach of this bird contained remains of numerous dung flies (*Scatophaga crinita*) and of a few other Diptera.

Family CORVIDAE.

Corvus corax principalis Ridgway. NORTHERN RAVEN.

The raven has only recently been observed in its natural state on the Pribilofs. Elliott (1874, unpaged, and 1875, p. 178) is authority

for the statement that the species was several times introduced by the Russians, but that none of the birds remained.

Dall, in an account of the birds of the western Aleutians (1874, p. 274), states that a few young ones were taken to St. Paul in the spring [of 1873] in the hope that they might be of use in devouring the remains of seals killed there, "which cause a very offensive odor during the hunting season."

G. Dallas Hanna has recently recorded (1920b, p. 174) the occurrence of the species on St. Paul as follows:

> During January, 1919, heavy ice surrounded St. Paul Island, but the natives were able to get out from shore in their boats in the open leads for the excellent duck shooting. On one of these occasions three ravens were seen near Sea Lion Rock. One was shot and wounded but could not be secured. * * * Identification could hardly be mistaken. The occurrence was confirmed by several reliable men to whom the species was well known when they were in Unalaska. So in this case it seems worth while to make the record without the specimen.

Family ICTERIDAE.

Euphagus carolinus (Müller). RUSTY BLACKBIRD.

A specimen of the rusty blackbird taken near the lake at Northeast Point, St. Paul Island, October 20, 1911, by M. C. Marsh, proved to be the first noted from the Pribilofs, and was recorded by Evermann (1913, p. 18.) According to field catalogue this bird measured in the flesh: Length, $9\frac{9}{16}$ inches; extent, $14\frac{1}{8}$.

A second specimen, taken on St. Paul in the autumn of 1915 and presented by George Haley to Hanna, was sent to the Biological Survey. It is now catalogued as No. 242573.

Family FRINGILLIDAE.

Coccothraustes coccothraustes japonicus (Temminck and Schlegel). JAPANESE HAWFINCH.

Evermann's account (1913, p. 18) of a male specimen of the Japanese hawfinch taken by M. C. Marsh near the village, St. Paul Island, November 1, 1911, added this species to the Pribilof and to the North American lists. The following notes, taken from Marsh's field catalogue, were made from the fresh specimen: Iris pale; lower mandible pale, the upper rather bronzed, its base paler; culmen black near tip; tarsus and feet uniform pale; claws darker.

The species has a range in eastern Asia including Japan, Korea, Northern China, and eastern Siberia.

Fringilla montifringilla Linnaeus. BRAMBLING.

A male brambling, the first known to have been taken in North America, was captured in the watch house at Northeast Point, St. Paul Island, on October 25, 1914. It is now in the collection of the

U. S. National Museum and has been recorded by G. Dallas Hanna, who preserved the specimen (1916, p. 400).

The brambling has a very extensive range in northern Eurasia, breeding regularly east to Kamchatka and wintering mainly in southern Asia.

Food.—The stomach of the bird collected contained bits of seeds of bunchberry (*Cornus suecica*), 90 per cent; and fragments of bugs (Hemiptera) and flies (Diptera), 10 per cent.

Pinicola leucura kamtschathensis Dybowski. KAMCHATKAN PINE GROSBEAK.

A fine adult male specimen of the Kamchatkan pine grosbeak, taken on the tundra on St. George Island in October, 1915, and preserved by A. H. Proctor, has been recorded by J. H. Riley (1917, p. 210). It forms the first record for the Pribilofs and for North America. It was sent to the U. S. National Museum, where it is now catalogued as No. 253121 of the bird collection. As indicated by its name, it is the breeding form of Kamchatka.

Loxia leucoptera leucoptera Gmelin. WHITE-WINGED CROSSBILL.

A female white-winged crossbill was taken by G. Dallas Hanna near Halfway Point, St. Paul Island, August 9, 1920, and has been recorded by Mailliard and Hanna (1921, p. 93). When shot the bird was apparently feeding on the unripe seeds of wild parsnip. It is now in the collection of the California Academy of Sciences.

Food.—The stomach of this bird was entirely filled with remains of blowflies (*Calliphora vomitoria*). This is a remarkable meal for a crossbill and no doubt reflects the predominance of blowflies among food items available to the bird at the time.

Leucosticte griseonucha (Brandt). ALEUTIAN ROSY FINCH.

The beautiful Aleutian rosy finch is a rather common breeder on the Pribilofs, nesting on the three larger islands, St. George, St. Paul, and Otter, and remaining in small numbers throughout the winter. It is the most familiar species on the islands, especially on St. George, where it is most common. It was first added to the Pribilof fauna by Dall, who took specimens on St. George in 1868 (Dall and Bannister, 1869, p. 282).

Although a few may be present in winter the bulk of the summer residents arrive in early spring. Hahn recorded them as numerous on St. Paul April 4, 1911, when they were heard singing for the first time, and as evidently pairing on April 5. Hanna, making observations on St. George in 1914, noted the birds as very common, singing and apparently mating, on March 28 and April 8, and estimated the number seen on the latter date as 500. On April 22 he considered them much more abundant than in winter, and on May 6 estimated a total of 2,000 birds seen.

On St. Paul, where the bird is less abundant, Hanna's notes for the spring of 1915 follow: March 31, 30 seen, first heard singing; April 6, 30 seen, singing general; April 18, 60 seen, paired; April 24, about 300 seen.

A nest and a set of 5 eggs were taken by Lutz on Otter Island, June 16, 1884 (1889, p. 31). Several sets of fresh eggs were collected by Hanna on St. George, June 15, 1914; on June 16 a set of 6 about one-half incubated was found. A female bird taken July 15, 1914, was nearly ready to lay what was presumably her second set of eggs. The previous year, also on St. George, Hanna saw one young bird not able to fly on September 15, and a brood just flying on September 18. H. P. Adams took eggs on St. George on June 4, 1916.

During the summer of 1914 the writer found the bird common on St. Paul Island. On June 22 a nearly completed nest was found on a narrow shelf beneath an arched rock about 15 feet from the ground. On July 4 this nest contained its complement of 5 eggs. Another nest found the same day in a small cavity on the face of a cliff contained 5 eggs which were obviously on the point of hatching. The first young out of the nest were seen on July 2. The bird continued to be abundant up to the time of my departure the last of August. The nests are quite bulky and are built of grasses and the dry stalks of various herbaceous plants, with a lining of fine grass and feathers. Hanna found a nest on St. George in 1914 which had a lining of reindeer hair. The eggs, usually 5 or 6, are white with a faint gloss.

Hahn, on St. Paul, noted the birds as common during September, October, and November, 1910; December 3, 20 seen; December 8, a flock; December 16, numerous; December 21, a few; January 2, 1911, 2 seen; February 1, 1; February 2, 1; February 27, 3; March 2, 30 or 40.

Hanna, making observations on St. George in 1913, saw upwards of 1,000 at Garden Cove, on September 28; many were seen at various times during the fall and winter. In 1914, on St. Paul, he observed approximately the following numbers: September 14, 16, 20, and October 12, about 150 birds each day; October 17, 20; October 25, 150; November 27, 200; December 4, 200. 1915, January 10, 25; February 18, 50; March 5, 30.

Ten male specimens collected and measured in the flesh by M. C. Marsh on St. Paul in the fall and winter of 1911-12, ranged in length from $7\frac{5}{16}$ inches to $8\frac{3}{8}$, and in extent of wing from $12\frac{1}{2}$ inches to $14\frac{1}{8}$. A male bird taken by Hanna on St. George, December 19, 1913, is recorded as having eyes, brown; feet, black; and bill, yellow, black at tip.

In the winter of 1916–17, owing to an unusual visitation of gyrfalcons, the rosy finches living on the Pribilofs were nearly all destroyed.

During a trip made around St. George in May, 1917, Hanna saw not over 4 pairs. Since that time, however, probably through migration, the birds have nearly or quite reached their former numbers.

Food.—William Palmer says of the Aleutian rosy finch on the Pribilofs (1899, p. 426):

> I have picked from the mouth of a freshly killed bird the most minute insects, and have watched them feeding on the drying carcass of a seal hanging outside of the house of an Aleut, and they do not scorn the possibilities afforded by the decaying seal carcasses on the killing ground.

The birds visited the latter situations, no doubt, for the insects attracted there, not with any intent of eating flesh or offal. Indeed, they take a surprisingly low proportion of animal food, if we may rely on the results from the collection of 22 stomachs examined for the present report.

The food in these stomachs was found to be vegetable, 75.5 per cent; and animal, 24.5 per cent. The plant diet was chiefly seeds, but in a few cases bits of leaves and fruiting capsules were eaten. Seeds of crowberry (*Empetrum nigrum*) were found more frequently than any other (i. e., in 6 gizzards) and from 20 to 40 seeds were present in certain of these stomachs. The largest numbers of seeds eaten by any of these rosy finches were 250 and 450, in two instances, of those of brook saxifrage (*Chrysosplenium beringianum*). In one case also 160 seeds of sea parsley (*Ligusticum scoticum*) were contained in a single stomach. Other seeds eaten included those of grass, rush (*Juncus* sp.), sedge (*Carex* sp.), chickweed (*Alsine borealis*), buttercup (*Ranunculus* sp.), water chickweed (*Montia fontana*), cinquefoil (*Potentilla* sp.), and bluebell (*Campanula* sp.).

Of the animal food, approximately 21 per cent of a total of 24.5 per cent consisted of two-winged flies, 2 per cent of beetles, and 1 per cent of springtails. The flies consumed were chiefly crane flies (Tipulidae), and the beetles included ground beetles (*Pterostichus* sp. and others), leaf beetles (*Chrysomela subsulcata*), beach beetles (*Aegialites californicus*), and weevils. Caterpillars occurred in 2 stomachs and springtails (Aptera: Collembola) in 1. The latter insects were identified as *Isotoma violacea* var. *mucronata*, and the record is the first of the occurrence of this species on American territory.

Mr. Hahn noted the rosy finch feeding on seeds of poochka, or wild parsnip (*Coeloplcurum gmelini*), and of rye grass, and Mr. Hanna observed that in winter they appeared to feed almost exclusively on the seeds of poochka.

Acanthis hornemannii exilipes (Coues). Hoary Redpoll.

G. Dallas Hanna has added the hoary redpoll to the Pribilof list by recording a female specimen taken at the village, St. Paul Island,

April 21, 1915 (1916, p. 401). Later notes taken on St. Paul by the same observer include the following: April 20, 1915, 1 seen; August 22, 6 seen in company with a small flock of *A. linaria*.

Food.—The single stomach of this bird available for examination (St. Paul, April 20, 1915) contained seeds of a plant of the pink family (*Lychnis apetala*), of a chickweed (*Alsine* sp.), of a grass, and of an unidentified kind.

Acanthis linaria linaria (Linnaeus). REDPOLL.

The common redpoll was added to the Pribilof fauna by H. W. Elliott, who took specimens on St. Paul, June 21, 1872. These he preserved in alcohol, but they were in some way lost (1881, p. 136); he had previously mentioned (1874, unpaged, and 1875, p. 172) having seen a small flock of redpolls on St. Paul in late October, 1872. No others appear to have been seen until 1910, when Hahn, on St. Paul, observed redpolls, probably of this species, as follows: October 5, about 50 seen; October 19, about 15; October 20, 3 at Northeast Point. No specimens were taken on these occasions. In 1913, Hanna, collecting on St. George, observed 5 birds on September 7, and collected 3. On October 18, 9 others, 1 of which was taken, were seen. These specimens are in the collection of the Biological Survey. On St. Paul, in 1914, Hanna observed the species as follows: September 14, 2; October 14, 1; October 25, 3; 1915: February 18, 1; April 18, 1; August 22, 8 seen and 1 collected at Northeast Point. The bird is thus, in all probability, a more or less regular migrant.

Food.—G. D. Hanna reports a small flock observed feeding on wild parsnip on St. George Island, September 7, 1913. This plant is *Coelopleurum gmelini*.

Spinus pinus pinus (Wilson). PINE SISKIN.

The pine siskin was added to the list of Pribilof visitors by G. Dallas Hanna, who recorded the capture (1919a, p. 177, and 1920a, p. 254). He comments (l. c., p. 254) as follows:

> A male pine siskin was secured from a flock of 12 found among the Northeast Point sand dunes, St. Paul Island, on September 24, 1917. The birds seemed to be perfectly satisfied to feed on the seeds of the few ground plants which grow there.

This specimen was deposited in the bird collection of the U. S. National Museum, and catalogued as No. 255168.

Plectrophenax nivalis nivalis (Linnaeus). SNOW BUNTING.

A male specimen of typical *nivalis* taken by M. C. Marsh on St. Paul Island, March 31, 1912, was recorded by Evermann (1913, p. 18), being thus added to the Pribilof list. A snowflake taken on

St. George Island, October 3, 1899, by Wilfred H. Osgood also proves to be of the mainland race. It is now No. 165738 of the U. S. National Museum, Biological Survey collection.

Plectrophenax nivalis townsendi Ridgway. PRIBILOF SNOW BUNTING.

Plectrophenax nivalis townsendi Ridgway, Manual North Amer. Birds, p. 403, 1887 (type from Otter Island).

The breeding snow bunting was first definitely recorded from the Pribilofs by Dall (in Dall and Bannister, 1869, p. 283), under the name *Plectrophanes nivalis;* it is altogether probable, however, that Veniaminof in 1840 (Translation by Elliott, 1874, unpaged, and 1875, p. 242) referred to the present species under the name "snowfinch." The Pribilof bird was described as a race of the circumpolar species by Ridgway from a series of specimens which included No. 106695 (U. S. Nat. Mus., Otter Island, June 8, 1885, C. H. Townsend), indicated as the type specimen. It is a year-long resident of the islands.

The species nests on St. George, St. Paul, and Otter Islands. Palmer (1899, p. 425) has described the nest and eggs. He took sets on June 4 and 24, 1890; these eggs and a set taken on Otter Island, June 15, 1884 (Lutz, 1889, p. 31), furnish the only definite nesting dates available.

During the breeding season, the snow buntings keep rather closely to the more elevated parts of the islands and are seldom seen about the village or the beaches. Hahn noted the bird on St. Paul as follows: Numerous during fall of 1910; occasional in December; not found in village during mild weather; numerous in village December 21 and 27; also observed there on January 2, 4, 23, and 28, 1911; February 4 to 10, appear in the village daily; first heard singing March 18, singing full song March 31. By April 16 the birds had lost the buffy tinge and were pure black and white.

Hanna, making observations on St. George in 1913, noted the species frequently during the autumn and winter, stating that the birds left the higher parts of the island about the end of September. They were singing and mating on May 6, 1914. H. P. Adams noted the species on St. George, January 13, 1917.

On St. Paul in the autumn of 1914 Hanna noted the bird as follows: October 4, common in village: October 17, 2; October 25, 200; November 27, 20; December 13, 50. 1915: January 10, 50; February 18, 50; March 20, 10; April 6, 4 (singing); April 18, 30; April 24, 30; May 6, 4.

My own experience with the species is limited, being confined to the observation and collection of a few specimens on both St. Paul and St. George in 1914, when the birds, sometimes accompanied by their young, were found to be fairly common on their breeding grounds.

There are numerous specimens in the collection of the Biological Survey and the U. S. National Museum. Specimens from St. Paul measured in the flesh by Hahn and Marsh varied as follows: Length, 7 to 7¾ inches; extent, 12¼ to 13¾.

Food.—The stomachs of Pribilof snow buntings collected by William Palmer have been reexamined, but the writer is unable to reconcile great discrepancies between the findings of Dr. Judd and those of the present investigation. He contents himself, therefore, with a simple statement as to what was identified in the stomachs available, a total of 21, including two for which percentages were not estimated and which, therefore, are not included in the calculations of food proportions. The articles of food composing more than 1 per cent of the total contents of the 19 well-filled stomachs were: Vegetable matter, chiefly seeds, 50.5 per cent; two-winged flies (Diptera), 32.52 per cent; beetles, 5.3 per cent, and caterpillars and moths, 1.5 per cent. The seeds eaten included those of sedge (*Carex* sp.), rush (*Juncus* sp.), water chickweed (*Montia fontana*), buttercup (*Ranunculus* sp.), cinquefoil (*Potentilla* sp.), crowberry (*Empetrum nigrum*), and lousewort (*Pedicularis* sp.). From 47 to 81 seeds of the latter were found in the stomachs of the four birds eating them.

The Diptera eaten by the snowflakes were largely crane flies (Tipulidae), but dung flies (Scatophagidae) were eaten as well as larvae of a snipe fly (*Spania edeta*). Among the beetles, the leaf beetle (*Chrysomela subsulcata*) was identified more frequently (in 5 stomachs) than any other species, among which were ground beetles (*Amara* sp. and *Pterostichus* sp.), rove beetles (*Tachinus* sp.), and beach beetles (*Aegialites californicus*). Hymenoptera (*Amblyteles* sp. and a sawfly) were found in two stomachs, and a spider in one.

Plectrophenax hyperboreus (Ridgway). McKay Snow Bunting.

G. Dallas Hanna has added the McKay snow bunting to the Pribilof list (1919a, p. 176), and later commented as follows (1920a, p. 254):

> Since this species is known to wander from its only breeding place, St. Matthew Island group, to the mainland of Alaska, it has been expected and searched for on the Pribilofs for several years. But it was not definitely known to come until March 30, 1918, when a male in full winter plumage was secured on St. Paul Island. It and a female, which escaped, were found on the top of Rush Hill, the highest point of the island.

This specimen is now catalogued as No. 255167 of the collection of the U. S. National Museum.

Food.—The stomach of the specimen above mentioned contained the following food: Remains of more than 160 seeds, apparently of a sandwort (*Arenaria* sp.), 57 per cent; 14 or more rove beetles (Staphylinidae), 8 per cent; 1 larva of a leaf beetle (*Chrysomela*

subsulcata), 4 per cent; 3 sawfly cocoons, 15 per cent; 1 moth cocoon, 15 per cent; 4 fly pupae, and 1 adult long-footed fly (*Hydrophorus innotatus*), 1 per cent.

Calcarius lapponicus alascensis Ridgway. ALASKA LONGSPUR.

Calcarius lapponicus alascensis Ridgway, The Auk, vol. 15, p. 320, Oct. 1898 (type from St. Paul Island).

The longspur, one of the few small land birds breeding on the Pribilofs, is an abundant summer resident. It is in some respects the most pleasing of the bird population, owing to its habit of delivering its beautiful song on the wing, while it slowly flutters earthward. It usually arrives in early May, and departs by the end of October. It was first recorded by Elliott (1874, unpaged, and 1875, p. 178).

Hahn noted the bird as common and singing on St. Paul, May 13, 1911, and as singing on the wing on May 29. Hanna observed it on St. Paul in 1915 as follows: May 6, 6 seen; May 9, 15; May 16, 40; May 28, abundant. On St. George, in 1917, he notes that the birds arrived in a body, already paired, on May 8.

It nests in late June and July, and fresh eggs may be found even as late as early August. Elliott took fresh eggs on St. George on July 7 [1873] (1874, unpaged, and 1875, p. 178). Palmer, in 1890, found nests on St. Paul as follows: June 20, 5 eggs; June 21, 5 eggs; June 21, 3 eggs, 2 young; July 2, 6 young, well feathered; July 5, 5 young just from the nest. Prentiss, in 1895, found the species nesting as follows: St. Paul, July 1, 5 young partly fledged; July 2, 6 eggs, well incubated; July 3, 6 eggs, fresh; July 6, 3 eggs, fresh; St. George, July 21, 3 eggs, fresh; July 22, 1 young, very small (1902, p. 102). The nest is usually placed on a sloping place, sometimes in the shelter of a tuft of grass or a tall plant.

During my own visit to the Pribilofs in 1914 I found the bird rather common and quite generally distributed on St. Paul, St. George, and Otter Islands, throughout my stay from June 21 to the end of August. A nest containing 4 fresh eggs was found on St. George on August 4, at which time the birds were still giving their pleasant aerial song. During the same autumn, after my departure, G. Dallas Hanna observed large numbers of the birds during September. On October 4 he saw 10, and on October 12 noted that all had departed. In the autumn of 1913, on St. George, Hanna had observed the bird last on September 28, when he saw about 20. On St. George, in 1916, he noted that it was still abundant on October 26.

Hahn in 1910 saw the species frequently during September on St. Paul Island, and during early October noted it as follows: October 3, 10; October 4, 5, and 6, about 50 each day; October 8, less common; October 10, observed; October 11 (the last observation recorded) 10.

Specimens taken on St. Paul by Hahn and Marsh in 1910 and 1912 measured in the flesh as follows: Length, $5\frac{5}{16}$ to $6\frac{5}{8}$ inches; extent, $9\frac{1}{2}$ to $11\frac{11}{16}$.

Food.—The collection of stomachs of Alaska longspurs from the Pribilof Islands consists of the six collected by Palmer and examined by Judd, which are said (1899, p. 423) to have contained only insect cuticle and grinding material; and 18 others, of which one contained food so finely ground that percentages for its constituents could not be estimated. The principal items of diet of the remaining 17 were: Seeds of various plants, 26.5 per cent; two-winged flies, 38.3 per cent; beetles, 15.8 per cent; caterpillars and moths, 10 per cent; bugs, 6 per cent; spiders, 1.4 per cent; and parasitic wasps, 1.2 per cent.

The seeds eaten by these longspurs were from a variety of plants, of which sedge (*Carex* sp.), cinquefoil (*Potentilla* sp.), and violet (*Viola langsdorfii*) were most frequently taken. Others identified were grass, water chickweed (*Montia fontana*), poppy (*Papaver macounii*), brook saxifrage (*Chrysosplenium beringianum*), crowberry (*Empetrum nigrum*), and gentian (*Gentiana* sp.).

Flies contributing to the diet of the Alaska longspur were chiefly crane flies (*Tipula* sp.), but blowflies (*Cynomyia hirta* and *Calliphora vomitoria*), dung flies (*Scatophaga crinita*), and kelp flies (*Fucellia* sp.) also were consumed. The beetles were about evenly divided between ground beetles (Carabidae), weevils (*Lophalophus inquinatus*), and leaf beetles (*Chrysomela subsulcata*). None of the moths and caterpillars eaten were more closely identified, but among the Hymenoptera, small parasitic wasps were named as follows: *Amblyteles*, *Campoplex* (?), and *Tryphon* (?); and among the spiders, the single species *Tegenaria derhami*.

Passerculus sandwichensis sandwichensis Gmelin. ALEUTIAN SAVANNAH SPARROW.

Palmer added the Savannah sparrow to the Pribilof list on the basis of one seen June 3, 1890, near Lukanin Beach, St. Paul Island (1899, p. 422).

Since it seems more likely that Savannah sparrows occurring on the Pribilofs should be referable to the race breeding in that region, I include under this heading those seen by Hanna on St. George Island, August 18, 1913, when he noted 10 individuals. He mentions, also, without giving details (1920a, p. 249), having collected a specimen on St. Paul Island, probably referring to a specimen, now No. 255169, female, of the collection of the U. S. National Museum, taken by him on St. Paul, September 24, 1917.

Passerculus sandwichensis alaudinus Bonaparte. WESTERN SAVANNAH SPARROW.

A female specimen of the western Savannah sparrow taken on St. George Island, September 1, 1913, by G. Dallas Hanna has been identified as this form and has been formally recorded by the collector (1916, p. 402). It was the only one seen at the time.

Zonotrichia gambeli Nuttall. GAMBEL SPARROW.

Evermann (1913, p. 18) recorded a male Gambel sparrow taken by M. C. Marsh on St. Paul Island, May 24, 1912, the only record for the Pribilofs. It measured: Length, 7 inches; extent, $9\frac{13}{16}$.

Junco hyemalis hyemalis (Linnaeus). SLATE-COLORED JUNCO.

On the same day that he added the pine siskin to the Pribilof list, G. Dallas Hanna took specimens of the slate-colored junco, before unknown on the group. He has recorded the occurrence (1919a, p. 177) and later (1920a, p. 254) published particulars, as follows:

> The female juncos were secured from a flock of 6 at Northeast Point, St. Paul Island, on September 24, 1917. They were feeding about the buildings there, apparently as contented as if they were in the midst of civilization.

These skins are now in the collection of the U. S. National Museum, being catalogued as Nos. 255170 and 255171.

Melospiza melodia sanaka McGregor. ALEUTIAN SONG SPARROW.

Among the numerous species which have been added to the Pribilof Island bird list by G. Dallas Hanna is the Aleutian song sparrow. He has recorded its occurrence as follows (1916, p. 401):

> Two specimens were collected on St. George Island, a male, October 28, 1913, at the village; and a female, December 21, 1913, at Garden Cove. Both birds were feeding on the beaches.

Passerella iliaca sinuosa Grinnell. VALDEZ FOX SPARROW.

This race of fox sparrow was added to the Pribilof list by Evermann, under the name *P. i. insularis*, on the basis of a male specimen collected on St. Paul Island, near the village, September 7, 1910, by W. L. Hahn. It measured in the flesh: Length, $7\frac{3}{4}$ inches; extent, $10\frac{3}{8}$. Dr. H. C. Oberholser, from a recent critical comparison of this specimen, identifies it as *P. i. sinuosa*.

Hahn's notes regarding this and other individuals observed follow:

> September 7, 1910, 1 shot among the rocks near Gorbatch Rookery. High northeasterly winds had prevailed for several days. October 4, 1 seen near where the first was killed. Another seen among the rocks back of Reef Rookery later the same afternoon. October 15, 1 seen among the rocks at Kaminista.

Passerella iliaca unalaschensis (Gmelin). SHUMAGIN FOX SPARROW.

This race, the Shumagin fox sparrow, was added to the Pribilof list by G. Dallas Hanna, who thus records the specimen (1920b, p. 173): "On May 20, 1919, a female fox sparrow was found at Northeast Point, St. Paul Island, feeding among the piles of drift wood. Mr. Mailliard is responsible for the identification." This specimen is deposited in the collection of the California Academy of Sciences.

Family HIRUNDINIDAE.

Petrochelidon lunifrons lunifrons (Say). CLIFF SWALLOW.

The cliff swallow was added to the list of Pribilof birds by G. Dallas Hanna, who thus records the specimen taken (1919a, p. 177, and 1920a, p. 254): "A cliff swallow was shot and skinned on St. Paul Island about June 10, 1918, by a native from whom the specimen was secured. This makes the second species of swallow to be collected on the island." (l. c., p. 254.) The specimen is now No. 255172 of the bird collection of the U. S. National Museum.

Hirundo rustica erythrogastra Boddaert. BARN SWALLOW.

The barn swallow was given a place in the Pribilof list by Palmer on the basis of a bird observed by him near the village of St. George, May 28, 1890. The same bird remained about the village for nearly two weeks. Another was seen near Black Bluffs, St. Paul Island, June 4, of the same year. The species has not been since observed.

Iridoprocne bicolor (Vieillot). TREE SWALLOW.

A male specimen taken by John Hanson, a native, at Northeast Point, St. Paul Island, May 25, 1922, and recorded by Mailliard (1923, p. 31), adds this species to the Pribilof list. The specimen is deposited in the California Academy of Sciences.

Tachycineta thalassina lepida Mearns. VIOLET-GREEN SWALLOW.

On August 22, 1914, while G. Dallas Hanna and myself were traversing St. Paul Island toward Zapadni Rookery, we saw three swallows flying about the cliffs near the head of the lagoon, and Mr. Hanna secured two of them. They were at once identified as this species, thus first detected on the Pribilofs. Mr. Hanna has since (1916, p. 401) recorded the occurrence. He also observed a single bird about some high bluffs on St. Paul, June 22, 1919.

Food.—The two stomachs of violet-green swallows available taken on St. Paul, August 22, 1914, were examined by the late Prof. F. E. L. Beal, who recorded that they were filled with finely ground Diptera.

Family COMPSOTHLYPIDAE.

Wilsonia pusilla pileolata Pallas. PILEOLATED WARBLER.

Two mummified specimens of the pileolated warbler, a male and a female, preserved by A. G. Whitney on St. Paul Island, August 25, 1913, are the first known from the Pribilofs. These specimens, as well as an individual observed on St. George Island, August 20, 1913, by G. Dallas Hanna, were recorded by Hanna (1916, p. 402).

Family MOTACILLIDAE.

Anthus spinoletta rubescens (Tunstall). PIPIT.

The pipit seems to have been first recorded from the Pribilofs by Nelson (1887, p. 208), who states that the species was taken on St.

George Island on August 15. He evidently refers to a specimen taken by W. H. Dall on St. George, August 15, 1868. This was recorded by Palmer (1899, p. 421) as being then in the collection of the U. S. National Museum, and formed the sole basis for the inclusion of the bird in his list.

In the course of Mr. Hanna's work on the Pribilofs he has found this bird to be a rather regular migrant in fall, and has taken it once in spring.

In the fall of 1913, on St. George Island, Hanna observed about 20 pipits on September 1, taking 2 specimens, and saw 10 on September 4. In 1914, on St. Paul, he noted the birds as follows: August 31, 2 seen, 1 collected; September 20, 1 taken; October 12, 1. The specimens taken by him are in the collection of the Biological Survey.

The only spring record is of a specimen taken by Hanna on St. Paul May 25, 1919, and recorded by him.

Food.—This species is reported by Hanna to feed during its stay on the islands in fall migration almost exclusively on maggots on the killing fields. However, the contents of two stomachs, collected August 31, 1914, and September 20, 1916, contained no trace of such maggots. The food in these gizzards consisted of 10 per cent vegetable matter (seeds of a violet, *Viola langsdorfii*) and 90 per cent animal matter. The components of the animal food were beetles (ground beetles, *Pterostichus* sp.; and weevils *Lophalophus inquinatus*), 37 per cent; caterpillars, 33.5 per cent; plant bugs (*Irbisia sericans*), 8 per cent; spiders, 7.5 per cent; flies, 2.5 per cent; and Hymenoptera, 1.5 per cent.

Anthus spinoletta japonicus (Temminck and Schlegel). JAPANESE PIPIT.

G. Dallas Hanna collected a Japanese pipit on St. Paul Island on August 29, 1916, thereby adding the species to the list of Pribilof visitors. The specimen, which is now No. 255173 of the bird collection of the U. S. National Museum, was recorded by him (1919a, p. 177, and 1920a, p. 251).

Family TROGLODYTIDAE.

Nannus troglodytes alascensis (Baird). ALASKA WREN.

Troglodytes alascensis Baird, Trans. Chicago Acad. Sci., vol. 1, 315, 1869 (type from St. George Island).

This interesting resident wren, the "Limmershin" (i. e., chew of tobacco) of the natives, was first recorded from the group by W. H. Dall (in Dall and Bannister, 1869, p. 280) and was formally characterized as a new species by Baird in a later article (1869, p. 315) of the same volume. The basis of these accounts, and the type specimen, was a bird taken by Dall on St. George Island on August 17, 1868.

The species is a year-long resident and varies greatly in abundance in different years, becoming scarce because of especially severe winters or an unusual visitation of predatory birds, but soon recovering its numbers evidently owing entirely to its rapid rate of increase. Thus Elliott (1875, p. 173) found it rather rare on St. George in 1873, but quite numerous in 1874. Palmer observed a few on St. George in 1890, and secured specimens. Hanna took a series of specimens on St. George in the autumn of 1913 and the following winter, and his notes show that the birds were common, since on one occasion, near Garden Cove on September 28, he estimated that he saw 200 individuals. I saw many and took a few on St. George in mid-July and early August, 1914.

Up to 1914 no naturalist had ever seen one of the birds on any island of the group excepting St. George, and the natives declared that it was absent elsewhere. It was, therefore, a great surprise when Mr. Hanna, on October 29, 1914, took 2 specimens along the shore between East Landing and Reef Rookery, St. Paul Island. On May 16, 1915, Hanna collected another specimen near Lukanin Rookery, and the natives reported seeing 2 near Rock Point. During the same summer, according to notes kindly furnished me by Mr. Hanna, Mr. George Haley saw 11 individuals on Otter Island, this being the first record for that place. The birds since seem to have become well established there, as Hanna (1920b, p. 175) states that it bred there in 1916, 1917, and 1918. He states also (1920a, p. 250) that a wren, probably from Otter Island, was seen on St. Paul in the summer of 1918. It seems likely, therefore, unless the species meets with a reverse on Otter Island from some cause, that it will in time become regularly established as a breeder on St. Paul, and that, therefore, the likelihood of the species surviving will be strengthened.

During the winter of 1916–17 St. George was visited by an unusual number of gyrfalcons, which preyed on the wrens and rosy finches to such an extent that they were almost extirpated. G. Dallas Hanna states that in May, 1917, he found not over six pairs of wrens during a trip made entirely around the island. Since then, however, as elsewhere detailed, the species has become at least fairly common again and has even spread to the other main islands, previously unoccupied. For many years after the discovery of this species its nest and breeding habits were almost unknown. A nest and incomplete set of eggs taken by a native in June, 1876, were forwarded with other specimens to the Museum of Comparative Zoology and were described by Dr. J. A. Allen (1877, p. 82). The attempts of various naturalists, who visited the islands subsequently, to find the nest of this abundant but elusive species failed entirely until 1918, when Dr. Harold Heath, in May and June, by studying the habits of the birds was able to discover upward of 16 nests. The number of eggs was generally 7, and

this seemed to be the maximum number. In the case of a nest found by Mr. C. E. Crompton on St. George later the same summer, a second set of eggs was deposited within a week after the first brood of young left the nest. The habit of raising two broods is almost unique among the birds of this far northern station.

The nests found by Heath were all situated in the faces of cliffs at elevations ranging from 8 to 100 feet. They usually occupied a crevice between shattered rocks, or blowholes in the lava, or cavities beneath mossy banks. In several cases the sites had been occupied in previous years. The nests were usually globular with the entrance at the side and were composed of a meshwork of grass and roots, often roofed with moss. The lining was usually composed of fine rootlets and lichen, mixed with feathers and fox hair, and in some cases reindeer hair. A very full and extremely interesting account of the nesting habits and homes of this species, from which the above notes are gleaned, was published by Doctor Heath (1920, p. 49–55).

Food.—Of the 11 stomachs of Alaska wrens available 9 were examined some time ago by less discriminating methods than those at present in use, and it is only possible, therefore, to indicate the nature of the food in very general terms. The sustenance was entirely animal and included the following groups: Amphipods, 24.1 per cent: two-winged flies (partly Borboridae), 24.1 per cent; beetles (including ground and rove beetles), 14.3 per cent; bugs (Hemiptera), 13.2 per cent; caterpillars, 12.9 per cent; and Hymenoptera, 11.4 per cent.

A recently examined stomach contained the following items: Six beetles of the sexton-beetle family (*Lyrosoma opaca*), 12 per cent; rove beetles (*Olophrum fuscum* and 2 *Liparocephalus brevipennis*), 3 per cent; 3 small parasitic wasps (including *Phygadeuon* sp. and *Plesignathus* sp.), 1 per cent; remains of dung flies (*Scatophaga* sp.) and perhaps other flies, 74 per cent; one mite of an undescribed genus of the family Gamasidae, trace; and amphipod remains, 10 per cent.

Another stomach, lately examined, taken October 29, 1914, contained remains of 24 or more rove beetles (Staphylinidae), 70 per cent; 4 beach beetles (*Aegialites debilis*), 19 per cent; 1 other beetle, 1 per cent; and a few flies, 10 per cent.

Family TURDIDAE.

Hylocichla minima aliciae (Baird). Gray-cheeked Thrush.

A chance specimen of the gray-cheeked thrush has been taken by G. Dallas Hanna, who recorded the incident as follows (1920a. p. 254): "A female gray-cheeked thrush was collected on St. Paul

Island September 9, 1917. It was found feeding on spaded-up ground about the Naval Radio Station." The specimen is deposited in the collection of the U. S. National Museum and is catalogued as No. 255175.

Food.—The contents of the stomach of this bird were 3 blowflies (*Calliphora vomitoria*) and 2 dung flies (Scatophagidae), 60 per cent; 4 ground beetles (*Pterostichus* sp.), 1 rove beetle (Staphylinidae), and 1 weevil (*Lophalophus inquinatus*), 40 per cent.

Planesticus migratorius propinquus Ridgway. WESTERN ROBIN.

Elliott observed a robin on the hill back of the village of St. Paul on October 15, 1872. The same bird was seen for several days, but the statement is made that he did not shoot the bird (1874, unpaged, and 1875, pp. 170, 172). In his later account of the occurrence Elliott states (perhaps through an error) that a specimen was secured in October, 1872. The bird seen by Elliott remained the only record until 1910, when Hahn recorded 1 found at the watch house at Northeast Point on October 19. The bird had been shot by a native two weeks previously. Among the specimens which had accumulated at St. Paul Island and which were brought in to Washington in 1914 were the head and feet of a robin, unlabeled, but probably the remains of this individual.

The above notes referring to birds not identified subspecifically are placed under the present heading, since a specimen taken by G. Dallas Hanna on St. Paul Island September 15, 1919, and recorded by him (1920b, p. 175) proves to belong to this race. This specimen was deposited in the collection of the California Academy of Sciences.

Oenanthe oenanthe oenanthe (Linnaeus).[15] WHEATEAR.

A specimen of the wheatear, taken by R. E. Snodgrass and A. W. Greely on St. Paul Island, August 29, 1897, was first recorded by Seale (1898, p. 139), and thus added to the list of Pribilof birds. Grinnell, reporting on the collection of which this specimen formed a part, comments on this bird as follows (1901, p. 20):

> An immature bird (No. 3486, Coll. L. S. Jr. U.), taken on St. Paul Island August 29, forms the first record for the Pribilofs and fills in another gap in the known range of this remarkably widespread species.

A second specimen was taken by G. Dallas Hanna on St. Paul Island, September 1, 1917, and has been recorded by Mailliard and Hanna (1921, p. 94). This is now No. 255174, male, of the collection of the U. S. National Museum.

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[15] *Saxicola oenanthe oenanthe* of the A. O. U. Check list, 1910.

MAMMALS OF THE PRIBILOF ISLANDS.

By Edward A. Preble.

While the birds of the Pribilofs are of great popular interest, the mammals, though fewer in number of species, are of even greater importance. The herd of fur seals is one of the most interesting and valuable aggregations of mammals in the world, and their presence is, of course, responsible for the settlement of the islands and the consequent comparatively intensive study of its fauna and flora. The foxes afford one of the best examples known of the selective breeding of a wild animal carried on under practically natural conditions. In the present treatment the accounts of these species are by no means commensurate in volume with their importance. Since, however, they have been the subject of many special reports, it has seemed unnecessary to treat them more than briefly here.

For convenience in citing references, the titles referring to mammals are given together with those relating to birds in the Bibliography (pp. 121–128).

Family SORICIDAE.

Sorex pribilofensis Merriam. Pribilof Shrew.

The Pribilof shrew, which is confined to St. Paul Island, was first discovered by William Palmer, in 1890, and a series of 16 specimens was collected. Other specimens were taken by Dr. C. Hart Merriam in the summer of 1891. The species was not named, however, until Doctor Merriam wrote his Synopsis of American Shrews in 1895, when he formally characterized it (1895b, p. 87). A. G. Whitney collected one in full winter pelage, and a small series in the summer of 1914. The writer also took a few in the summer of 1914, and during the next year or two G. Dallas Hanna collected a large series. Altogether, about 135 specimens have been collected, nearly all of which are in the U. S. National Museum. Most of these specimens were taken in a partially marshy tract, grown up to rank grasses, bordering a shallow pond between the village and East Landing. A few have been collected at Northeast Point.

Ten specimens, measured in the flesh by the writer, average in measurements: Total length, 103.1 mm.; tail vertebrae, 35.8; hind foot, 13.2. This series showed remarkable uniformity in size, the total length ranging only from 100 to 106 mm., and the tail vertebrae only from 34 to 37.

Family URSIDAE.

Thalarctos maritimus (Phipps). POLAR BEAR.

Polar bears have been transported to the Pribilofs on drift ice and have landed on a number of occasions. True (1899, p. 354) merely mentions the fact but gives no details.

W. L. Hahn found in the St. Paul Island log, under date of September 20, 1874, an entry stating that a party visited the cave on Bogoslof and brought back a bear skull known to have been there since the time of the first occupation of the island. Other notes from the same source record a white bear seen at Halfway Point March 28 and 30, 1880, and at Northeast Point, March 13, 1884. Frederic A. Lucas (1898, p. 718) has recorded the skull of a polar bear from the Pribilofs, but whether this is the Bogoslof specimen above noted is not known. I have been unable to find any Pribilof specimen in the U. S. National Museum collection.

The following account of a bear observed on St. George Island, by G. Dallas Hanna (1914, p. 218) summarizes the evidence relating to that place:

> On February 14, 1914, a polar bear was seen and shot at by an Aleut at Zapadni Rookery, St. George Island. The tracks were seen on shore in the snow by the writer and others. This animal was formerly an abundant inhabitant of the northern part of Bering Sea, but rarely came south of St. Matthew Island. If native reports are to be believed, it has been seen on St. Paul Island on at least three different occasions, but this was many years ago. From the same source of information comes the only previous record of the animal on St. George. This was about 1820, when a bear came ashore from the ice pack at the village and went westward to a small pond where it spent some time on the ice. Thereafter this has been known as Bear Lake. The numerous tracks along the beach in the snow show that the bear seen at Zapadni had been ashore also. During the winter no drift ice had been sighted from the island. But this could not have been seen unless it had come within 10 miles.

Family CANIDAE.

Alopex pribilofensis (Merriam). PRIBILOF ARCTIC FOX; BLUE FOX.

Pl. VII, fig. 3.

The foxes of the Pribilof Islands have been described as a separate race, the long period of isolation evidently having resulted in their differentiation from the mainland stock. On the Pribilofs the blue phase of coloration, which is really an abnormal type and which occurs more or less rarely throughout the range of the Arctic foxes, at least in America, has become predominant. The white fox is merely the winter condition of the normal animal, which in summer has tawny sides and brown back and shoulders. The so-called blue fox is brownish or sooty in its summer coat and lighter in winter.

The animals usually mate in March or early April, and new-born young have been found from May 17 to June 6. Among 22 litters

examined, the smallest contained 5 and the largest 11 pups. A newly born pup weighed 2¼ ounces. The adults vary greatly in weight, according to sex and condition. Males taken in midwinter may range from 5½ to 17½ pounds, and have reached as high as 20¼ pounds. Females are recorded weighing from 4 to 15 pounds, and in one case 21¾ pounds. (Chichester, 1908, p. 51.)

Foxes have been found on both St. Paul and St. George Islands ever since they were first discovered, and it seems that the blue phase of coloration has always been predominant there. Indeed, the early accounts of the islands aver that at the time of their discovery only the blue foxes were found, but that white ones came (presumably on the ice) a few years later. But since white foxes are still known to come from time to time in the same way, it is likely that some of this color were always found there. From the first efforts have been made to keep down the number of the less valuable white foxes. On St. Paul, where only steel traps are used, these efforts have been only partially successful, and, judging from the catches of the past few years, about 17 per cent of the foxes there are white. On St. George, however, where food is much less abundant, the foxes can be attracted to certain places and then taken in large cage traps. By this means, a good proportion of all the foxes of the island being annually handled, no white ones are allowed to live, and a supply of the best blue ones are annually liberated as breeders. The natural result of this selective method has been to improve the blue ones and to restrict the normal phase to a minimum. Thus the catch of white foxes on St George, in spite of the fact that all white ones taken are killed, has averaged during the past few years considerably less than 1 per cent of the total.

We know little about the numbers of foxes found on the islands in earliest times. During the period from 1842 to 1860, inclusive, the Russian-American Co. made on the Pribilofs an average annual catch of 1,829 foxes, more that two-thirds of which came from St. George. Figures from 1861 to 1870 are not available. Between 1871 and 1890, 24,792 skins were taken; 20,412 came from St. George. From 1890, the foxes diminished rapidly, owing, no doubt, to the lessened number of seals killed, the bodies of which had formed their chief food. Special feeding was then resorted to, but in spite of this, and of some close seasons, only 11,250 were taken from the seasons 1890–91, to 1913–14, inclusive, a yearly average of only 469. During recent years the numbers taken are again increasing as shown by the table given below.

Most of the improvements in methods of dealing with the foxes on the Pribilofs are the results of the painstaking work of James Judge, who studied the problem carefully on St. George for many years and published two papers on the subject. (See Bibliography.) From

these papers and from his manuscript notes are taken much of the data on which the present account, as well as the one referred to later, are based.

The history of the fox industry on the Pribilofs was discussed in a fairly comprehensive manner by the writer (in Osgood et al., 1915, pp. 105–116). In a table there given the numbers taken between 1890 and 1914 are set forth in detail. In order to bring the subject up to date the following table, compiled from figures published by the Bureau of Fisheries, and so arranged as to be readily comparable with the table referred to, has been prepared.

Number of foxes taken on Pribilof Islands, 1914–1921.

Year.	St. Paul.			St. George.			Total, Pribilof Islands.		
	Blue.	White.	Total.	Blue.	White.	Total.	Blue.	White.	Total.
1914–15	173	39	212	63	1	64	236	40	276
1915–16	211	18	229	209	2	211	420	20	440
1916–17	150	37	187	417	2	419	567	39	606
1917–18	90	14	104	602	5	607	692	19	711
1918–19	119	25	144	548	5	553	667	30	697
1919–20	156	32	188	746	4	750	902	36	938
1920–21	123	13	136	1,002	1	1,003	1,125	14	1,139
1921–22	138	21	159	574	.....	574	712	21	733

Formerly even the best fox skins from the Pribilofs were worth only a few dollars, but during the period of inflated prices following the World War, due partly to the growing scarcity of furs, large sums have been realized. Thus 665 blue foxes sold at St. Louis September 10, 1919, brought an average price of $195.90. On February 21, 1921, 901 blue foxes brought an average of $88.12, and 37 white foxes brought $35 per skin. On September 28, 1921, 1,125 blue foxes were sold at an average price of $96.83.

Vulpes alascensis Merriam. Alaska Red Fox.

Red foxes are said to be sometimes brought to the Pribilofs on the pack ice, but I have no definite data. True (1899, p. 354) states that Mr. Palmer reported in 1890 that not more than six or seven had been taken in twenty years.

Family MUSTELIDAE.

Latax lutris Linnaeus. Sea Otter.

At the time of the discovery of the Pribilof Islands sea otters were found in great numbers, but the cupidity of the Russian fur hunters soon caused their extirpation. According to Elliott (1874, unpaged, and 1875, p. 54) as many as 5,000 were killed on St. Paul Island during the first year of its occupation (1787); after this the decline was rapid. Veniaminof, quoted by Elliott (l. c., p. 242),

states that the animals became scarce there in 1811, and extinct within the next 30 years. Elliott himself, in 1872 and 1873, seems not to have observed any, nor to have added anything to the history of the species on the islands.

W. L. Hahn found in the St. Paul Island log entries to the following effect: A sea otter was seen by fishermen September 23, 1889, the first for several years. On June 1, 1896, one which had been crushed by the ice was found at Rocky Point. On December 1 (apparently of the same year) one was reported close inshore at Southwest Bay. True (1899, p. 353) mentions a skull found on St. Paul by C. H. Townsend in 1892, and the Rocky Point find, above noted. There are two skulls in the collection of the U. S. National Museum, received years ago from the Bureau of Fisheries, which may be these specimens. The Biological Survey collection contains two large skulls collected by A. G. Whitney on St. Paul Island, a very much weathered one picked up on lagoon beach on October 9, 1913, soon after a violent storm, and one which seems much more recent found at Rocky Point on June 21, 1914.

Hanna notes that the St. George Island log for July 24, 1892, records the finding of a dead sea otter by a native at Zapadni Rookery. The skin of this animal was sold for about $100.

Family ODOBENIDAE.

Odobenus divergens (Illiger). Pacific Walrus.

The walrus formerly resorted to the two main islands of the Pribilofs in some numbers judging from the reports of early historians and by the remains which are still found there. There is no indication, however, that the animal ever bred in the vicinity, and most of the visitors apparently were males. They must have occurred most commonly in the vicinity of Cross Hill, near Northeast Point, at that somewhat remote time when the encroaching sand was closing up the passage between the main island and that portion, topped by Hutchinson Hill, which now constitutes Northeast Point, and concerning which both tradition and topographic features indicate former separation. Considerable quantities of bones and teeth have been dug out of the sand dunes there, and remains are still sometimes found. The last stand as a regular hauling place, however, was Walrus Island, where upwards of 150 individuals were observed by Elliott in 1872. These were all males, but he was afterwards informed that on one occasion a single female was seen there. The animals continued to resort there as late as 1890, when, according to True (1899, p. 354), William Palmer observed 8, "but killed none, and they were reported all killed the following season."

The following notes, taken from the St. Paul Island log by W. L. Hahn, afford some indication of the number killed, and the diminishing frequency of their appearance in recent years:

Walrus Island: June 10, 1872, many seen; June 29, 1873, a few; August 21, 1873, 3 killed; May 22, 1874, very few; May 23, 1877, 1 taken; June 2, 1876, 3 shot; February 26, 1881, 1 seen; May 21, 1881, 60 seen near the island; June 8, 1881, 1 killed; June 14, 1881, 3 seen; June 22, 1890, 3 killed; August 24, 1890, 1 shot; June 10, 1893, 1 seen. St. Paul Island: February 26, 1875, 3 found dead at Northeast Point; May 26, 1875, 1 found dead at Gorbatch Rookery; December 25, 1877, 1 killed on Reef Rookery; March 23, 1899, 1 found dead near Rocky Point; April 22, 1899, 1 found dead at Northeast Point; March 17, 1900, 1 found dead at Northeast Point; August 4, 1904, 2 found dead at Rocky Point; November 4, 1904, 1 seen in water near East Landing; June 23, 1907, 1 found dead at Northeast Point.

During my visit to the Pribilofs, in 1914, I saw a few skulls near Northeast Point, one on Otter Island, and a number among the rocks on Walrus Island. Later in the same year Hanna (1914, p. 218) published the following note:

During the month of March, 1914, walruses were sighted three different times swimming along just offshore. They were at no very remote time abundant on St. George, as the skulls may yet be seen about the beaches. Five dead ones floated in at Garden Cove about 1907.

In July, 1918, Hanna observed a young male walrus asleep on a surf-washed rock at North Rookery, St. George. The animal was not at all wary, and Hanna was able to photograph it at a distance of a few feet, and to retire without disturbing it.

Family OTARIIDAE.

Eumetopias jubata (Schreber). STELLER SEA LION.

Only a few hundred sea lions, found in two small breeding colonies, are all that now remain of the many thousands which until comparatively recent years inhabited the islands. Elliott (1875, p. 153) estimated that in 1872 there were from 20,000 to 25,000 about St. Paul Island, and 7,000 or 8,000 on St. George. They then occupied a considerable area at Northeast Point, St. Paul, and several locations on St. George.

Elliott (l. c., p. 71) states that a few formerly bred on Walrus Island, but apparently this colony no longer exists, although a few of the animals sometimes haul out on rocks there, as well as at many points on all the islands. According to True (1899, p. 351) at least one harem persisted on Walrus Island as late as 1890. He states that on St. George the principal stations were near Tolstoi Point and East Rookery. Sea lions are believed to breed still at these places, and also at Garden Cove.

Their breeding habits are similar, in general, to those of the fur seal. The harems are smaller, usually numbering only 10 or 12 cows

to a bull. The young are born about the middle of June. The animals are much more timid than the seals, and therefore their intimate habits are more difficult of observation. The bulls fight among themselves with great ferocity. With the exception of a few old bulls all the sea lions are said to leave the islands in winter. They return in March, April, and May, the old bulls first.

Like the fur seal, the difference in size of the male and female sea lion is very great. The breeding males have been estimated to weigh from 1,500 to 2,000 pounds, while a cow may weigh up to 500 or 600. I have no data on the weight of the new-born young. Young approximately 3 weeks old, observed by the writer at the breeding rookery at Northeast Point, on June 27, 1914, were estimated to weigh about 35 pounds.

The animals were formerly of great economic importance to the natives, being used as food, clothing, and in the construction of their skin boats. They were formerly killed in large numbers, not only for use on the Pribilofs but for exportation to Unalaska, Kodiak, and other points. Between 1870 and 1890 from 30 to 500 were killed annually. The animals were formerly gathered in small herds, called pods, by a party of natives stealing at night between a sleeping herd and the water, and by suddenly rising with a clamor of shouting and firing of pistols, getting as many as possible of the startled animals to start inland instead of toward the water. When once headed away from the sea they were easy of control, and when, by a number of such sorties, a sufficient number had been collected, they were started to the village. This was to save the labor of transporting the skins and meat by teams. The journey of 11 or 12 miles took from 5 days to 3 weeks according to the weather, for the huge beasts could travel but slowly, and could not be forced in warm weather without great mortality. On arrival at the village the entire herd were killed with guns and lances. Since about 1882 the lessened number of the animals has made driving impracticable, and the killing has been done at Northeast Point. The topographic conditions on St. George are such that driving has never been practicable there.

During recent years they are seldom killed except for their skins, which are still used to cover the framework of the large bidarras, used principally to land the cargoes from the supply steamers, which must anchor some distance from the wharves. For this purpose the young bulls only are killed, as the hides of the old bulls are unsuitable. The skins of 12 animals are needed for covering one boat and this cover lasts four or five years.

Callorhinus alascanus Jordan and Clark. PRIBILOF FUR SEAL.

The fur seal, which seems to have been directly responsible for the discovery of the Pribilof Islands, and which has been the dominant

FIG. 1.—BULL SEALS IN SPRING, ON THEIR ROOKERY STATIONS.

The males arrive early in spring and select a home site, where they are joined later by the females. Photograph by A. Christoffersen, on Reef Rookery, St. Paul Island.

FIG. 2.—BULL SEALS IN AUGUST, ON THE GRASSY LEVELS.

The old males, which arrive in spring fat and full of energy, are much reduced in flesh and spirits after three months of fasting. Photograph by G. Dallas Hanna, St. Paul Island.

FIG. 3.—BLUE FOX (ALOPEX PRIBILOFENSIS).

The blue phase of coloration practically attains perfection as regards quality of fur and freedom from inferior strains on St. George Island. Photograph by G. Dallas Hanna, November, 1916.

factor in its subsequent history, is one of the most interesting animals known. It resorts to these islands only during the breeding season, and spends the remainder of the year at sea, not being known to land at any other place. Its migration carries it as far south as the latitude of southern California, the females going farthest and the old bulls wintering mainly south of the Aleutians or in the Gulf of Alaska.

On the approach of the breeding season the old bulls return to the islands, the earliest arriving about the first of May, and each one takes a position on the rookery ground, often in the spot occupied the previous year. (Pl. VII, fig. 1.) From the time he lands until the end of the breeding season, late in July or early in August, the bull never leaves his station and consequently takes no food. Shortly after the first of June the females begin to arrive, each one impelled by her pregnant condition to seek a place to bring forth her pup. On arrival the females land and join some male which is gathering a harem. (See frontispiece.) Before many days, sometimes almost at once, the female is delivered of her pup, and within a few days is again impregnated. She is then allowed to depart in her quest for food, which she must have in abundance in order to nourish her pup. She feeds at sea, going from 50 to 100 miles, and after gorging on fish remains in the water until digestion has taken place. She then returns to the land, picks out her own pup from among the thousands that swarm over the rookeries, and nurses it until she is impelled to repeat her trip for food.

The harems, comprising from a few to as many as 100 cows and each attended by a single bull, are crowded together until practically all the rookery ground is occupied. As the young grow larger they wander farther afield during the absence of their mothers, but the female always finds her own pup, and will nurse no other.

By early August practically all the cows have given birth, and the old bulls, exhausted by their long fast and their protracted harem service, after a few days' rest, go to sea to feed and recuperate (Pl. VII, Fig. 2). The females, however, continue to nurse their young, which learn to swim during the late summer, until November, when they, too, leave the islands.

The sexes differ greatly in size, the breeding bulls weighing from 400 to 500 pounds, while the breeding cows vary from 50 to 60 to about 100 pounds, according to age and condition. The pups when born weigh from 10 to 12 pounds. Just before leaving the islands in November the pups have been found to weigh from about 25 to 50 pounds; when they return, in the following August, or when a little over a year old, they weigh from 33 to 40 pounds, having become

longer but much less fat since being weaned and living the life of the adults.

During the early years of the occupancy of the group, the slaughter of the animals for their valuable skins was pursued in a very wasteful manner, both males and females being killed in such numbers as to exceed the hunters' resources for the proper preservation of the catch, and to glut the market. The imperfect records of these early days indicate that more than 1,800,000 seals were killed between 1786 and 1834, and the herd was seriously depleted. From 1835 to 1867 the females were spared, and the killing was otherwise restricted so that the herd gradually increased. At the time of the purchase of Alaska by the United States in 1867 various estimates placed the number of fur seals between 2,000,000 and 5,000,000 animals.

In 1870 the privilege of sealing on the islands was leased to the Alaska Commercial Co. for a term of 20 years. During this period 1,977,377 skins were taken on the islands. At the expiration of this lease the North American Commercial Co. was awarded the sealing privilege for a further period of 20 years, and 342,651 skins were taken.

About 1890 the effect of killing seals at sea, a large percentage being females, the death of which caused the loss of unborn or young pups, began to be recognized as an intolerable waste of valuable life. As a result, by agreement between the countries interested, pelagic sealing was curtailed, and finally, in 1911, by a treaty between the United States, Great Britain, Russia, and Japan, it was abolished for a period of 15 years. Under its provisions the United States and Russia, as guardians of the seal herds, agreed to pay Great Britain and Japan a percentage of the value of the seals taken on land.

In 1912, owing to the fear that the seal herd had become depleted to the danger point, all killing was forbidden by law for a period of five years, excepting such numbers as were needed by the natives for food purposes. At this time, more intensive studies of the herd were inaugurated, and as a result it became possible to estimate the numbers of the animals with more accuracy than had before been possible. One of the important features was the counting each year of the newly born pups, which afforded an index to the increase of the herd. This, and related matters, was rather fully discussed by Osgood, Parker, and Preble (1915, pp. 39, 44, etc.), the data being brought up to 1914.

Since 1914 a summer survey of the breeding herd has been made annually. The following table, giving the number of pups born since 1912, and the estimated size of the entire herd, will serve to

show the steady increase in numbers. The figures have been taken from publications issued by the Bureau of Fisheries. Those for the pups up to 1916, inclusive, are actual counts; while from 1917 on they are based on counts for some of the rookeries, the others being estimated by counting the harems and applying the figures representing the average harem.

Count of seal pups, and estimated numbers of entire herd.

Year.	Pups.	Seals of all ages.	Year.	Pups.	Seals of all ages.
1912	81,984	215,738	1917	128,024	468,692
1913	92,266	268,305	1918	143,005	496,600
1914	93,250	294,687	1919	157,572	524,235
1915	103,527	363,872	1920	167,527	552,718
1916	116,977	417,281	1921	176,665	581,457

Family PHOCIDAE.

Phoca richardii pribilofensis Allen. PRIBILOF HARBOR SEAL.

The hair seal of the Pribilofs, which has been separated as a race of *Phoca richardii*, the harbor seal of the northwest coast, is found in comparatively small numbers mainly on the larger islands. The animals have their young on the bare sea-washed rocks, breeding on St. Paul mainly or entirely on the unfrequented north shore, though they frequently haul out on the rocks at various other places. I have no definite data on the breeding of the species about St. George, but the animal is frequently seen there, and probably breeds about the less accessible parts of the shore. The young, which are said by Elliott (1884, p. 28) to weigh from 3 to 7 pounds when born, are white in color, but change in a few months to the color of the old ones, which is usually steel gray, blotched and mottled with dark brown.

Hahn collected notes from the St. Paul Island log, showing that hair seals were taken nearly every year by the natives. Under date of May 30, 1910, about 50 are stated to have been seen on Otter Island. On the only occasion when we visited that place in 1914, on June 27, we saw about a dozen at the edge of the surf near the landing place.

The flesh of this seal is very much relished by the natives, and the few that are taken are shot mainly for this reason.

True (1899, p. 351) noted a few solitary examples at various points about St. Paul in 1895 and states that three young ones were brought to the village.

Phoca fasciata Zimmermann. RIBBON SEAL.

This species was recorded by True (1899, p. 351) as follows:

A young female of this species was taken by one of the sealers 84 miles west of St. Paul in August, 1896, so that it may be regarded as a probable occasional visitant to the Pribilofs.

Erignathus barbatus nauticus (Pallas). Pacific Bearded Seal.

The bearded seal has only recently been added to the list of Pribilof mammals. G. Dallas Hanna (1921b, p. 126) records a specimen taken at St. George Island in the winter of 1917–18 by C. E. Crompton.

In a recent note Hanna gives more data regarding this species. The specimen referred to was shot at East Rookery by a native, on January 29, 1918. The animal was in advanced age, judging by the fact that it had lost all its teeth; it was fat, however, indicating that it had been able to capture sufficient food. Its sex was not recorded. Among the detailed measurements made from the fresh specimen the following may be noted: Total length (nose to tip of tail), 93 inches; tail, 7 inches; hind foot, 17½; girth behind fore flippers, 60.

The seals referred to by a reliable St. George native, who reported to Hanna that several very large hair seals, 8 to 10 feet long, were found on the beaches in 1900, a record year for pack ice, were most probably of this species.

Family MURIDAE.

Lemmus nigripes True. Pribilof Lemming.

The Pribilof lemming, which is found only on St. George Island, was first reported by Elliott (1874, unpaged; 1875, p. 72), under the name *Myodes obensis*, but Merriam in 1891 seems to have been the first naturalist to collect specimens. In 1892 or 1893 two specimens were taken by C. H. Townsend. One of these, No. 59152, U. S. National Museum, male, was made the type of the species, which was formally characterized by Frederick W. True (1894, p. 2).

In recent years Hanna has taken a series, and in the summer of 1914 the writer collected a few. Two adult males then taken measured, respectively: Total length, 152 mm.; tail vertebrae, 21; hind foot, 20; and 154, 19, 23. Two adult, though not fully grown, females measured 140, 18, 21, and 136, 18, 21. A female measuring 128, 17, 21, collected on July 23, contained three small embryos.

As in other regions, the lemmings of St. George suffer considerable fluctuations in numbers. Elliott reported them very abundant in 1873; Palmer in 1890, and True in 1895, 1896, and 1897, reported them scarce. They were rather common in 1913 and 1914. Their periodical scarcity has been attributed to the foxes, but G. Dallas Hanna states that he has found no evidence that these animals prey on the lemmings. It would be very remarkable, however, if a fox did not occasionally snap up such a tender morsel.

True (1899, p. 346), on information furnished by Palmer, stated that a few had been introduced on St. Paul from St. George, and in 1911 Hahn was assured by a native chief that this had taken place on two occasions, the last time about 15 years before, but that he did not know of any having been seen afterwards.

Fiber zibethicus zalophus Hollister. ALASKA PENINSULA MUSKRAT.

The introduction of muskrats on the Pribilofs was advocated some years ago, and has once been attempted, but was not successful. Seven individuals were captured near Nushagak in the summer of 1913 by G. Dallas Hanna for planting on St. George Island. During transit to the islands the animals preyed on each other until only the strongest was left. This was liberated in a pond near the village, but is not known to have survived the winter.

With a view to introducing these animals most of the ponds on St. Paul Island were surveyed by W. L. Hahn, but were found to be too shallow. Among the ponds not critically examined, one in particular, Antone Lake, seems to the writer to be suitable, at least as far as its physical characteristics are concerned. The introduction of the animals, however, is not advocated by the writer, since it is not believed that they would be of any importance as food for the foxes, and it is unlikely that the comparatively small number that could live in the one or two ponds of possible suitability would prove economically profitable.

Mus musculus Linnaeus. HOUSE MOUSE.

Elliott, from observations made in 1872-73, says that mice had been brought to the islands in ships' cargoes long before and were a great pest (1875, p. 73). True, from observations made in 1895, states that the animal was extremely abundant about the village of St. Paul, and had been noted by various observers on St. George (1899, p. 348). G. Dallas Hanna thinks that there are now none on St. George, but there seems to be no good reason for this condition, unless the pests are kept from increasing there by the greater number of foxes. On St. Paul, however, they were abundant in 1914, not only about the village, but were taken in my traps set for shrews at some distance from the buildings, and were found even about the salt house at Northeast Point.

Rattus norvegicus (Erxleben). NORWAY RAT.

Elliott (1875, p. 73) states that at the time of his observations the islands were free from rats. True (1899, p. 348) reports as follows:

> I saw nothing of rats while on the islands in 1895, but observe that Mr. Palmer has noted [1890] that they arrive occasionally in ships, but do not breed.

While on the islands in 1914 I saw no evidence of rats.

Family SCIURIDAE.

Citellus plesius ablusus Osgood. NUSHAGAK GROUND SQUIRREL.

Ground squirrels have been liberated on the Pribilofs with a view to furnishing an additional source of food for the foxes. Preble (in Osgood et al., 1915, p. 129) has summarized the matter as follows:

> The introduction of ground squirrels has been attempted on two occasions, but neither has proven a success. In 1899 some were brought from Unalaska

and liberated on St. Paul, near the village. Their disappearance has been attributed to cats, but whether they were eaten by cats or foxes is immaterial.

In the summer of 1913 the assignment of G. Dallas Hanna for work on St. George Island afforded an opportunity to make another attempt, and 22 ground squirrels, including both sexes and different ages, were captured at Nushagak. Of these, four died from natural causes before their journey was begun. Various circumstances made it impracticable to provide small cages for the animals, and they were shipped in a single large crate. Although plentifully supplied with green food, they preyed on each other, and while this tendency was overcome to some extent by supplying them with meat, the stock of 18 had been reduced to 5 before they reached their destination. These 5, an adult female and 4 young, including both sexes, were liberated near the village on St. George Island in August. At least two survived the winter, and were seen on several occasions in early May, 1914. They were not known to have been observed later; during our visit in early August none were seen, and a careful search disclosed no positive evidence of their presence. It is doubtful if any survived the summer, and in view of the fact that numbers of foxes continually ranged in the vicinity of the spot where they had been observed, the destruction of the squirrels would seem to be inevitable.

Family CERVIDAE.

Rangifer tarandus (Linnaeus). REINDEER.

Reindeer were introduced on the Pribilofs in the summer of 1911, when a herd of 40 animals was brought from Unalakleet. Twenty-one cows and four bulls were landed on St. Paul; one of the bulls was injured in landing, and died soon after. Of the 15 landed on St. George, 3 were males, 1 adult and 2 yearlings; the adult bull met with some accident a few days later and disappeared. During the following summer 18 fawns were born on St. Paul, and 11 on St. George. The herds have since continued to increase, and now number over 400 animals. Annually since 1917 a number of the surplus bulls have been killed for food, and have furnished a welcome and substantial addition to the tables of officials and natives.

Upon their introduction, the animals sought out the least frequented and most favorable parts of the islands, over which they roam at will. The lichens on which they mainly subsist in winter grow over considerable tracts, and a recent survey of the situation shows that large areas still remain practically untouched, so that even considering the comparatively slow growth of these plants, no apprehension need be felt at present that the herd is becoming too large for its natural food supply.

On each island a corral has been built into which the respective herds have been driven from time to time for examination. As the herds have increased and the commercial taking of seal skins has been resumed, less attention could be devoted to the reindeer, because of the increased demand on the time of the able-bodied natives, and in consequence the animals have become somewhat wild and unmanageable. Since, however, they are steadily increasing, cost

nothing for maintenance, and are more and more valuable as a source of food, the experiment may be considered highly successful.

The rate of growth of the two herds since their introduction, under practically natural conditions and without special care, is of interest.

Growth of reindeer herd on Pribilof Islands.

Year.	St. Paul.	St. George.	Total.
1911	25	15	40
1912	40	25	65
1913	[1] 55	40	95
1914	75	58	133
1915	92	62	154
1916	111	85	196
1917	144	[2] 93	237
1918	[3] 158	[4] 114	272
1919	[5] 164	[6] 123	287
1920	[6] 192	[7] 125	317
1921	[8] 250	[9] 160	[1] 410

[1] Approximate.
[2] Excluding 3 killed.
[3] Excluding 2 killed.
[4] Excluding 18 killed.
[5] Excluding 14 killed.
[6] Excluding 22 killed.
[7] Excluding 31 killed.
[8] Excluding 32 killed.
[9] Excluding 19 killed

Family BALAENIDAE.

Balaena mysticetus Linnaeus. BOWHEAD WHALE.

In a number of instances whales have drifted ashore on the Pribilofs, and in some cases they have been identified. St. Paul has apparently received the larger share, a natural result of its longer and more easily observed coast line. Hahn collected notes from the St. Paul Island log detailing some of these occurrences. On January 1, 1890, a large right whale was discovered at East Landing, St. Paul. The head was gone; the body was more than 60 feet long. Another carcass came ashore at Zoltoi, near the village, on August 31 of the same year. From the same source Hahn learned that other whales (species not stated) were stranded as follows: October 18, 1886, a whale 56 feet long, bearing a harpoon, drifted into English Bay. Others were recorded as coming ashore on September 13, 1892; March 27, 1903; and August 9, 1906.

Dr. Frederick W. True, himself a student of this group, examined the bones of a number of individuals of this species, and made measurements of the right mandible of one found on the beach north of Lukanin (1899, p. 352). He mentions also a bowhead whale which came ashore on St. George in 1889, from which the natives secured about 1,500 pounds of whalebone. The remains of others found by True near East Landing and at Zoltoi were probably those of individuals above mentioned, records of which were found by Hahn.

Scammon says (1874, p. 68): "The last seen of them in high latitudes, by whalemen, is on their return from the Arctic Ocean, when they are found in the vicinity of St. Paul's Island, Behring Sea, in the month of October, and these are usually very large."

Family BALAENOPTERIDAE.

Balaenoptera velifera (Cope). Large Finback Whale.

True summarized the result of his observations on the large finback whale as follows (1899, p. 352):

The hind part of a skull of a large finback, which may be this species, was found by Mr. Prentiss and myself on the shore of the lagoon in 1895. The greatest breadth across the temporals was 6.35 feet. The height of the occipital from the upper margin of the foramen magnum to the nasals was 3.15 feet.

I saw nothing of these whales about the Pribilof Islands in the summer of 1895, but when returning homeward observed them in large numbers on September 3 along the south coast of Kadiak. Mr. Palmer remarked in 1890: "Not common about the islands in summer, but a number were seen after leaving St. George for the south on August 11. A dead one was stripped of its 'bone' on St. Paul last winter."

Hahn found in the St. Paul Island log a record of a large finback which drifted ashore at the north end of St. Paul Island on February 13, 1884.

Balaenoptera davidsoni Scammon. Davidson Lesser Rorqual.

True (1899, p. 352) gives the following brief account of the rorqual, which comprises all the data available:

The bones of a small finback, belonging without doubt to the species, were found at Rocky Point, St. Paul. There were 27 in all—the seventh cervical, 11 dorsals, and 15 lumbars and caudals.

Megaptera versabilis Cope. Pacific Humpbacked Whale.

According to a note taken by Hahn from the St. Paul Island log, a female humpback, about two-thirds grown, came ashore at Zoltoi beach on September 27, 1876.

Family PHYSETERIDAE.

Physeter macrocephalus Linnaeus. Sperm Whale.

The only record of the sperm whale on the Pribilofs seems to be that of G. Dallas Hanna (1914, p. 218), who thus details the occurrence:

A sperm whale or cachelot came ashore at Zapadni Rookery April 14, 1914. It was a male 47 feet long and had probably been dead a week. About 5 tons of blubber were saved for fox food when the head and carcass floated away. Although other species of whales are abundant about the island, the cachelot had never been seen before by any of the Aleuts.

In a recent note Hanna mentions a female sperm whale which came ashore in an advanced stage of decomposition near Kitovi Rookery, St. Paul Island, in the summer of 1919.

Family ZIPHIIDAE.

Berardius bairdii Stejneger. PACIFIC BEAKED WHALE.

The first notice of the occurrence of this species is apparently that of True, who recorded it as follows:

Two large beaked whales were found on the coast of St. George Island, Pribilof Group, Alaska, in June, 1903, by Mr. James Judge, the resident treasury agent. One of these, a female, was reported by Mr. Judge as being 40 feet 2 inches long. * * * The other specimen, a male, was 25 feet 5 inches long.

These were skeletonized and sent to the U. S. National Museum, and were later exhaustively discussed and figured by True, together with a third individual reported by Ezra W. Clark as occurring at the same place on August 21, 1909, but which, apparently, was not preserved (1910, pp. 2, 60 et. seq.).

Family DELPHINIDAE.

Orcinus rectipinna Cope. KILLER WHALE.

Killer whales are often seen about the Pribilofs and are known to prey on seals and sea lions, both young and adults. True (1899, p. 353) reported as follows:

The skull of a killer was brought from St. Paul Island in 1895 by Mr. Charles H. Townsend, obtained from a specimen which came ashore to the south of Hutchinsons Hill. Many nominal species of killers have been established, but it has not yet been demonstrated whether there are really several or only one.

I saw two killers on one occasion quite close inshore at St. Paul in 1895. In 1890 Mr. Palmer wrote: "A few seen about the islands in May and early in summer. They return in August. We saw quite a number on August 12 between St. George and Unalaska."

Most of the natives have seen killers chasing sea lions, and have seen both sea lions and killers strand on the rocky shore. The majority of the killers seen had a large whitish blotch on each side of the back, immediately behind the dorsal. In no case was this blotch pure white, though the center and upper part of it was always lighter than the sides. The tip of the dorsal in no case turned over.

Preble (in Osgood, et al., 1915, p. 72) has summarized the relations of this species to the fur seal, as follows:

While the young pups are still about the islands in autumn many are destroyed by killer whales (*Orca gladiator*), which are frequently observed singly or in small schools cruising about in front of the rookeries and are known to prey especially on the pups. The following actual records of killer whales observed about St. Paul Island in autumn, selected from a large number of observations taken from the island log by the late Doctor Hahn, indicate to some degree the part played by them in the destruction of young seals. A large school of killers was seen near East Landing on October 21, 1875, and 5 near the same place on September 21, 1891; 1 seen off Reef Rookery on December 2, 1902, was playing havoc with a band of seals; fragments of both

cows and pups, the work of killer whales, were found strewn along the beach at Northeast Point on November 6, 1904. In the autumn of 1907 killers were reported on numerous occasions, and native watchmen at Northeast Point and Polovina reported considerable destruction. A killer 24 feet long was stranded at Northeast Point on December 16, 1908. On November 1, 1913, G. Dallas Hanna observed three killers close to the reef near the village of St. George preying on the seal pups. Two of these came so close to the bluffs that he was able to hit them with a rifle and killed at least one.

These records indicate that killer whales are by no means uncommon about the Pribilofs. The stomachs of two killers examined by Captain Bryant contained, respectively, 18 and 24 seal pups [Rept. Fur-Seal Investigations, 1896–97, pt. 3, p. 93, 1899], and it is certain that the total number of young seals killed by them must be very great.

As possibly having some bearing on the seasonal movements of killer whales, the dates on which they have been noted in the St. Paul Island log, as extracted by Hahn, may be given: October 21, 1875; June 6, 1877; May 21, 1881; June 8, 1881 (Walrus Island); June, 1882; May 15, 1884; May 21, 1884; May 19, 1886; May 28, 1888; May 31, 1889; September 21, 1889; June 1, 1894; May 26, 1895; May 22, 23, 24, and 26, 1900; July 18, 1902 (school); December 2, 1902; May 5, 1903; November 8, 1904; October 12, November 16, 1907; December 16, 1908; December 6, 1909; June 6, 1910; June 21, 1910; May 31, 1911 (Hahn).

G. Dallas Hanna, in notes kindly forwarded recently, gives some data regarding the occurrence of killer whales about the islands within the past few years. A part of his account may be quoted:

In the fall schools of them cruise round and round the beaches in close formation and actually devour seals by the hundreds. The official journals which are kept on the islands contain many accounts by eyewitnesses of their depredations. I once saw two killers take three seals in five minutes.

The fall visit of the animals coincides with the period when the young seal pups are learning to swim, and it is upon them that the greatest damage is wrought. At times, however, they have been seen to capture older animals. In the spring of 1917 a school of them maintained a stand between St. Paul Island and Sealion Rock, and for more than a week succeeded in capturing or driving away practically every seal which approached the great breeding grounds in the vicinity.

Phocaena phocaena (Linnaeus). Harbor Porpoise.

True (1899, p. 353) sums up the evidence regarding the occurrence of this species in Bering Sea as follows:

A few bones of a small porpoise, apparently of this species, were picked up at St. Paul June 3, 1890, and two small schools were seen in the harbor at Unalaska May 20 and 21, the same year. A specimen of this species was obtained by Mr. Charles H. Townsend at Captains Harbor, Unalaska, August 17, 1895.

I find in the collection of the U. S. National Museum the skull and skeleton, No. 49428, taken by True and Prentiss at St. Paul, in the summer of 1895. Another skull and skeleton No. 217912, male, was taken at Northeast Point, St. Paul, by G. D. Hanna, on July 19, 1916.

On February 12, 1917, a school of porpoises was forced ashore by the heavy ice in the Village Cove at St. George Island. Thirteen were thus trapped, 12 of which were carefully measured and skeletonized. Eleven of these, 10 complete skeletons and 1 skull, are now in the collection of the U. S. National Museum.

Family ELEPHANTIDAE.

Elephas primigenius Blumenbach. MAMMOTH.

Remains of the mammoth have been found on several occasions. The earliest specimen seems to have been a tooth found on St. George in 1836. Dall (in Dall and Harris, 1892, p. 266) refers to this in part as follows: "[The discovery of] a mammoth tooth on the island of St. George of the Pribilof group, in 1836, vouched for by Veniaminoff (Unal., I, p. 106)." A native chief, Gromoff, informed Dr. W. L. Hahn that he had found two mammoth tusks on St. Paul, one on the north shore and the other at Northeast Point. The latter is probably the one referred to by Stanley-Brown (1892, p. 499), who says:

> There are two fragments of paleontologic evidence connected with the islands which, as they have been used by writers, demand a cautionary word. The tusk of a mammoth was found in the sands of Northeast Point on St. Paul Island, and the tooth of one is reported as coming from the shores of St. George. As there is not a foot of earth on either island, save that which has resulted from the decomposition of the native rock and the decay of vegetation, the value of such testimony is questionable.

Whether Stanley-Brown doubts that the specimens were actually taken on the islands, or questions the deductions which had been drawn from their presence by previous writers on the geology of the North, is not clear.

George M. Dawson (1894, p. 4), in the course of a somewhat extended discussion of the subject of mammoth remains in northwestern America, refers to these finds and to Stanley-Brown's comment, and professes not to understand "the precise intention of the cautionary remark just quoted." His conclusion is that the presence of these remains on the Pribilofs indicates a former connection with the mainland.

Frederic A. Lucas (1898, p. 718) has put on record two teeth of the mammoth obtained by R. E. Snodgrass from the cave on Bogoslof Hill, St. Paul Island, in 1897. Lucas (l. c., p. 718) is also of the

opinion that the presence of the remains of the mammoth on the group argues for former land connection. Maddren (1905, p. 21), in discussing this and other finds, has described at some length the circumstances attending the collection of these teeth from the testimony of Bristow Adams, who was a member of the party which made the collection.

G. Dallas Hanna, in a recent paper on the geology of the Pribilofs (1919c, p. 222), makes the following statement:

> It should be stated here that the reports of the finding of bones of fossil elephants on the Pribilof Islands are probably attributable to practical jokes which have been played on credulous naturalists in the past. No such bones have thus far been found that were not planted by man, according to reports of eyewitnesses to some of the pranks.

This statement can hardly be considered as applicable to the finding of the teeth and tusks above mentioned, since their authenticity seems to be as well established as is usual in such cases. It would seem to the writer, however, that these remains were most probably accidentally transported to the islands, most likely on floating ice, and that, therefore, their occurrence there has no special geological significance.

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The following list of titles relate mainly to the birds and mammals of the Pribilof Islands, and, while known to be incomplete, is believed to include all the more important works. It is designed mainly to furnish complete citations of works referred to in the preparation of the present lists of birds and mammals, and especially the articles drawn upon for information. Most of the voluminous literature relating to fur seals is listed in Fur Seals and Other Life of the Pribilof Islands, by Osgood, Preble, and Parker, published in 1915, and no attempt has been made to include such titles in the present list.

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1877. Nest and eggs of the Alaskan wren: Bull. Nuttall Ornith. Club, vol. 2, no. 3, p. 82, July.

Descriptions of first nest and eggs known, taken on St. George Island, in June, 1876.

1902. The hair seals (family Phocidae) of the North Pacific Ocean and Bering Sea: Bull. Amer. Mus. Nat. Hist., vol. 16, art. 34, pp. 459-499, December 12.

Original description of *Phoca richardii pribilofensis* (p. 495). Mention of ribbon seal (*Histriophoca fasciata*) from vicinity of Pribilofs.

Baird, Spencer Fullerton.

1869. On additions to the bird-fauna of North America, made by the scientific corps of the Russo-American Telegraph Company: Trans. Chicago Acad. Sci., vol. 1, pt. 2, art. 10, pp. 311-325.

Contains discussion of several species first noted from the islands by Dall and Bannister, including original description of *Troglodytes alascensis* from St. George Island.

Baird, S. F., T. M. Brewer, and Robert Ridgway.

1884. The water birds of North America, vol. 2.

Original description of *Rissa tridactyla pollicaris* (p. 202).

Bean, Tarleton Hoffman.

1882. Notes on birds collected during the summer of 1880 in Alaska and Siberia: Proc. U. S. Nat. Mus., vol. 5, pp. 144-173, July 8, 1882.

Notes on a few species from the Pribilofs or vicinity.

Bent, Arthur Cleveland.

1919. Life histories of North American diving birds, order Pygopodes: Bull. 107, U. S. Nat. Mus. 245 p.

Contains many references to habits of birds on the Pribilof Islands.

BENT, ARTHUR CLEVELAND—Continued.

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CHICHESTER, HARRY D.

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COINDE, J. P.

1860. Notice sur la faune ornithologique de l'ile de Saint-Paul, suivie de l'énumération de quelques espèces d'insectes (Coléoptères) des Aléoutiennes et du Kamtschatka: Rev. et Mag. de Zool., vol. 12, 2e sér., pp. 396–405.

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DALL, WILLIAM HEALEY.

1873. Notes on the avifauna of the Aleutian Islands from Unalaska eastward: Proc. Calif. Acad. Sci., vol. 5, 1873–74, pp. 25–35, February 8.

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ELLIOTT, HENRY WOOD, and ELLIOTT COUES.

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Notes on 25 species observed on St. George and St. Paul during the summer of 1895. Specimens of *Pagophila alba*, *Aegialitis semipalmata*, and *Oceanodroma furcata* recorded from the islands for the first time.

RIDGWAY, ROBERT.

1886. *Tringa damacensis* (Horsf.) in Alaska; a sandpiper new to the North American fauna: The Auk, vol. 3, no. 2, p. 275, April.

Records specimen taken by C. H. Townsend on Otter Island, June 8, 1885.

1887. A manual of North American birds; 631 p., 124 pls.

Original description of *Plectrophenax nivalis townsendi*, from Otter Island (p. 403).

1898. New species, etc., of American birds, II: The Auk, vol. 15, no. 4, pp. 319–324, October.

Description of *Calcarius lapponicus alascensis*, from St. Paul Island (p. 320).

RILEY, JOSEPH HARVEY.

1917. A bird new to the North American fauna: The Auk, vol. 34, no. 2, p. 210, April.

Records specimen of *Pinicola c. kamtschathensis* taken on St. George Island, October, 1915.

SCAMMON, CHARLES MELVILLE, and W. H. DALL.

1874. The marine mammals of the northwestern coast of North America, described and illustrated: together with an account of the American whale-fishery. 4to., p. 319+V, San Francisco and New York.

An appendix, by W. H. Dall, pp. 281–319, comprises mainly a catalogue of the Cetacea of the North Pacific Ocean.

SEALE, ALVIN.

1898. Notes on Alaskan water birds: Proc. Acad. Nat. Sci. Philadelphia, 1898, pp. 126–140.

Includes brief annotations on eleven species taken on the Pribilofs by A. W. Greely and R. E. Snodgrass. *Totanus melanoleucus* and *Saxicola oenanthe* added to the Pribilof list; *Tringa couesi*, also added, evidently based on misidentification; dates of specimens unreliable.

STANLEY-BROWN, JOSEPH.

1892. Geology of the Pribilof Islands: Bull. Geol. Soc. Amer., vol. 3, pp. 496–500, 1892.

Reference made to discovery of remains of mammoth on the islands.

STEJNEGER, LEONHARD.

1889. Notes on the downy young of the parrot auk and of the crested auk: Rept. of Cruise of Revenue-Steamer *Corwin* in Arctic Ocean, 1884, pp. 125, 126.

Describes and figures the young of these species, not before known, from specimens taken on Otter Island by J. E. Lutz in 1884.

1885. Results of ornithological explorations in the Commander Islands and in Kamtschatka: Bull. 29, U. S. Nat. Mus., 382 p., 8 pls.

A few notes on Pribilof birds.

TOWNSEND, CHARLES HASKINS.

1887. Notes on the natural history and ethnology of northern Alaska: Rept. of Revenue Marine Steamer *Corwin* in Arctic Ocean in 1885.

Includes "Notes on Mammals, Birds, and Fishes obtained at various places between the Aleutian Islands and Kotzebue Sound" (pp. 96–102). A number of species recorded from the Pribilofs.

TRUE, FREDERICK WILLIAM.

1899. Mammals of the Pribilof Islands: In Fur Seals and Fur-Seal Islands of North Pacific Ocean, by David Starr Jordan and others; pt. 3, pp. 345–354.

Notes on 16 species, native and introduced, found about the group, and two extirpated species.

1904. Note on three very large beaked whales from the North Pacific: Science (N. S.), vol. 20, no. 521, pp. 888–889, December 23.

Records two large specimens, the skeletons of which were later received by the U. S. National Museum, found by James Judge, on the shore of St. George Island in June, 1903.

1910. An account of the beaked whales of the Family Ziphiidae in the collection of the United States National Museum, with remarks on some specimens in other American Museums: Bull. 73, U. S. Natl. Mus., 89 p., 42 pls.

Includes account of two skeletons of *Berardius bairdii* from St. George Island.

TURNER, LUCIEN M.

1886. Contributions to the natural history of Alaska, extending from May, 1874, to August, 1881: Arctic ser. publ., issued in connection with Signal Service, U. S. A.; no. 2, pt. 5; Birds, pp. 115–196.

A few species mentioned as found on the Pribilofs.

VENIAMINOF, BISHOP INNOCENT.

1840. [Extract from] Zabieska ob Octrovah Oonahlalshkenskaho Otdayla. St. Petersburg, 1840. Translation of "selections most pertinent to subject" (Pribilof Islands) published by Elliott in his report on the condition of affairs in the Territory of Alaska, 1875, pp. 241–244.

A paragraph mentioning somewhat over a dozen species of birds which visit the Pribilof Islands seems to be the earliest note on the ornithology of the group.

A BIOLOGICAL SURVEY OF THE PRIBILOF ISLANDS, ALASKA.

Part II. INSECTS, ARACHNIDS, AND CHILOPODS OF THE PRIBILOF ISLANDS, ALASKA.

INTRODUCTION.

By W. L. McAtee, *In Charge Food Habits Research, Bureau of Biological Survey.*

The bulk of the material upon which the present report is based was collected by Alvin G. and Elsie G. Whitney from October, 1912, to July, 1914, and by G. Dallas Hanna in 1914, 1915, 1916, and 1917. The collectors were employed on the Pribilof Islands during these years by the U. S. Bureau of Fisheries and thanks are due the Chief of that Bureau for turning over their collections of invertebrates to the Biological Survey. It has been of great assistance to have this material for working up simultaneously with the examination of the bird stomachs, reported on in earlier pages, which also for the most part were donated by the Bureau of Fisheries. Material of both classes from this source was supplemented by collections made by Edward A. Preble, of the Biological Survey, in 1914. The Whitneys and Hanna used a system of lot numbers for their collections of invertebrates, and these numbers have in all cases been placed on the specimen labels. Data for lot numbers applying to more than single specimens are reproduced on pages 132 to 138, as they may be useful in future when these collections are distributed. All type specimens mentioned in the following reports as well as the bulk of the remaining material will be deposited in the U. S. National Museum.

Previous general treatises upon the insects and arachnids of the Pribilof Islands are three in number. The first of these is the List of Insects Hitherto Known from the Pribilof Islands, which appeared in the report on The Fur Seals and Fur-seal Islands of the North Pacific Ocean, Part III, pages 547–554, 1899; prepared by E. A. Schwarz, with the assistance in a few groups of M. L. Linell, W. H. Ashmead, D. W. Coquillett, and Herbert Osborn. The second report was contained in several of the Papers from the Harriman Alaska Expedition, mostly published in the Proceedings

of the Washington Academy of Sciences from 1900 to 1902, and reprinted with some additions as volumes 8 and 9, Reports of the Harriman Alaska Expedition, 1904. These articles appeared under the authorship of the following 12 entomologists: W. H. Ashmead, Nathan Banks, A. N. Caudell, O. F. Cook, D. W. Coquillett, R. P. Currie, H. G. Dyar, J. W. Folsom, Otto Heidemann, Trevor Kincaid, Theo. Pergande, and E. A. Schwarz. More recently a report on specimens of insects collected in the summer of 1920 has appeared in Proceedings of the California Academy of Sciences, Fourth Series, volume 11, No. 14, pages 153–195, November 2, 1921. The collaborators in this case were E. C. Van Dyke, M. C. Van Duzee, F. R. Cole, J. R. Malloch, C. P. Alexander, H. Frison, A. D. MacGillivray, and E. P. Van Duzee.

Like its predecessors, the present report was brought to completion only through the efforts of a number of specialists, and the Biological Survey desires to put on record its hearty appreciation of their valued cooperation. The authors of parts of the following report are C. P. Alexander, Nathan Banks, R. V. Chamberlin, G. F. Ferris, W. T. M. Forbes, Morgan Hebard, W. L. McAtee, J. R. Malloch, Edith M. Patch, H. L. Viereck, W. R. Walton, and H. F. Wickham. The bureau is also indebted to Dr. J. W. Folsom for assistance in identifying specimens of Collembola.

The progress of knowledge of the insect, arachnid, and myriapod fauna of the Pribilof Group is shown in the subjoined table. Only fully identified forms have been included in the tabulation, generic determinations being ignored.

Species of insects, arachnids, and chilopods reported from the Pribilof Islands.

Group.	Fur-seal Islands Report, 1899.		Harriman Reports, 1900–1904.		California Academy Report, 1921.		Present report.	
	Number of species.	Described as new.	Number of species.	Described as new.	Number of species.	Described as new.	Number of species.	Described as new.
Apterygota	.....	.....	3	1	.....	.....	4	.....
Orthoptera	.....	.....	.....	.....	1	.....	2	.....
Mallophaga	.....	.....	.....	.....	.....	.....	5	.....
Anoplura	1	1	.....	.....	.....	.....	3	.....
Homoptera	.....	.....	2	1	.....	.....	3	1
Heteroptera	1	.....	1	.....	1	.....	3	.....
Trichoptera	.....	.....	2	2	3	.....	5	.....
Lepidoptera	.....	.....	2	.....	6	.....	8	.....
Coleoptera	20	.....	4	.....	26	1	49	.....
Mecoptera	.....	.....	.....	.....	.....	.....	1	1
Diptera	7	.....	.....	.....	33	8	75	21
Hymenoptera	1	.....	66	53	7	6	81	2
Arachnida	1	1	.....	.....	.....	.....	33	2
Chilopoda	.....	.....	3	1	.....	.....	4	.....
Total	31	2	83	58	77	15	276	27

While a comparatively large number of species of insects are known from the Pribilof Group, discussion of the relations of this fauna to that of other areas can be only tentative for the following

reasons: (1) More than a third of the species recorded in the foregoing table have been described as new from the islands; (2) very few of these have been collected subsequently elsewhere; and (3) the distribution of most of the remaining species is very imperfectly known.

These limitations understood, the following may be said of species known both from the Pribilof Islands and other areas: All of the previously known spring-tails (3 species of Collembola) seem to be Holarctic in distribution. The two species of roaches (Orthoptera) are only waifs on the Pribilofs brought there on ships from the south. Of the 5 kinds of bird lice (Mallophaga), 3 have been recorded from Europe and probably are Holarctic, while 2 are known from other localities in the Pacific Ocean. The distribution of these ectoparasites as well as of the sucking lice (one species on man and two on the fur seal) depends entirely on that of their hosts; by living next the skin of warm-blooded animals they enjoy a habitat almost uniform as to temperature and other essentials and are thus practically exempt, so far as direct influence is concerned, from factors bearing on the distribution of animals in general.

One of the Homoptera recorded from the Pribilofs was described from Bering Island, while of the Heteroptera, one plant bug is Holarctic, another is known from northwestern North America and the northern Pacific Islands, and the bed bug exists practically everywhere that there are permanent habitations of man. Of the caddis flies (Trichoptera), one is known from the mainland of Alaska and another is Holarctic. Of the several species of moths (Lepidoptera), 2 occur in northwestern North America, 2 in Alaska, 4 in Arctic America, and 2 are Holarctic.

The distribution of the beetles is better known than that of most of the orders; 9 species recorded from the Pribilofs occur also in northwestern North America, 14 in Alaska, 7 in northern North America, and 6 in Alaska and Siberia; while 11 are Holarctic and 2 are cosmopolitan, being carried about in commerce. Of the flies (Diptera), 3 species are known from northwestern North America, 13 from Alaska, 12 from northern North America, and 9 are Holarctic.

Hymenoptera exceed in number of species any other order of insect on the Pribilofs, but their distribution is very imperfectly known. Five of those collected elsewhere have been taken in northern North America, 5 in Alaska, and 9 on other islands of the northern Pacific, while 1 is known to be Holarctic.

Summarizing the distributional data for all of the orders, it appears that the largest number of species the Pribilof Islands are known to have in common with another region is 35, with Alaska; 30 are Holarctic; 28 occur more or less throughout northern North

America; 15 in northwestern North America (usually including Alaska); 14 on other islands of the northern Pacific; 6 in Alaska and Siberia; and 6 are "tramp" species, parasitic on man, or distributed in commerce. As information on the distribution of insects increases it is probable that a large proportion of the Pribilof fauna will prove to be Holarctic.

Lot numbers and field notes of G. Dallas Hanna, from St. George Island, 1914.

1. Diptera, 96 specimens collected about fox houses and on beach among bowlders. The most abundant species, the very woolly one, has become abundant the past few days in the outhouses, and the fox and meat houses, and among the bowlders on the beach. The smooth-bodied species so common in the lot sent to Washington in May is becoming scarce. June 4.
2. Diptera, 30 specimens, 4 species. In the grass and on very wet soggy ground near village landing. June 4.
3. Coleoptera, 20 specimens. Found living in grass, under stones, and in sun near village landing. June 4.
4. Coleoptera, 11 specimens, 1 species. Found in copulation on sunny side of bowlders about surf line, village landing. June 4.
5. Coleoptera, 17 specimens, 4 species. In grass and about stones, village landing. June 4.
6. Spiders, 4 specimens. Under stones, village landing. June 4.
7. Diptera, 14 specimens. Found on several species of flowers and in grass. When approached it darts into the grass but never tries to fly away. Uplands. June 8.
8. Diptera, 17 specimens. The two largest from flowers. Near village. June 8.
9. Diptera, 64 specimens. The most abundant species is one which is very common along the beaches, living upon the decaying marine algae. Near North Rookery. June 10.
10. Coleoptera, 5 specimens. Crawling over grass and rocks of highlands. 2 copulating, 1 eating piece of dead bird. Near North Rookery. June 10.
11. Diptera (minute), 12 specimens from near beach at East Landing. June 10.
12. Coleoptera, 23 specimens. 2 water beetles seen eating a dead earthworm. Small very black beetles found only on bowlders of beach near East Landing. June 10.
14. Coleoptera, 5 specimens. Found crawling over grass of bench lands. Not yet seen on top of high hills. June 12.
15. Coleoptera, 6 specimens. Crawling over grass of bench lands. Young found on wild parsnip. June 12.
16. Diptera, 4 specimens. Found crawling over grass of dry bench lands. Not seen near bogs or on top of high hills. June 12.
17. Diptera, 12 specimens, long legged. In wet places, mostly, but some seen crawling over grass far from water. None seen flying. Those with wings best developed from Spring Creek, Garden Cove. June 14. One seen with the very fuzzy fly in No. 18 beneath it; apparently they were fighting.
18. Diptera, 9 specimens, 5 species. Vicinity of Garden Cove. June 14.
19. Diptera, 10 specimens. Vicinity of Garden Cove. June 14.
21. Neuroptera, 3 specimens from Garden Cove. June 14.
23. Diptera, 5 species, 15 specimens from Garden Cove. June 14.

24. Coleoptera, 3 species, 8 specimens from Garden Cove. June 14.
25. Coleoptera, 5 specimens from Garden Cove. June 16. Mrs. E. G. Whitney, collector.
26. Diptera, 9 specimens from Garden Cove. June 16. Mrs. E. G. Whitney, collector.
27. Diptera, 5 specimens, from Garden Cove, June 16. Mrs. E. G. Whitney, collector.
28. Coleoptera, 10 specimens, toward East Rookery from Village; 2 females seen depositing eggs in wet packed earth which was clear of vegetation. Each had made a trench about 2 inches long, very shallow, and was depositing the eggs in a hole in the trench. The holes were ½ to ¾ inch deep. June 16.
29. Coleoptera, 9 specimens. Toward East Rookery from Village. June 16.
30. Diptera, 7 specimens, long-legged. Toward East Rookery from Village. None seen with wings developed. June 16.
32. Diptera, several species, 78 specimens (small). Sweepings toward East Rookery. June 16.
33. Aphididae, 9 specimens. About East Landing. June 16.
34. Diptera, 50 specimens. Toward East Rookery from Village. June 16.
35. Diptera, 43 specimens. Toward East Rookery from Village. June 16.
36. Diptera, 24 specimens. Several species. Toward East Rookery from Village. June 16.
37. Diptera, 207 specimens (small), 1 Hymenoptera. Staraya Artel Rookery, June 17.
38. Diptera, 7 specimens. Neuroptera, 1. Uplands toward Staraya Artel Rookery. June 17.
39. Lepidoptera, 4 specimens (only 5 seen). Uplands toward Staraya Artel Rookery. June 17.
40. Diptera, 4 specimens (all seen) in bog plants, border Gull Lake beside Staraya Artel Rookery; caught on wing. June 17.
41. Diptera, 3 specimens. Uplands toward Staraya Artel Rookery. June 17.
42. Diptera, 36 specimens, spiders 1. Uplands toward Staraya Artel. June 17.
43. Aphididae, 4 specimens. Uplands toward Staraya Artel. June 17.
44. Diptera, 6 specimens. Around a sphagnum bog ¼ mile west of Village. June 17.
45. Caterpillars, 3 specimens with eggs and cocoons made. Preserved in alcohol. June 18.
46. Insects, 30 specimens, from toward East Rookery. June 24.
47. Insects and spiders, 30 specimens from toward North Rookery. June 25.
48. Lepidoptera, 17 specimens from top of ridge, Zapadni Trail. June 27.
49. Insects, 75 specimens approximately. Toward Zapadni. June 27.
50. Diptera, 13 specimens; Coleoptera, 1. Both common. Flies feeding about meat and fox dung. Toward Zapadni. July 4.
51. Lepidoptera, 5 specimens. Cream-colored species is very rare. Toward Zapadni. July 4.
52. Diptera, 29 specimens. From toward Zapadni Rookery. July 4.
53. 10 Coleoptera from trail toward Zapadni. July 4.
54. 4 wood ticks, 2 species. From Tolstoi Point. Found under bowlders just above surf line on beach. July 9.
55. 50 insects, many species. Small black beetle is very common in some places, always found at surf line among bowlders.

Lot numbers and field notes of Alvin G. Whitney and Elsie G. Whitney, from St. Paul Island, unless otherwise stated, 1912 to 1914.

1. 3 caterpillars in grass. Telegraph Hill. October 11, 1912.
4. Galls from *Salix*. Adult insects had emerged during September. (Slide No. 5 may be larvae from willow galls, No. 14 of collection). Flat north of Telegraph Hill. Autumn, 1912.
5. 9 larvae, 1 spring-tail, found in bottom of bag in which willows and mosses had been collected, March 23. St. Paul Island. Southwest Bay to Southwest Point. March 23, 1913.
11. Mites. April, 1913.
14. 4 larvae. Probably from galls on *Salix*. May, 1913.
21. 2 coleopterous larvae. At roots of native plant. May 14, 1913.
22. 5 chrysalids of black and red caterpillars. Caterpillars were collected on Lukanin Hill about May 1. After two days in the laboratory, they began to spin cocoons in this bottle, and finished within a day, when they were placed in alcohol. May 14, 1913.
23. 3 gnats. Company house. May 16, 1913.
24. 2 parasitized dipterous flies. 1 parasitic mite from one of the flies. Company House bathroom. May 16, 1913.
26. 13 dipterous flies. Company House. May 16, 1913.
27. 3 dipterous flies. Company House bathroom. May 16, 1913.
28. 2 dipterous flies. Laboratory. May 16, 1913.
33. Pupae in grass stems growing in shelter of rock crevices. 1 hymenopterous fly, which emerged from one of these pupae in warmth of laboratory. Tolstoi Hill. Spring (probably about May 20), 1913.
36. 10 bumblebees. June 5, 1913.
37. 2 (parasitized?) gnats; nearly dead when found. Laboratory. June 5, 1913.
39. 6 gnats. From a great many on window, probably hatched from native *Sagina* transplanted to Laboratory a few days before. Laboratory. June 5, 1913.
40. 2 crane flies. In grass, 1 at Kitovi and the other on Reef Peninsula. June 9 and 10, 1913.
41. 1 fly and pupal skin. Pupa collected June 10, hatched June 20. June 20, 1913.
42. 6 flies. The first of this species seen this season. Sand dunes, Reef Peninsula. June 11, 1913.
43. 8 centipedes. From crevices and holes in vesicular lava, under a thin layer of soil. Coll. by E. G. W. Centipedes were found also near bowlder beach just northeast of Little Polovina Rookery, July, 1914. (Prof. G. H. Parker collected specimens on Akutan Island, in the Aleutians, June, 1914.) Gorbatch Cliffs. June 11, 1913.
44. 3 flies. Abdomens covered with white woolly hairs. Sand dunes, Reef Peninsula. June 11, 1913.
45. 2 beetles. Sand dunes, Reef Peninsula. June 15, 1913.
47. 4 Carabidae. In grass and moss. Southwest Bay. June 17, 1913.
49. 2 ground beetles. A very common form. Tolstoi Hill. June 18, 1913.
50. About 20 hymenopterous flies and their pupa-cases. Egg cluster collected by E. G. W., May 29, flies hatched out some time before June 20, in the pill box in which collected. May 29, 1913.

51. 12 larvae. Orange-colored in life. Abundant on willow catkins in the "pussy" stage, slightly before blossoming. The larvae were secreted among the buds in the compact heads. These willows covered with galls just beginning to develop. Flat north of Telegraph Hill. June 22, 1913.
52. 4 mites. From plants. June, 1913.
56. 2 weevils. June 20, 1913.
57. 2 flies. Male and female mating. From house. June 24, 1913.
60. 2 flies; 1 crane fly; 1 beetle; 1 spider. Otter Island (6 miles from St. Paul). July 3, 1913.
63. 2 flies. Company House. July 6, 1913.
64. 2 flies. Same 2 species as No. 63. Company House. July 6, 1913.
66. 2 flies. Duplicate of species Nos. 64 and 65. Several eggs. The eggs were ejected by larger fly in its struggles to escape from vial. Company House. July 6, 1913.
68. 4 aphids. On *Pedicularis*. July 9, 1913.
69. 8 aphids. On lettuce. Originally on *Pedicularis* blooms brought to laboratory June 22, and escaped to lettuce bed where they multiplied rapidly. Laboratory hotbed. July 10, 1913.
74. 4 blue flies. Collected by E. G. W. Zoltoi Beach. July 17, 1913.
75. 2 mites. On *Montia fontana*. July 17, 1913.
77. 12 larvae. Abundant everywhere around the roots of grasses and of herbs, and especially under beds of moss on the roots of which it feeds, killing the moss over considerable areas. Under such a moss bed I found as many as 20 to the square foot. This larva is found over all the island in grassy or mossy places and all through the summer season. It must also be of considerable ecological importance, because of its food value to the birds and foxes. The foxes will dig over large areas of moss beds to feed on these larvae. Was unable to find the species in adult form. Could not seem to raise adults in laboratory by keeping larvae with one of the food plants. It may possibly be the larval form of the crane fly, which is very abundant. Color not altered by pickling in alcohol. St. Paul Island. Reef "Parade Ground." July 18, 1913.
78. 16 larvae. Same as No. 77. July 20, 1913.
80. 2 flies. Male and female mating. Reef Peninsula. July 18, 1913.
87. 7 mites. This form very abundant, found everywhere in moss and on flowering plants. July, 1913.
90. 3 cast larval skins of crane flies. Hutchinson Hill. July 22, 1913.
91. 20 gnats. Big Lake. Swarms of these insects were being driven by the breeze southeastward off of the lake. These clouds of gnats noticeable throughout July and August. July 22, 1913.
92. 10 gnats. Same as No. 91. Big Lake. Collected from our coats as they swarmed past us while driving along the lake. July 22, 1913.
93. 3 small gnats. Big Lake. Collected at same time with larger ones from lake shore. July 22, 1913.
94. 3 Diptera, 1 bug, 2 Neuroptera, 1 moth, 1 beetle. Northeast Point Peninsula. July 22, 1913.
95. 11 Hymenoptera. Collected by a native boy who said he found a nest of them. July 23, 1913.
96. 4 caterpillars. Collected by a native September 8; then left in a dry box until October 6, in the hope that they would pupate. None did so; several dried up. The specimens preserved were the ones left living October 6. October 6, 1913.

98. About 10 larvae from mud of dried-up pond, where *Leucosticte* had been scratching for them. This pond, about one-fourth mile long and eighteen inches deep, was dry from August 5 to mid-September. During this time its whole mud bottom was scratched entirely over by turnstones to get at these larvae, which were abundant. Color of larvae *ruby-red.* Mud bottom of Village Pond. August 10, 1913.
102. 4 water beetles. Creek outlet of Antone Lake. Fall, 1913.
104. 33 mites from *Stellaria.* September 13, 1913.
105. 6 Mallophaga. On choochkie (*Aethia pusillus*). November 4, 1913.
106. 11 Mallophaga. On *Aethia pusillus.* Same as No. 105. November 4, 1913.
107. 14 Mallophaga. On *Aethia pusillus.* Same as Nos. 105 and 106. November 4, 1913.
108. Lice on *Mus musculus.* November 16, 1913.
109. Lice on *Mus musculus.* Duplicate of No. 108. November 16, 1913.
110. Lice on *Mus musculus.* Duplicate of No. 108. November 16, 1913.
111. 6 caterpillars. On a sandy road. Halfway Point. August 1, 1913.
112. 5 caterpillars. Collected September 8 by a native, same as No. 96, left in box to pupate, but dried up without transforming. October 6, 1913.
113. 8 bumblebees. Collected by a native who killed them in grease. Northeast Point. May 31, 1913.
116. 3 caterpillars. About 300 feet up on bare south cinder slope, where the snow was melted off and the surface of the cinders warmed by the sun. All insects in the wet, half-frozen tundra below were still dormant. Polovina Hill. March 29. 1914.
117. 2 larvae and 3 pupal shells. Found close together in moss on the flat near Polovina Lake. A fox was digging up insects near by. March 29, 1914.
118. 3 larvae; 3 rove beetles. From moss on flat near Polovina Lake. March 29, 1914.
119. 3 small beetles and several mites. April 5, 1914.
120. 2 aphids and one empty aphid skin, and 1 hymenopterous fly. The live aphids were bluish with whitish "bloom"; collected in moss on scoria bank back of "Company House." April 7, 1914. The fly emerged apparently *from one of these aphids* about April 18, 1914.
121. 1 beetle. Village Hill. April 15, 1914.
126. 2 lice from Aleut child's hair. April 22, 1914.
127. 4 Mallophaga, from European widgeon shot May 9 at Icehouse Lake. May 11, 1913.
128. 2 beetles. Male and female mating. From surface of tide pool under Gorbatch Cliffs. May 13, 1914.
129. 2 insects. Found jumping like springtails on the bare sand dunes, Diamond Hill dunes. May 16, 1914.
131. 4 beetles. May 22, 1914. 5 beetles from Zoltoi Beach sand dunes. May 19, 1914.
132. 6 flies; 8 mites. From privy. The mites were parasitic on the flies, sometimes two or three mites on a single host. May 19, 1914.
133. 3 coleopterous larvae. Lukanin Hill. May 19, 1914.
3 coleopterous larvae. Zoltoi Beach sand dunes. May 22, 1914. These beetle larvae, resembling those of "potato beetles," are exceedingly common all summer, and feed on a large variety of plants, including *Pedicularis.* Probably are the larval stage of the species in No. 145 and the largest species in No. 189.
135. 9 rove beetles. Zoltoi Beach sand dunes. May 22, 1914.

138. 10 weevils. May 19, 1914.
139. 6 mites. Parasitic on flies. Same as in No. 132. May 19, 1914.
141. 7 mites. Parasitic on flies. Same as Nos. 132 and 139. May 23, 1914.
143. 6 Diptera. May 23, 1914.
146. 6 beetles, May 19, 1914. 7 beetles from Zoltoi sand dunes May 22, 1914. 7 beetles from meadow by villages. July 24, 1914.
147. 2 beetles, May 21, 1914. 1 beetle, Zoltoi sand dunes, May 22, 1914.
148. 22 rove beetles. Zoltoi sand dunes. May 22, 1914.
149. 8 click beetles. This species is found abundantly under spreading *Mertensia maritima* plants. Zoltoi sand dunes. May 22, 1914.
150. 39 beetles, Lukanin Hill, May 19, 1914. 3 beetles, Zoltoi sand dunes, May 22, 1914, 1 beetle, July 24, 1914.
152. 13 Diptera. From outside of laboratory window. May 23, 1914.
153. 4 flies. From privy. May 23, 1914.
154. 4 Diptera. May 23, 1914.
155. 2 Diptera. Gray in color, with 2 diagonal bands on under side of abdomen. Laboratory. May 23, 1914.
156. 10 Diptera and their parasitic mites. From outhouse. May 23, 1914.
157. 2 ————, male and female (?). Perhaps same species as No. 129. Bronze-lustered, wingless insects, found among the moss. Grassy bank beyond village wells. May 23, 1914.
159. 6 beetles. These beetles were taken when a very heavy wind had been blowing all day, and they had been swept into the hollows among the dunes. Their wings protruded from under the half-expanded elytra, indicating that they had been in flight. I have never seen any other beetles on the Pribilofs that could fly. This was the only time I saw this species, which was fairly abundant in the one locality this one day. I saw perhaps twenty or more in the sand hollows. They were velvety brown in color, with blotches of darker brown, and when touched drew their legs into grooves on the body, so they were then as smooth as a bean. (Same as No. 166.) Zoltoi sand dunes. May 23, 1914.
160. 2 carabid (?) larvae. In moss. Grassy bankside near village wells. May 23, 1914.
167. 5 beetles. May, 1914.
168. 12 gnats, flying in a swarm by laboratory. Spring, 1914.
169. 1 bed bug, from native boy's clothes. 2 ————(?). Dark bluish in life, except the young ones, which are white. Probably same species as Nos. 13 and 200. These insects are common in damp herbage, especially in moss beds, and are sometimes seen in myriads in crevices of low ledges along the shores and crowded together on the surface of tide pools. April, 1914.
170. About 25 crane flies. 1 harvestman. Crane flies were crawling everywhere at this time, and many were mating. Tolstoi sand dunes. About June 1, 1914.
173. 2 beetles. Male and female, mating. (Probably same species as Nos. 180 and 181.) Ledges, Kitovi Rookery. June 16, 1914.
174. 3 mites, 1 moth, 1 hymenopteron, 1 crane fly. Spring, 1914.
176. 1 fly and several pupa cases. The pupa cases were found June 14 in the interstices of the nasal bones of a fur seal skull on the killing field. From these one fly hatched out in the vial June 20. Near village. June 20, 1914.

180. 12 beetles. From crevices and face of cliffs on southwest side of Sealion Rock, an islet less than ¼ mile long and about ¼ mile from St. Paul Island. The center of the island is about 60 ft. high and supports a little grass (*Glyceria*) and a few herbs. The island is similar in character to Walrus Island (12 miles distant), where a rare species of Coleoptera exists. Possibly this is the same species. June 29, 1914.
181. 44 beetles; 2 beetles; larvae. From face of cliffs and crevices of rocks on southwest side of island. Same as No. 180, and probably same species as No. 173. Sealion Rock. June 29, 1914.
182. 10 Diptera. From grassy summit, 60 ft. high. Sealion Rock. June 29, 1914.
183. 5 moths. June, 1914.
184. 3 moths. June, 1914.
185. 2 mites. From *Lunda cirrhata*. Color, pale blue. June 30, 1914.
187. 56 beetles (several species). Collected from mud shore of village pond. Many were mating. June 30, 1914.
188. 60 carabid beetles. Grass-covered upland. East Landing to village wells. These carabids are abundant and especially active and noticeable during June and July. June, 1914.
189. 181 beetles of several species. Near village. June, 1914.
190. 2 coleopterous larvae. June, 1914.
191. 5 mites. On *Rissa t. pollicaris*. July 4, 1914.
192. 4 Mallophaga. On *Rissa t. pollicaris*. These were from the same bird as the mites in No. 191, namely, E. A. Preble's catalog No. 2239. July 4, 1914.
193. Lice on *Sorex pribilofensis*. July 5, 1914.
194. Lice on *Sorex pribilofensis*. (Same as 193.) July 5, 1914.
195. 55 Diptera. This species was very abundant and active on *Chrysanthemum arcticum* flowers (in full bloom on this date) in salt marsh on north side of Salt Lagoon. Do not think I've seen it elsewhere on the Pribilofs. "Salt Lagoon" marsh. July 24, 1914.
196. 4 rove beetles. July 24, 1914.
197. 4 white larvae. 1 immature click beetle. (From underside of moss bed.) Reef "Parade Ground." July 28, 1914.
200. 2 ————. (Probably same species as Nos. 13 and 169.) Found in moss. Spring, 1914.
201. 2 click beetles, 1 small beetle. Summer, 1914.
204. 3 larvae, 1 beetle. Summer, 1914.
210. 7 Diptera. Summer, 1914.
212. 3 beetles. Summer, 1914.

APTERYGOTA.[1]

By W. L. McAtee, *Bureau of Biological Survey.*

Family PODURIDAE.

Neanura gigantea Tullberg.

Anura gigantea, Tullberg, Tycho. Collembola borealia-Nordiska Collembola. Öfversigt af. Kongl. Vetenskaps Akademiens Forhandlingar, No. 5, p. 41, Pl. X1, fig. 59. 1876. [Siberia.]

Two lots collected on St. Paul Island in spring of 1914 by A. G. Whitney, who says: "Dark bluish in life, except the young which are white. These insects are common in damp herbage, especially in moss beds, and are sometimes seen in myriads in crevices of low ledges along the shore and crowded together on the surface of the tide pools."

Aphorura dentata Folsom.

Aphorura dentata Folsom, J. W., Proc. Washington Acad. Sci., vol. 4, pp. 91–92, Pl. VII, figs. 29–36, 1902.

Originally described from material including one specimen collected on St. Paul Island, August 1, 1897.

Isotoma viridis Bourlet.

Isotoma viridis Bourlet. Memoire sur les Podures. Memoires de la Societe Royale des Sciences, de l'Agriculture et des Arts, p. 401, Lille, 1839. [France.]

Two lots collected on St. George Island, June 8, 10, 1914, by G. D. Hanna, and two from St. Paul Island, by A. G. Whitney, one collected May 19, 1914. The remark, "common in tundra moss" accompanies last lot.

Isotoma violacea Tullberg var. **mucronata** Axelson.

Isotoma violacea Tullberg, Tycho. op. cit., p. 36. [Siberia.]

Isotoma violacea Tullberg var. *mucronata* Axelson, W. M. Vorläufige Mittheilung über einige neue Collembolen-Formen aus Finnland. Meddelanden af Societas pro Fauna et Flora Fennica, 36. p. 118, 1899–1900 (1900). [Finland.]

Several specimens of this variety representing a species previously known, according to Dr. J. W. Folsom, only from Norway, Sweden, Finland, and Greenland, were found in the stomach of a *Leucosticte grisconucha*, collected on St. George Island, August 2, 1920.

[1] The insects of this order were identified by Dr. J. W. Folsom. He has recorded from the Pribilofs three of the species here mentioned, in his admirable report on the Apterygota in Papers from the Harriman Alaska Expedition, XXVII, Proc. Washington Acad. Sci., vol. 4, pp. 87–116, pls. 4–7, March 27, 1902.

ORTHOPTERA.

By Morgan Hebard, *Academy of Natural Sciences of Philadelphia.*

Family BLATTIDAE.

Subfamily Panchlorinae.

Panchlora cubensis Saussure.

P[anchlora] cubensis Saussure, Rev. et Mag. de Zool., (2), vol. 14, p. 230, 1862 [♀, Cuba].

A single green cockroach (♀) collected on St. Paul Island, in 1916, by G. Dallas Hanna apparently represents this common and widely distributed tropical American species, which is frequently introduced into the temperate regions of North America in bananas. As the northernmost point at which a species of the genus is known to be native is Brownsville, Tex., there is no doubt that the present is an adventive specimen, having been transported to the Pribilofs on board ship.

It agrees fully with West Indian material before me, except in having the interval between the eyes exceptionally wide (.5 millimeter) for females of the species, nearly three-quarters the occipital ocular width. The interocular width is subject to variation in the species, but in the great majority of females approximates one-third the occipital ocular width. For a detailed discussion of *cubensis* see Mem. Amer. Ent. Soc., No. 2, p. 198 (1917).

Blatella germanica Linnaeus is recorded as having been introduced into the Pribilof Islands at least twice and a preserved specimen has been reported from St. George. (Van Duzee, E. P., Proc. Calif. Acad. Sci., Fourth Ser., 11, p. 193, Nov. 1921.)—W. L. M.

MALLOPHAGA.

By G. F. Ferris, *Assistant Entomologist, Stanford University.*

All of the material here reported on was collected by A. G. Whitney on St. Paul Island. While the collection is small it contains two very interesting records, two of the species not having been recorded previously from North America, their host records also being new.

Docophorus lari Denny.

Four specimens of this widely spread gull-infesting species from the Pacific kittiwake, *Rissa tridactyla pollicaris.* It has previously been recorded from the same host.

Docophorus merguli Denny.

Several specimens from the least auklet, *Aethia pusilla.* This species has previously been recorded but twice, both times from the little auk or rotchie, *Alle* (*Mergulus*) *alle*, of Europe. The specimens at hand agree very well with specimens from the latter, sent us by Mr. Waterston.

Nirmus maritimus Kellogg and Chapman.

Several specimens from *Aethia pusilla.* This record also is new. Another species of *Nirmus* (*N. citrinus* Nitzsch) has been recorded from the same host and this record may, perhaps, refer to the same species as the two are not very different.

Menopon lutescens Nitzsch.

Several specimens from *Aethia pusilla.* This is also a new record, both as to host and locality, the species previously having been recorded from *Alca torda* and *Alle* (*Mergulus*) *alle* of Europe. The determination of any species of *Menopon* is always attended with uncertainty, but this species has been figured by Waterston (Proc. Royal Phys. Soc. Edinburgh, vol. 18, No. 4, pp. 266–267, f. 3, 1912), and as it is apparently rather characteristic of the auklet group the determination is reasonably safe.

Trinoton luridum Nitzsch.

Four specimens of this common duck-infesting species from the European widgeon, *Mareca penelope.* It has previously been recorded from the same host.

ANOPLURA.

By W. L. McAtee, *Bureau of Biological Survey.*

Family PEDICULIDAE.

Pediculus capitis De Geer.

Pediculus (*humanus capitis*), De Geer, Charles, Memoires pour servir à L'Histoire des Insectes, Tome Septieme, p. 67, 1778.

Five specimens are in the collection, all collected from the heads of Aleuts on St. Paul Island in April and in "summer."

Family ECHINOPHTHIRIIDAE.

Antarctophthirus callorhini Osborn.

Haematopinus callorhini, Osborn, Herbert, The Fur Seals and Fur Seal Islands of the North Pacific Ocean. Part 3, p. 553, 1899.

This species was originally described from specimens collected on fur seals from the Pribilof Islands.

Echinophthirius fluctus Ferris.

Echinophthirius fluctus, Ferris, G. F., Anoplura from Sea-Lions of the Pacific Ocean. Ent. News, vol. 27, no. 8, pp. 366-370, Oct. 1916.

Mr. Ferris kindly gives me permission to publish the fact that this species, originally described from the Steller sea lion, has also been taken on the fur seal, and must therefore occur on the Pribilofs.

HOMOPTERA.

By EDITH M. PATCH, *State Entomologist, Maine Agricultural Experiment Station.*

Family APHIDIDAE.

(Plate VIII.)

Macrosiphum constrictum, new species.

Alate viviparous female.—Beak short, reaching second coxa. Antenna 3.09 mm. in total length with joints measuring: I, .13 mm.; II, .07 mm.; III, .78 mm.; IV, .49 mm.; V, .53 mm.; VI, base including sensoria .22 m., spur .87 mm. III with nine sensoria in a row. Cornicle .65 mm. long, slightly but distinctly swollen at middle of distal half and constricted a little near the tip, where it is marked by faint reticulations for about .04 mm. There is nothing particularly distinctive about the venation of the wing, which is 3.55 mm. in length.

Apterous viviparous female.—Beak short, reaching second coxa. Antennae from two individuals were measured, one of which was 2.72 mm. long with joints as follows: I, .14 mm.; II, .08 mm.; III, .7 mm.; IV, .51 mm.; V, .5 mm.; VI, base including sensoria .22 mm., spur .57 mm. This antenna had nine sensoria on III. The other antenna measured 2.93 mm. with the joints as follows: I, .14 mm.; II, .10 mm.; III, .72 mm.; IV, .42 mm.; V, .49 mm.; VI, base including sensoria .25 mm., spur .81 mm. III in this case with six sensoria. Cornicle .63 mm. long, with shape and reticulations like that of the alate female except that the bulge of the distal half is slightly more pronounced.

Apterous oviparous female.—Beak short, reaching second coxa. Antenna 2.28 mm. in total length, with the joints measuring: I, .14 mm.; II, .09 mm.; III, .6 mm.; IV, .38 mm.; V. .39 mm.; VI, base including sensoria .2 mm., spur .48 mm. Sensoria of III variable in number. One individual had two on one side and three on the other. Cornicle .57 mm. long with shape and reticulation similar to those of the viviparous females. The tarsus to base of claw is .15 mm. long. The hind tibia is not perceptibly swollen.

As aphids vary somewhat in size in different collections and as the number of antennal sensoria is subject to fluctuation, the foregoing items should be taken as approximate rather than absolute.

Described from one alate viviparous, two apterous viviparous, and two apterous oviparous females.

Cotypes.—Locality St. Paul Island. Collection (Lot No. 69) taken by A. G. Whitney, June 22, 1913, from *Pedicularis*, and escaped from the laboratory to lettuce bed, where they multiplied rapidly. Specimens removed from lettuce July 10 comprised one apterous and one alate female and some nymphs. Collection (Lot No. 68) taken by A. G. Whitney from *Pedicularis* comprised two apterous oviparous females and one apterous viviparous.

Metatype, collected by A. G. Whitney, St. Paul Island, on *Saxifraga*, spring 1914, comprised one nymph (Lot No. 164).

Ideotypes collected by G. D. Hanna, St. George Island, June 16 (Lot No. 33) and June 17 (Lot No. 43), 1914. Nymphs only. Food plant not recorded.

This species shows certain resemblances to *Macrosiphum antirrhinum* (Macchiati) as described and figured by Theobald,[1] but the short beak of *M. constrictum* and the antennal sensoria of the apterous viviparous female and several minor differences serve to distinguish it. The most striking characters of *M. constrictum* are the slight dilation of the cornicle, with its very restricted area of faint distal reticulation; the short beak; the long slender basal portion of antennal joint VI and the short-pointed antennal setae.

Another species of plant louse, *Nectarophora insularis*, was described from St. Paul Island by Theo. Pergande (Proc. Washington Acad. Sci., vol. 2, p. 515, Dec. 20, 1900); and a fulgoroid leaf-hopper, *Delphax stejnegeri* Ashmead, originally described from Bering Island, has been recorded as occurring on the Pribilofs (Ashmead. W. H., Harriman Alaska Expedition, vol. 8, p. 130, 1904).—W. L. M.

EXPLANATION OF PLATE VIII.

Details of Plant Louse (*Macrosiphum constrictum*).

Fig. 1. Antenna of alate female.
Fig. 2. Antenna of apterous viviparous female.
Fig. 3. Antenna and tarsus of apterous oviparous female.
Fig. 4. Cornicle of apterous viviparous female.
Fig. 5. Cornicle of apterous oviparous female.
Fig. 6. Cornicle of alate female.
Fig. 7. Wing of female.

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[1] Theobald, Fred V. The British Species of the Genus Macrosiphum. Pt. II, Jour. Econ. Biol., vol. 8, p. 151, 1913.

DETAILS OF PLANT LOUSE (MACROSIPHUM CONSTRICTUM).

(Explanation on page 144.)

HETEROPTERA.

By W. L. McAtee, *Bureau of Biological Survey.*

Family MIRIDAE.

Irbisia sericans Stal.

Leptomerocoris sericans Stal. C. Beitrag zur Hemipteren-Fauna Siberiens und des Russischen Nord-Amerika. Entomologische Zeitung (Stettin) 19, p. 188, 1858. [Sitka.]

Irbisia (*Leptomerocoris*) *sericans* Stal. Heidemann, O., Papers from the Harriman Alaska Expedition, vol. 13, Entomological Results (7); Heteroptera. Proc. Washington Acad. Sci., vol. 2, p. 504, December 20, 1900.

This, the only species of Heteroptera in the collection, has a wide distribution in Alaska and on the neighboring islands, and is known to occur as far south as Oregon. The specimens at hand were obtained on St. Paul Island in June, July, and September, and on St. George Island in August.

Orthocephalus saltator Hahn, also of the family Miridae, was collected on St. Paul Island by Barrett-Hamilton (Schwarz, E. A., the Fur Seals and Fur-Seal Islands of the North Pacific Ocean, Part 3, p. 552, 1899). *Cimex lectularius* Linnaeus also is known to be present on the islands.

TRICHOPTERA.

By NATHAN BANKS, *Museum of Comparative Zoology, Harvard University.*

Family LIMNEPHILIDAE.

Limnephilus kincaidi Banks.

Two from St. George Island, August 4 and September, and one apparently this species from St. Paul, August 17. Originally described from St. George Island.

Arctoecia consocia Walker.

One from St. Paul Island, August 16.

Asynarchus simplex Banks.

Three from St. Paul Island, July 14 and 22, and one apparently this species, from St. George, August 4. Originally described from St. Paul Island.

A description of the larva of this species from the Pribilofs, has been published by R. A. Muttkowski, Bul. Wisconsin Nat. Hist. Soc., vol. 13, N. S., No. 1, pp. 42–45, March, 1915.—W. L. M.

Chilostigma praeterita Walker.

Three from St. George Island, June 17, and St. Paul Island, May 1, and "Summer." In these specimens the bristle-bearing areas or the posterior warts, prothoracic lobes, mesothoracic stripes, and tegulae are yellowish or reddish. The typical form was described as having these black, but they are pale in some of my European specimens, and I believe are normally pale; sometimes drying out dark.

In addition to the above-mentioned species, *Anabolia simplex* Banks has been recorded from St. Paul Island. (Van Duzee, E. P., Proc. Calif. Acad. Sci. Fourth Ser., 11, p. 193, Nov., 1921.)—W. L. M.

LEPIDOPTERA.

By Wm. T. M. Forbes, *Department of Entomology, Cornell University.*

There are nine species represented in this little collection, besides some larvae which can not be surely identified. The complete absence of butterflies is surprising, but may perhaps be explained by some peculiarity of the climate. The same thing occurs in Iceland, although as a rule butterflies are common in the Arctic regions.

There seems to be a slight tendency for the two islands, St. George and St. Paul, to have different local forms, but it is not marked enough to be certain. One specimen of *Hyphoraia subnebulosa* from St. George is exceptionally pale and shows some differences of marking but the other is like those from St. Paul. *Psychophora sabinii* is represented by a suffused specimen from St. Paul, while all those in good condition from St. George show crisp clean-cut markings, but such suffusion occurs commonly in the Arctic and is likely to be an individual rather than a racial character.

Family ARCTIIDAE.

Hyphoraia subnebulosa Dyar.

Three from St. Paul, June; 2, St. George, July. The type, in the U. S. National Museum, comes well within the range of this series, but is in poor condition. The thorax of the type in particular is beyond description. As the specimens in this series show it, the collar is yellow, with some black hairs along the posterior edge, the disk of the thorax is red-brown, concolorous with the wings, edged on each side by a broad yellow stripe, each side of which the black underscaling shows more or less distinctly as a black line. The upper two-thirds of the tegulae is chocolate brown, while the part just over the base of the wing is black in front and yellow behind. The hair is loose and erect in the male, but in the female the vestiture of both body and legs is smooth and close, like that of Apantesis. The series in the National Museum (from a variety of places) indicates that there may be a large number of minor local forms.

Family NOCTUIDAE.

Agrotiphila alaskae Grote.

Three males and one female, from St. George, appear to be of this species. The males are normal enough. The female has reduced,

lanceolate wings of half the area of the male's, with no black markings at all. The specimen from St. George is marked in two shades of pale olive, but one from Popof Island in the National Museum is purple-brown. The antennae are serrate and fasciculate, not simple as Hampson describes them. Superficially the moth could be easily mistaken for *Pachnobia wockei*.

Anarta richardsoni Curtis.

One from St. Paul. The hair on the deeply sunken eyes is sparse and easily overlooked.

Family GEOMETRIDAE.

Psychophora sabinii Curtis. (*Scinneria* Dyar).

There can be no doubt that this is *P. sabinii* of Curtis, as has been most generally believed and as has been specifically noted by Barnes and McDunnough since the preparation of this manuscript. They have proposed for it the genus *Barrovia*. "*Psychophora*" *fasciata* has nothing to do with this and no special resemblance to Curtis's figure. In it the pectinations of the antennae are as broad at the base as farther out, while in our form as well as in Curtis's figure they are shown as narrowing at the point of attachment and apparently articulated to the shaft. In *fasciata* the fringe is dark at the base with a white tip, the hind wing is dark-veined without transverse lines, the fore wing has no dark shade at the base; the t. a. line is angled on the cell only, while the t. p. line is not at all toothed. The antennae are serrate at the tip. In all these points *fasciata* differs from Curtis's figures and from the specimens in this lot. *Fasciata* is a noctuid, as shown by the venation and the large ocelli.

The long series from St. George (23 specimens, part of which look as if they were collected in alcohol) are very crisply marked and look like *Trichochlamys polata*. Some of them tend to show the four pale ovals in the median area which Curtis figures, and one is chocolate brown with contrasting white-filled lines. There is some tendency to suffusion, especially in the St. Paul specimen, but nothing like the forms *frigidaria* and *polaris*.

Family PYRALIDAE.

Titanio sp.

St. Paul.

Phlyctaenia sp.

Too poor to identify with certainty. It may possibly be *P. washingtonialis* Grote. St. George.

Family PTEROPHORIDAE.

Platyptilia sp.

It seems too far north for the Californian *P. modesta*, but there seems to be nothing else as close to it among the species of *Platyptilia* with obsolescent scale tuft. *P. pterodactyla* as described by Walker and as figured by Walsingham is a paler species with a pure white area and a couple of black dashes on the first feather, while this species is almost immaculate mouse-gray. The usual black scale-tuft in the third feather of the hind wing is represented by four or five scattered scales. Three from St. George. August.

Family TORTRICIDAE.

Sparganothis moeschleriana Wocke.

All the specimens I have seen of this species show the venation and other structures of *Sparganothis*, group *Cenopis*, and the markings would indicate the same reference; 1, St. George, August.

TINEID.

Family Undetermined.

Too poor to name, 2 from St. George, June.

E. P. Van Duzee lists from the Pribilofs the pyralid, *Phlyctaenia washingtonalis* Grote, the tortricid, *Argyroploce schulziana* Fabricius (with a query), and the oecophorid, *Borkhausenia pseudospretella* Stainton. (Proc. Calif. Acad. Sci., Fourth Ser., 11, pp. 194–5, Nov. 1921.) H. W. Elliott stated (Report on the Seal Islands of Alaska, Rept. 10th Census, Vol. 8, 1884, p. 12) that "a very few species of butterflies, principally the yellow Nymphalidae, are represented by numerous individuals." However, no butterflies have thus far been collected on the Pribilofs, and it is likely that Elliott's note was merely from recollection, and perhaps bad reference to the rather profusely yellow-marked *Hyphoraia*.—W. L. M.

COLEOPTERA.

By Prof. H. F. WICKHAM, *Department of Applied Zoology, University of Iowa.*

The present collection of Coleoptera is probably by far the most complete of any ever brought out from the Pribilof Islands. Many of the species were obtained in large series, exhibiting wide variation and giving valuable information as to time of occurrence. The fact that both St. George and St. Paul were consistently worked for material enables us to form an opinion as to the faunal relations of these islands with each other; and finally it should be noted that a few species were obtained that had not previously been reported from Alaska.

Two features stand out very clearly from examination of the material and data—first the long season over which the adults of many species may be found, and second, the great individual variation. Color, sculpture, size, and even outline appear to have become inconstant as if the restraints which ordinarily hold the species within narrow limits had been relaxed. An explanation of this variability which seems to me probably fundamental was suggested by Alexander Wetmore, of the Biological Survey—namely, close interbreeding brought about by the narrow quarters to which these insects are confined. A contributing cause may perhaps be found in the rigorous climatic conditions which must often subject the forming chitinous exoskeleton of the newly emerged adult to severe physiological stress, resulting in modifications of the surface sculpture and possibly even of its texture. Retardation or hastening of evaporation is known to affect the intimate sculpture of the tegument in semiarid districts and may well have an influence here.

Several species of beetles have been found upon one of these islands which are not yet known to occur upon the other, but I do not see any evidence of the development of different races where a given species inhabits both St. Paul and St. George, even though a large percentage of the Coleopterous fauna is incapable of flight and probably rarely crosses the distance of forty miles or so between the land areas. A few cosmopolitan beetles are becoming introduced by commerce.

Family CARABIDAE.

Genus *Carabus* Linnaeus.

Carabus truncaticollis Eschscholtz.

Numerous specimens are contained in the collections from St. Paul and St. George. Those from the former island were found in every month from May to October, and those from the latter island from April 14 to September 10. Taken as a whole, the series ranges from a vivid green through duller and bronze greens, red or copper bronzes to a brown bronze. In general the greens predominate, but the dates do not indicate any relation between season and color. Neither is there any correlation between color and locality, as specimens from either island show practically all of the intergrades. The legs vary from reddish yellow, with dark tarsi and tibial apices, to piceous. The size runs from 15.5 mm. to 20 mm. Several larvae, apparently about fully grown, are dated May 23 and June.

Genus *Nebria* Latreille.

Nebria bifaria Mannerheim.

Three specimens, St. Paul, without date other than "Summer, 1914." Already known from this island as well as from Alaska, Siberia, and Kamchatka.

Genus *Pelophila* Dejean.

Pelophila eschscholtzii Mannerheim.

Three specimens, St. Paul, one without date, the other two taken August 16; numerous specimens June 30. The first-mentioned example is distinctly metallic in color with greenish elytral border; the others are nearly black above, the elytra castaneous. Great variation is shown in number and position of the elytral foveae, even on the two sides of the same individual.

Genus *Patrobus* Dejean.

Patrobus septentrionis Dejean.

St. George and St. Paul. The dates run through every month from June 25 to September 3. A common and widespread species.

Genus *Pterostichus* Bonelli.

A very fine series of small pterostichi, belonging to the subgenus *Pseudocryobius*, was brought out by the collectors. It contains representatives of all the species hitherto known from the Pribilof group and also a few others apparently described from different parts of Alaska. The separation and identification of these forms has been a difficult task and the results of my study are by no means

satisfactory. In common with better known and more readily recognized insects like *Carabus truncaticollis* and *Chrysomela subsulcata*, these pterostichi appear to vary enormously in size, color, and depth of sculpture. There seems, also, to be some variation in thoracic outline; the basal foveae are affected by the sculptural inconstancy and the number of elytral striae of one individual. In consequence the characters ordinarily used for specific distinction become much lessened in value and one has to depend, in great part, upon facies for separation. Nevertheless the only basis for assigning most of the species to their names, most of which were given by Dejean and the early Russian writers, is found in these same characters and the attempt has been made to use them with discrimination. A study of the species of *Pseudocryobius* of both hemispheres is absolutely needed for the proper delimitation of our native forms.

Pterostichus vindicatus Mannerheim.

St. George, June, July 16; St. Paul, June. While placed in this species on account of the much finer elytral striae, the identification must be considered provisional. This is the first record for the Pribilofs.

Pterostichus ventricosus Eschscholtz.

St. George, April 17, May 6, June 4 and 25, July 16, August 4, September. St. Paul, June.

Pterostichus subexaratus Mannerheim.

St. George, April 1 and 17, May 6 and 17, August 4, September 2; St. Paul, June. Some doubt attaches to this identification. The species has not hitherto been recorded from these islands.

Pterostichus pinguedineus Eschscholtz.

St. Paul and St. George, taken every month from April 17 to September 3. Evidently a common species.

Pterostichus hyperboreus Mannerheim.

St. George, May 6 and June 10.

Pterostichus similis Menetries.

Common on both islands. Records from St. George are June 4, 10, 14, 19, 25, July 4 and 16, August 4; from St. Paul, April 15 and "May to July".

Pterostichus quadricollis Menetries.

St. George and St. Paul, June. Less abundant than *P. similis*.

Pterostichus subcaudatus Mannerheim.

St. Paul and St. George, June. This is the first record for the Pribilof Islands.

Pterostichus empetricola Dejean.

St. George, June 4, 10, 25, July 4 and 16, August 4; St. Paul, May 17, 19, 22, 31, June, July 13, September 1 and 3; also Sea Lion Rock, June 29. Fairly abundant and seems variable in size.

Genus *Amara* Bonelli.

Amara brunnipennis Dejean.

St. Paul and St. George. Dates are shown for each month between April 17 and September 3. Specimens run from shining black to some with distinct metallic tinge and several are of the form with brown elytra. There is also a good deal of variation in the extent of punctuation of the prothoracic basal impressions. This insect belongs to the subgenus *Curtonotus* Stephens.

Amara glacialis Mannerheim.

Several specimens from St. Paul, without definite date. Belongs to the subgenus *Bradytus* Zimmermann.

Amara brunnea Gyllenhal.

Many examples from St. Paul, May, June, and July. Belongs in the subgenus *Acrodon* Zimmermann.

Family DYTISCIDAE.

Genus *Hydroporus* Clairville.

Hydroporus sp. indet.

A few specimens are at hand from St. George (April 4 and September 3) and St. Paul (June 11). At present it is not feasible to attempt specific determination of this insect, which is a small black species 3.5 mm. long; it is evidently close to or identical with *H. nigellus* Mannerheim, which figures in our lists as a synonyn of *H. tartaricus* Leconte.

Hydroporus sp. indet.

Three examples of a bicolored species, 5 mm. in length, come from St. George, dated June 10. They appear to be related to *H. truncatus* Mannerheim in size, color, and oblique truncation of the elytral apices, but differ from the description in some details.

Genus *Agabus* Leach.

Agabus sp. indet.

Three females from St. George, June, August, and September. The male is necessary for identification.

Family SILPHIDAE.

Genus *Lyrosoma* Mannerheim.

Lyrosoma opaca Mannerheim.

St. George, abundant; St. Paul, two specimens; taken every month from May 17 to September 6; Sealion Rock, June 29.

Family STAPHYLINIDAE.

Genus *Atheta* Thomson.

Atheta (Megista) nomadica Casey.

St. Paul, May 22 and July 4, many specimens. The determination is due to Dr. A. Fenyes who writes that it is probably correct. He has also given us the generic references for the two species following.

Atheta sp. indet.

St. Paul, May 22.

Genus *Ocyusa* Kraatz.

Ocyusa sp. indet.

St. George, May 4, one specimen in bad condition.

Genus *Liparocephalus* Mäklin.

Liparocephalus brevipennis Mäklin.

St. Paul, a pair, May 13: St. George, one specimen, September 2.

Genus *Quedius* Stephens.

Quedius hyperboreus Erichson.

St. Paul, May 22, one specimen.

Quedius molochinus Gravenhorst.

One specimen, St. George, August 4.

Genus *Tachinus* Gravenhorst.

Tachinus apterus Mäklin.

About sixty specimens of *Tachinus* belong to a species which runs close to *instabilis* Mäklin by Dr. Horn's table. Some of the females, however, have the median dorsal lobe of the abdominal apex short, this being the character upon which *T. apterus* Mäklin is based. Likely enough, the whole series might properly be referred to *T. apterus*, which was not known to Dr. Horn. Specimens occur on both Islands, and the dates cover April, May, June, July, and September.

Genus *Bryoporus* Kraatz.

Bryoporus near insignis Mäklin.

A specimen of *Bryoporus* collected on St. Paul, May 22, may be compared with *Mycetoporus insignis* Mäklin from the island of Afognak. The description seems to agree in most of the principal points but differs in regard to coloration. The St. Paul specimen is 5.5 mm. in length, very shining, piceous black, the elytra tending toward castaneous. The antennae are blackish, strongly thickened externally and as long as the head and prothorax together, the two basal joints yellowish, third a little darker. Legs pale testaceous, coxae darker, hind femora and trochanters infuscate. Hind margins of abdominal segments scarcely perceptibly lighter above, more distinctly

so beneath. The four punctures described by Mäklin as being placed slightly in front of the hind margin of the pronotum are very distinct, the lateral and apical series are small. Elytra sparsely and finely punctate on the disk, a little more closely toward the scutellum, in addition to showing the usual sutural, discal, and lateral series of larger punctures. I do not make out any sexual characters. *Mycetoporus* and *Bryoporus* are separated by slender characters and have been united by Fauvel. It is entirely probable that the species in hand is congeneric with that of Mäklin though perhaps not conspecific.

Genus *Deliphrum* Erichson.

Deliphrum sp. indet.

About a dozen specimens, St. Paul and St. George, covering the months of April, May, June, August, and September. These belong to *Deliphrum* or some closely allied genus but the species can not be identified with any hitherto recorded from North America. Quite possibly it may be described from Siberia.

Genus *Olophrum* Erichson.

Olophrum marginatum Kirby.

St. George, May 6 and September 2.

Olophrum fuscum Gravenhorst.

St. George, June and September; St. Paul, May.

Genus *Micralymma* Westwood.

Micralymma dicksoni Mäklin.

St. George, April 12, June 4, 25, August 16, September 2; St. Paul, April 5. The identification of this very interesting beach-inhabiting insect is based upon comparison with specimens in the United States National Museum, having the above specific label in the handwriting of Mr. Schwarz.

Family LATHRIDIIDAE

Genus *Enicmus* Thomson.

Enicmus protensicollis Mannerheim.

St. Paul, one specimen. May 24.

Family BYRRHIDAE

Genus *Byrrhus* Linnaeus.

Byrrhus fasciatus Fabricius.

St. Paul, several specimens. The only dates given are May 23 and July 13. These specimens agree very closely with examples in the United States National Museum from Copper Island, carrying the above specific label.

Family ELATERIDAE.

Genus *Cryptohypnus* Eschscholtz.

Cryptohypnus littoralis Eschscholtz.

Several, from St. Paul. The dates given are April 30 to May 22, but most of the specimens are simply marked "Summer."

Genus *Hypnoidus* Stephens.

Hypnoidus musculus Eschscholtz.

St. Paul, four specimens. The only definite date is June 20. Common at various points on the Alaskan seacoast, occurring under shingle along the beaches.

Family PTINIDAE.

Genus *Trigonogenius* Solier.

Trigonogenius globulum Solier.

St. Paul, April; St. George, April 17. Widely distributed by commerce.

Genus *Ptinus* Linnaeus.

Ptinus fur Linnaeus.

St. Paul, January 6, May 16; St. George, May 17 and September 3. Common in houses over most of the civilized world.

Family CHRYSOMELIDAE.

Genus *Chrysomela* Linnaeus.

Chrysomela subsulcata Mannerheim.

The collection contains a beautiful and extensive series, varying in size, color, and depth of sculpture. Some specimens are green, others blue, while several are decidedly coppery. A few are blackish with very little luster. They come from both St. George and St. Paul and were mostly collected in May, June, and July, though the dates run as early as April 30 and as late as September 3. Several larvae of different sizes bear the date of May 14–22.

Family AEGIALITIDAE.

Genus Aegialites Mannerheim.

Aegialites californicus Motschulsky.

Numerous specimens from St. Paul, St. George, and Sea Lion Rock. The dates run between June 4 and July 8. Larvae were taken June 4 and June 29.

Family CURCULIONIDAE.

Genus *Lophalophus* Leconte.

Lophalophus inquinatus Mannerheim.

St. Paul, fairly common, May 19 to August 16.

Genus *Trachodes* Germar.

Trachodes ptinoides Germar.

St. George, May 6 to September 10.

Genus *Orchestes* Illiger.

Orchestes parvicollis Leconte.

Three specimens, St. Paul, spring of 1914.

A specimen of *Ilybius angustior* Gyllenhal was present in the stomach of a red phalarope, collected on St. George Island August 2, 1920, and one of *Hadrotes*, not specifically identified, in the stomach of a pectoral sandpiper collected on St. Paul Island August 22, 1914.

In addition to the beetles mentioned in the preceding list, E. A. Schwarz recorded (Report on Fur Seals and Fur Seal Islands, Pt. 3, pp. 548–549, 1899), partly on the basis of Wosnesenski's specimens as reported by Menetries, Motschulsky, and Mannerheim, the following species as inhabitants of the Pribilofs:

Laccophilus decipiens Le Conte. St. George.
Berosus maculosus Mannerheim. St. George.
Cercyon lateralis Marsham. St. Paul.
Hadrotes crassus Mannerheim. St. George.

In his paper on the Metamorphoses of some Alaska Coleoptera (Proc. Washington Acad. Sci., vol. 2, p. 201, Nov. 24, 1900) Trevor Kincaid records also the weevil *Lepidophorus lineaticollis* Kirby from St. Paul and describes its larva and pupa.

E. C. Van Dyke in the 1921 report (Proc. Calif. Acad. Sci., Fourth Ser., 11, pp. 156–166, Nov., 1921) adds the following 7 species: *Pterostichus hudsonicus* Le Conte, *Amara remotestriata* Dejean, *Agabus hypomelas* Mannerheim, *Atheta grominicola* Gravenhorst, *Quedius fulvicollis* Stephens, *Arpedium beringenus* Van Dyke, and *Lepyrus palustris* Scopoli.

An easily overlooked paper recording 26 species of Coleoptera from the Aleutian Islands, but none specifically from the Pribilofs, is the following: Coinde, J. P., Notice sur le faune ornithologique de l'Ile de Saint-Paul, suivie de l'énumération de quelques espèces d'insectes (Coléoptères) des Aléoutiennes et du Kamtschatka. Rev. et Mag. Zool., 2'e Sér., T. XII, pp. 396–405, 1860.—W. L. M.

MECOPTERA.

By NATHAN BANKS, *Museum of Comparative Zoology, Harvard University.*

Pl. IX, fig. 8.

Family PANORPIDAE.

Boreus borealis, n. sp.

Brassy black; the legs, including coxae and the pleura, the lower half of the beak, the wings (except tip in the male), and the ovipositor (except tip), are yellowish; the extreme tips of tibia and tarsal joints black; male genitalia pale; face hairy, vertex shining; wings in male very long and slender, fully one-half as long as abdomen, tip curved downward and ending in two points, one more slender than the other; ventral plate of male truncate, not notched at tip; in the female wings reach to abdomen, about twice as long as broad, larger than in allied species; ovipositor one-half the length of the abdomen, basal part concave above, beyond straight, below hairy.

Length: Male, 3.8 mm.; female, with ovipositor, 5 mm.

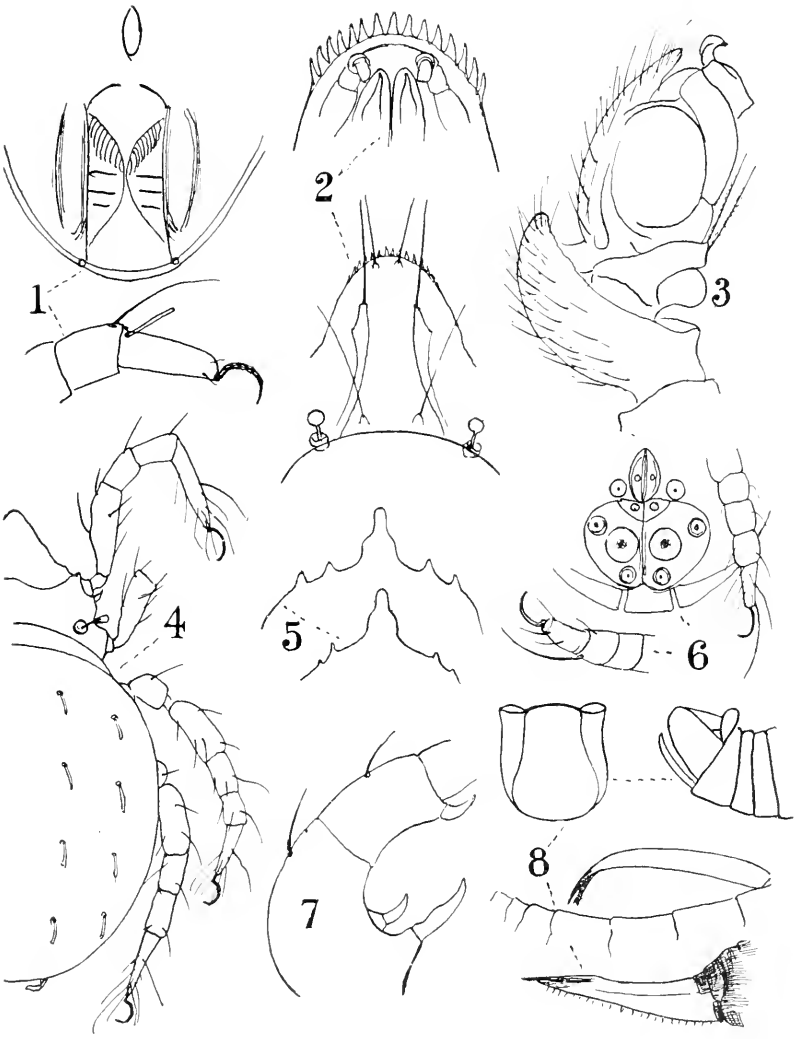
From St. Paul Island, Bering Sea, Alaska, May 16–23, 1914 (Whitney coll.). Differs from other American species in pale coxae and pleura, longer wings, and larger size.

See Plate IX, Figure 8, male gentalia from side and behind, and side view of wings and ovipositor.

EXPLANATION OF PLATE IX.

Details of Scorpion Fly (Mecoptera) and Mites (Arachnida, pp. 237–239).

Fig. 1. *Dermacarus* sp., venter and tarsus I—hypopus.
Fig. 2. *Notaspis scrrifrons*, edge of head and top of cephalothorax.
Fig. 3. *Hilaira glacialis*, palpus of male.
Fig. 4. *Lohmannia scabra*, dorsum.
Fig. 5. *Parasitus borealis*, epitomae showing variation.
Fig. 6. *Tyroglyphus whitneyi*, venter and tarsus I—hypopus.
Fig. 7. *Parasitus borealis*, leg II of male.
Fig. 8. *Boreus borealis* (Mecoptera); above, male genitalia from side and behind; below, side view of wings and ovipositor.



DETAILS OF SCORPION FLY (MECOPTERA, FIG. 8) AND MITES (ARACHNIDA, FIGS. 1–7).

(Explanation on page 158.)

DIPTERA.

Suborder Orthorrhapha.

Division NEMATOCERA.

Families TIPULIDAE and RHYPHIDAE.

By CHARLES P. ALEXANDER, *Department of Entomology, Massachusetts Agricultural College.*

(Plates X and XI.)

Our knowledge of the crane flies of the Pribilof Islands is due largely to the collections made by G. Dallas Hanna on the island of St. George and by Alvin G. and Elsie G. Whitney on the island of St. Paul, previous collections yielding very fragmentary data. In E. A. Schwarz's list[1] the following records for members of this family of flies occur:

Trichocera sp. A single specimen collected by Mr. Barrett-Hamilton. To this or an allied species I am inclined to refer the "gnat" mentioned by Mr. Elliott which "flits about in large swarms, but it is inoffensive and seeks shelter in the grass."

Tipulid. A single larva from Mr. Barrett-Hamilton's collection from St. Paul indicates a larger species than the *Trichocera* just mentioned.

The above material was determined by the late D. W. Coquillett; additional specimens that were collected by Mr. Elliott in 1895 were found among the undetermined material in the United States National Museum and will be found recorded under *Tipula whitneyi* on a later page.

The crane fly fauna of these islands is similar to that of many other wind-swept islands, in the large number of species with the wings so atrophied that the flies are incapable of flight. The relatively large number of species that seem to be confined to the Pribilofs is partly accounted for in this manner. The Alaskan Tipulidae named by Mr. Coquillett and now contained in the National Museum have been compared with the Pribilof material and were found to represent quite a different fauna, some comparisons to which are noted in later pages.

The notes of the collectors of the material are quoted under their original numbers.

[1] Schwarz, E. A., List of insects hitherto known from the Pribilof Islands: Report on Fur Seals and Fur-seal Islands, Part 3, pp. 550–552, 1899.

Family RHYPHIDAE.

Genus *Trichocera* Meigen (1803).

Trichocera sp.

Numerous specimens of these crane-flies were included in the collection, but the systematic condition of the species of the genus is such that it is impossible to identify the insects at this time. St. George Island, June 14, 1914; St. Paul Island, Sept. 30, 1911. Mr. Whitney's note on his number 168 follows:

"Spring 1914. 12 gnats (?) flying in a swarm by the laboratory, St. Paul Island."

Family TIPULIDAE.

Subfamily LIMNOBIINAE.

Tribe Pediciini.

Genus *Tricyphona* Zetterstedt (1840).

Tricyphona hannai, n. sp.

Male, length about 7.7 mm.; wing, 5.8 mm.

Rostrum and palpi very short, dark brown. Antennae short, dark brown, first segment about half again as long as the second; flagellum short, of an indeterminable number of segments, the basal segments greatly enlarged, thence tapering to the apex; the terminal segments very small, more or less fused, and provided with long verticils; eyes small, hairy; head with the front and vertex broad, dark brown, with a grayish yellow pollen.

Pronotum prominent; thorax dark brown with a grayish-yellow pollen; halteres long, more or less flattened and twisted, the knob not prominent; wings considerably atrophied both in length and width, the venation considerably degenerated (see pl. 10, fig. 1); the color is light brown, the disk darker anteriorly; the costa is incrassated and provided with several ranks of stout hairlike bristles; *R*'s elongated, straight, in a line with R_{4+5}, which is forked at the apex, R_4 and R_5 being separate at the wing-margin; R_{2+3} indistinct on its terminal portion; cross-vein *r–m* elongate, prominent; media with only the upper branch clearly defined, this branch apparently unforked; cubitus well developed, dark brown, well defined; two anal veins, the second very long and straight; some of the veins with strong hairs or hairlike bristles on them, a group of about five in the stigmal region, about six along R_{2+3}; a considerable series on the apical portion of R_{4+5} and on R_4 and R_5; about twelve on the upper branch of M, others on the forks of Cu, and about nine, evenly spaced, on the second anal vein.

Abdomen dark brown, with sparse long, yellow appressed hairs; caudal and lateral margins of the segments paler; hypopygium (see Pl. X, fig. 6) with the ninth tergite rather broad, the caudal margin

gently concave; pleurites very short and stout, the outer face with numerous pale hairs, the inner face with numerous black spicules; appendages two, the dorsal appendage a capitate lobe on a very short pedicel, the head with numerous black spicules and a few long yellow hairs; ventral appendage a flattened blade-like subchitinized arm; ninth sternite narrow, the caudal margin with the median portion straight but slightly denticulate at the ends.

Holotype, ♂, St. George Island, Bering Sea; June 10, 1914 (Hanna). "Lot-number 13. Found near a pool in Sphagnum bog, west of village."

There can be little doubt but that this insect is a degenerate species of *Tricyphona* with the fused portion of veins R_{4+5} of the wings very extensive, and many details of the venation considerably atrophied or hypertrophied. The insect is named in honor of the collector, G. Dallas Hanna.

Subfamily TIPULINAE.

Tribe Tipulini.

Genus *Tipula* Linnaeus (1758).

Tipula whitneyi, n. sp.

Male, length 13–14 mm.; wing, 2.8–5.5 mm.

Female, length 19–22 mm.; wing, 2.5–3 mm.

Frontal prolongation of the head moderate in length, gray, nasus indistinct; palpi dark brown. Antennae dark brownish-black, the segments of the flagellum very slightly constricted beyond the enlarged base; the segments covered with a short, dense, gray pubescence. Head clear whitish gray with a distinct impressed median line.

Pronotal scutum light gray with a narrow median brown vitta. Mesonotal praescutum and scutum clear light gray without apparent darker markings of any kind; scutellum and postnotum brownish gray with a narrow brown median vitta; pleura brownish gray; halteres short, yellowish brown, the knob darker brown; legs with the coxae prominent, light gray, with numerous long pale hairs; trochanters reddish brown; femora and tibiae reddish brown, tipped with dark brown; tarsi dark brown to black; wings extremely reduced in both sexes, in some specimens a little longer than in others, one male having the right wing twice as long as the left wing; in most specimens the wings extend about to the tip of the first abdominal segment; wings light brown, the costal margin very greatly incrassated, the region immediately behind the costa with an abundance of short bristles; venation (see Pl. X, fig. 2) indistinct, distorted, but traceable.

Abdomen varying from brown to reddish brown, with a broad, dark brown dorso-median stripe; first tergite largely dark brown;

lateral margins of the sclerites broadly, caudal margins very narrowly, pale; sternites grayish brown; hypopygium (see Pl. X, fig. 7) with the ninth tergite (see Pl. XI, fig. 13) prominent, the caudal margin with a broad U-shaped median notch which is notched again by a smaller W-shaped incision; the lateral lobes are broadly truncated, with the caudal margin shiny, tumid; ninth pleurite large, complete, situated on the dorso-caudal face of the ninth sternite, the ventral inner angle clothed with numerous long pale yellow hairs; pleural appendages two, the outer appendage a slender, cylindrical fleshy lobe that is clothed with comparatively short hairs; inner pleural appendage large, prominent, compressed, projecting cephalad as a narrowed lobe which occupies the notch of the tergite; near the apex it is split into a smaller lobe which is deflected laterad; ninth sternite with a broad U-shaped notch on the caudal half; on the cephalic half the margins of each side are approximated but not contiguous, the median area membranaceous; eighth sternite with the caudal margin simple, unarmed.

The female is similar to the male but the dorso-median abdominal vitta is often interrupted on the basal third of each segment; the wings are still shorter, extending to just beyond the base of the first abdominal segment; valves of the ovipositor (see pl. 11, fig. 21) very long and slender, the tergal valves slightly divergent, enlarged basally, thence gradually narrowed to the tip; sternal valves shorter, compressed, the apices rather blunt.

Holotype, ♂. St. George Island, Bering Sea; June 12, 1914 (Hanna); lot 16. Allotype, ♀, topotypic; lot 27, June 16, 1914. Paratypes, 35 ♂'s, ♀'s, as follows: 18 ♂'s, 8 ♀'s, topotypic, June 12 to July 8, 1914 (Hanna); lots 16, 17, 27, 30, 41, 46, 49, 52, and 55. 1 ♂, Otter Island, July 3, 1913 (Whitney); lot 60. 1 ♂, 1 ♀, St. Paul Island, June 10, 1913 (Whitney); lot 40. 2 ♀'s with the last, June 1, 1914; lot 170. 1 ♂, bred from pupa, with the last, June, 1914; lot 186. 1 ♂, 1 ♀ (gravid), St. Paul Island, July 10, 1895 (H. W. Elliott). 1 ♂, with the last, July 12, 1895; U. S. Nat. Mus. Acc. No. 30147.

The accompanying collectors' notes with the above lot numbers are as follows:

Hanna: Lot 16. Found crawling over grass of high beach lands, not seen near bogs or on top of high hills; lot 30, toward East Rookery from village—none seen with wings developed; lot 41, uplands toward Staraya Artel Rookery; lot 46, from toward East Rookery; lot 49, toward Zapadni—damaged by cyanide; lot 52, from toward Zapadni Rookery.

Whitney: Lot 40. In grass, one at Kitovi and the other on Reef Peninsula; lot 60, Otter Island (6 miles from St. Paul).

This fly is named in honor of the collector of certain of the paratypes, Mr. Alvin G. Whitney.

The pupal skin from which one of the paratypes was bred was collected about June 1 and the adult fly emerged early in June. The following notes on the exuvium are included:

Length about 21.5 mm; diameter about 5 mm.; prothoracic breathing horns very short, finely crenulated; abdominal tergites with the caudal half of each segment bearing four blunt tubercles in alignment; the eighth segment with a fleshy tubercle on each side; ninth tergite (see Pl. XI, fig. 23) with the caudal margin deeply concave; the lateral angles wrinkled; tergal valves very elongated, blunt at their apices; sternal valves shorter; caudal half of sternite five (see Pl. XI, fig. 24) with four subacute fleshy tubercles on each side of the median line; sixth sternite with three similar tubercles; seventh sternite with two similar tubercles; eighth sternite with six large tubercles; leg pads ending about at the base of abdominal segment four; wing pads ending just beyond the base of segment three.

Tipula pribilofensis, n. sp. Pls. X and XI.

Male.—Length 12.5–13.5 mm.; wing, 10.5–11.5 mm.; antennae about 5.5 mm.

Female.—Length, 15.5–19 mm.; wing, 10–11 mm.

Frontal prolongation of the head rather short, dark brown, with a dark gray bloom; nasus distinct; palpi short, dark brown; antennae rather elongated, black, the flagellar segments beyond the first deeply constricted at their middle; head dark with a dense, dark gray bloom.

Pronotal scutum gray, the scutellum yellowish on the lateral margins, this color becoming confluent with the same color of the dorsopleural membranes; mesonotum gray, stripes not indicated; sides of the scutellum and postnotum more yellowish; pleura brownish gray; halteres rather short, dull yellow, the knobs more brownish; legs with the coxae gray, trochanters, femora and tibiae brown, the two latter a little darkened at their apices; tarsi black; wings semi-atrophied, the length little reduced but the width considerably restricted so that the venation is much distorted; color of the wings pale brownish, the stigma distinct, pale brown, not encroaching into the base of cell R_2; veins brown; venation as in Plate 10, Figure 3.

Abdominal tergites reddish yellow with three indistinct interrupted brown lines, the lateral stripes becoming distinct only on the apical segments where they suffuse the entire bases of the sclerites; ninth tergite black; tergites with conspicuous transverse punctured areas on the basal half of each segment, these areas interrupted on the mid-dorsal line; hypopygium (see Pl. X, fig. 8) with the ninth tergite (see Pl. XI, fig. 14) extensive, the caudal margin with a very broad V-shaped notch, the lateral angles prolonged caudad as shiny impunctate horns; pleural appendages two; the outer appendage a conspicuous elongated fleshy lobe, narrowed at

the base, thence very slightly expanded and tapering gradually to the blunt apex; it is clothed with abundant hairs, on the caudal face very long, divergent, on the cephalic and lateral faces short, more appressed; inner pleural appendage a complex, flattened, chitinized lobe divided into two lobules, the ventral or caudal lobule projecting caudad as a compressed blade that is blunt at the apex, the outer face with about eight short bristles, the inner face with several long pale hairs; the inner or dorsal lobule jutting into the notch of the ninth tergite, flattened, compressed, with indistinct parallel grooves; the sterno-pleural suture is indistinct; at the point where it is usually located a short, slender, fleshy setigerous lobe; eighth sternite (see pl. 11, fig. 19) produced caudad as a very flattened, depressed, median arm that is shaped like a spade; the apex is gently notched medially by a broad U-shaped incision; the caudal margin of this tongue is fringed with delicate pale hairs.

The female is similar to the male; the antennal segments simple throughout; abdominal tergites dark gray, the caudal margins of the segments brighter, more yellowish; ovipositor (see Pl. XI, fig. 20) with the last tergite extremely elongated, smooth, shiny black, chitinized; tergal valves of the ovipositor triangular, lying both transversely and vertically, short, acutely pointed from very broad bases, the apices divergent; the dorsal face smooth, light chestnut brown; the outer face with a prominent median carina running from the base to the apex, the remaining surface of this face with a roughened irregular meshwork of raised lines; the ridges between the three faces of the valves with numerous fimbriate hairs; sternal valves reduced to tiny lobes.

Holotype, ♂, St. Paul Island, June 1, 1914 (Whitney); lot 170. "No 170. About June 1, 1914. Tolstoi sand dunes. Crane flies were crawling everywhere at this time and many were mating. Allotype, ♀, topotypic. Paratypes, 20 ♂'s, 3 ♀'s, topotypic.

Tipula aleutica, n. sp. Pls. X and XI.

Male.—Length about 13–14 mm; wing, 13.5 mm. Discolored by cyanide.

Frontal prolongation of the head dark brown, short and stout; nasus indistinct; antennae dark brown, rather short, the segments not constricted; head dark grayish brown with abundant long pale hairs.

Pronotal scutum grayish brown with abundant long pale hairs; mesonotal praescutum gray with blue-gray stripes, these latter indistinctly margined with darker; the median stripe broadest at the cephalic end, narrowed at the suture, these stripes appearing to be discolored, probably by the action of cyanide; scutum gray, the lobes blue-gray; pleura dull gray; halteres short, pale yellowish

throughout; legs with the coxae dull gray densely covered with long pale hairs; trochanters brown; femora and tibia light brownish yellow, the apices slightly darkened; tarsi dark brown; wings with a very faint brownish tinge, the stigma brown; veins dark brown; venation as in Plate 10, Figure 4.

Abdomen brownish gray, the caudal margins of the segments ringed with paler; hypopygium (see Pl. X, fig. 9) with the ninth tergite (see Pl. XI, fig. 15) moderately prominent, the caudal margin straight across, with two lobes, one on either side of the median line; these lobes pale yellow, conical, their apices rather acute, the notch between them narrowly V-shaped; ninth sterno-pleurite prominent, the pleural region partially separated from the sternite by a conspicuous arcuated suture beneath; pleural appendages two, situated far out near the apex of the sterno-pleurite, the outer ap pendage pale, prominent, flattened, a little narrowed toward the blunt apex; inner appendage of a very simple structure, a pale slightly chitinized lobe whose anterior angle is produced cephalad as a long subacute lobule, on the outer face near the caudal margin, a slender, acutely pointed horn directed cephalad; ninth sternite profoundly incised by a very narrow V-shaped notch, the adjacent margins pale-pubescent, not approximated; eighth sternite narrow, the caudal margin straight across, unarmed.

Holotype, ♂, St. George Island, June 27, 1914 (Hanna). "Lot 49. Toward Zapadni."

This crane fly belongs to the group of *perlongipes* Johnson, *sulphurea* Doane, *tenebrosa* Coquillett, and *kennicotti* Alexander. The only species with which it requires comparison are *cimmeria* Speiser, and *tenebrosa* Coquillett, and this comparison is given herewith, the notes and figures being based upon the types in the United States National Museum.

Tipula cimmeria Speiser (Dem Kilimandjaro, dem Meru Expedition, 10, Diptera. 4, Orthorhapha. Nematocera, p. 57, 1909) is the correct name for *Tipula strigata* Coquillett. Type number 5205, U. S. National Museum, from Yakutat, Alaska, June 21, 1899, collected by Kincaid.

The type of *strigata* is a male; antennae rather short, scape dull yellow, flagellum, dark brown, the segments a little constricted beyond the base: Frontal prolongation of the head short, nasus very prominent; Wing-venation with the basal deflection of R_{4+5}, *r-m* and the basal deflection of M_{1+2} almost in a line. Hypopygium with the tergite, pleurite and sternite fused in an almost continuous ring, the pleural suture well-indicated beneath; the tergo-pleural notch small, on the caudal margin only; ninth tergite (see Pl. XI, fig. 16) subquadrate, dark brown, with the caudal margin transversely truncated and bearing a pair of median lobes (as in the

tephrocephala group); these lobes pale, darkened at their apices, very closely approximated on the basal three-quarters, the tips more separated, the apices of the lobes minutely spiculose; the length of these lobes is about the same as the length of the tergite; they are fringed on their outer lateral margin with long hairs; ninth pleurite with the suture conspicuous beneath, broadly U-shaped; the ventrocaudal angle with a tuft of long hairs which are decussate on the median line beneath; outer pleural appendage (see Pl. X, fig. 12) large, prominent, pale, fleshy, very flattened, elongate, slightly constricted beyond the base, then expanded, the apex a little pointed; the outer face with scanty strigose yellow hairs; inner pleural appendage very large, powerful, bilobed, the outer or caudal lobe short, subrotund, the apex a little truncated, densely and finely pale strigose on the inner face; inner lobe flattened, compressed; ninth sternite deeply divided, at the caudal angle just behind the suture with a sparse tuft of long pale hairs, decussate on the median line beneath; near the base of the split a dense tuft of golden yellow hair; eighth sternite prominent, straight across the caudal margin, unarmed with any brush or tuft.

Tipula tenebrosa Coquillett was described from Berg Bay, Alaska; collected June 10, 1899, by Kincaid; type number 5206, U. S. National Museum. The type is a male; the hypopygium has the ninth tergite (see Pl. XI, fig. 17) large, convex, the caudal margin with a prominent stout lobe on either side of the median line, these separated by a space equal to about one-half the diameter of the lobe; the apices of these lobes blackened, minutely spiculose; caudal margin of the tergite sloping obliquely backward from these lobes; notch between the ninth tergite and the ninth pleurite quite deep, but not running back to the eighth segment; ninth pleurite incomplete, the pleural suture well indicated beneath; the pleural region produced caudad as a blunt triangular arm bearing the appendages out near its apex; outer pleural appendage (see Pl. X, fig. 11) flattened, subquadrate or slightly elongated, bearing at the base on the inside the inner pleural appendage which is flattened, bilobed, the caudal lobe a short, blackened, chitinized point; the caudal face of the lobe on the basal half is downy pubescent; ninth sternite deeply cleft on the median line beneath but the adjoining sides contiguous; eighth sternite prominent, the caudal margin unarmed. Coquillett's description of the hypopygium does not agree at all with the type; the outer pleural appendages are described as being nearly twice as long as wide, the lower outer angle considerably prolonged beyond the upper one; this agrees much better with the somewhat similar *Tipula cimmeria*, discussed above.

Tipula alascaensis, n. sp. Pls. X and XI.

Male.—Length, 11–13.5 mm.; wing, 14.5–15 mm.

Female.—Length, 15–18 mm.; wing, 17.5 mm.

Frontal prolongation of the head bluish gray, very short, nasus indistinct; palpi gray, short; antennae very short, black, with a sparse grayish bloom; first segment elongated, longer than the second and third together; the flagellar segments very short, slightly constricted beyond the basal swelling; head blue-gray with abundant long hairs, especially a tuft on the genae.

Mesonotum dark gray with rather indistinct stripes, the median vitta very broad, rapidly narrowed behind; lateral stripes narrow, beginning behind the conspicuous pseudosutural foveae; thoracic interspaces with short pale, erect hair; scutum and lateral portions of the postnotum with abundant erect black hairs; pleura dark gray, smooth, a large setigerous area on the mesepisternum behind the fore coxae; halteres short, brown, the knobs a little brighter; legs with the coxae gray, clothed with abundant long yellow hairs; femora yellowish brown tipped with dark brown; tibiae brown tipped with darker brown; tarsi dark brown; wings fully developed in both sexes, strongly tinged with brownish yellow, the costal cell not different in color from the other cells of the wing; stigma conspicuous, oval, dark brown; small areas before the stigma in cell 1st R_1 and beyond the stigma in cell 2d R_1, and the base of R_2 slightly paler; veins dark brown; venation as in Plate X, Figure 5.

Abdomen dark gray, the segments narrowly ringed with pale yellowish around the caudal margin; hypopygium (see Pl. X, fig. 10) very inconspicuous and somewhat concealed; ninth tergite (see Pl. XI, fig. 18) rather prominent, the caudal margin rounded, with a deep, narrow median notch; the lateral lobes are thus very broad and somewhat obliquely truncated; dorsal surface of the sclerite densely hairy; ninth pleurite small, complete, situated on the dorsocaudal face of the ninth sternite; outer pleural appendage short, clavate, slightly enlarged at the base, the head rounded, clothed with abundant golden hairs; inner pleural appendage compressed, flattened, on the outer face clothed with short, appressed golden hairs; ninth sternite prominent, with a very deep median notch whose margins are widely separated.

The female is generally similar to the male; the ovipositor has the last two segments exceedingly narrowed as in *besselsi* Osten Sacken and *pilicops* Alexander; the tergal valves (see Pl. XI, fig. 22) acute but small, tapering gradually from the broad base, the apices divergent.

Holotype, male, St. George Island, June 14, 1914 (Hanna), Lot number 17. Allotype, female, topotypic. Paratypes, 2 males, 3 females, topotypic; 2 females, topotypic on June 16, 1914 (Lot 27). "Lot number 17. In wet places, mostly, but some seen crawling over grass far from water. None seen flying. Those with wings best developed (the present species) from Spring Creek, Garden Cove. One seen with the very fuzzy fly in No. 18 (*Scatophaga*) beneath it; apparently both were fighting." "Lot number 27. Garden Cove. Mrs. E. G. Whitney."

Tipula, sp.

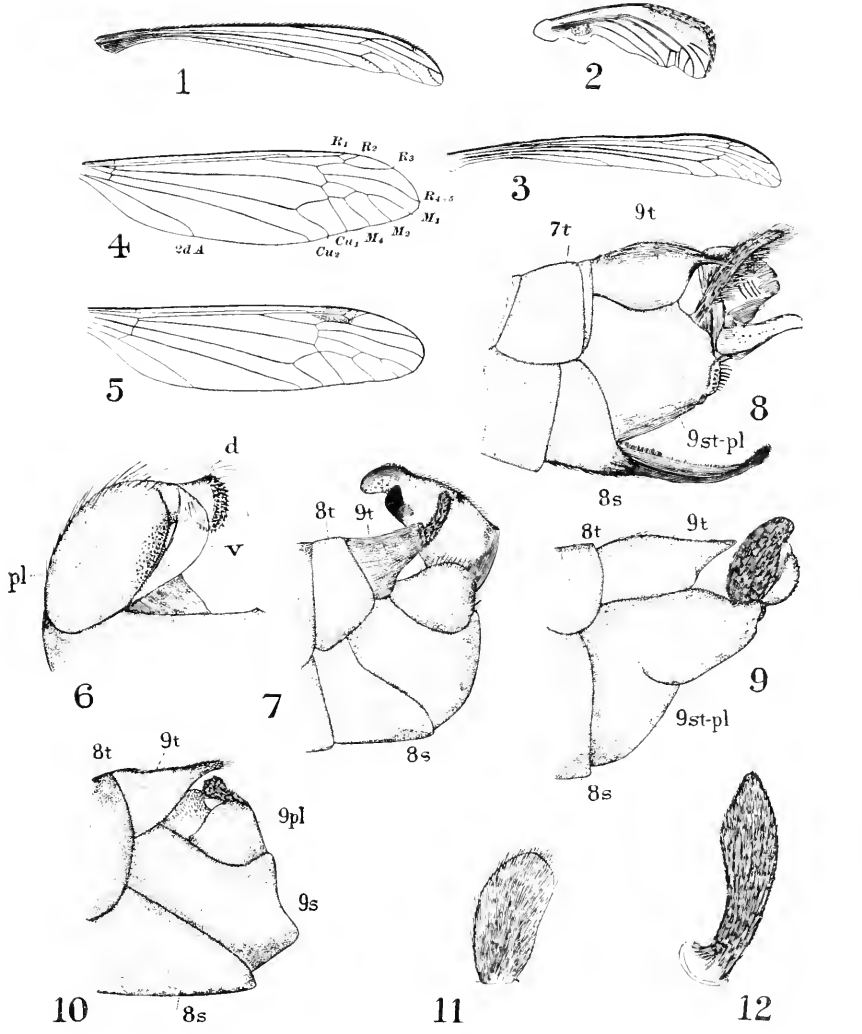
Abundant larvae of an unknown species of *Tipula* taken on St. Paul island July 18–20, 1913. Mr. Whitney's notes on the species are very interesting:

No. 77. July 18, 1913. Reef Parade Ground. 12 larvae. Abundant everywhere there around the roots of grasses, herbs, and especially under beds of moss on the roots of which it feeds, killing the moss over considerable areas. Under such a moss bed I found as many as 20 to the square foot. This larva is found all over the island in grassy or mossy places and all through the summer season. It must be of considerable ecological importance because of its food value to the birds and foxes. The foxes will dig over large areas of moss beds to feed on these larvae. Was unable to find the species in adult form. Could not seem to raise adults in laboratory by keeping larvae with one of the food plants. It may possibly be the larval form of the crane fly, which is very abundant. Color not altered by pickling in alcohol.

The identity of the form with any of the adult flies known from the Pribilofs is very doubtful. The large size of the larvae in mid-July would imply a species that emerges at or near the very end of the growing season, and it seems possible that they belong to such a species, as yet unknown.

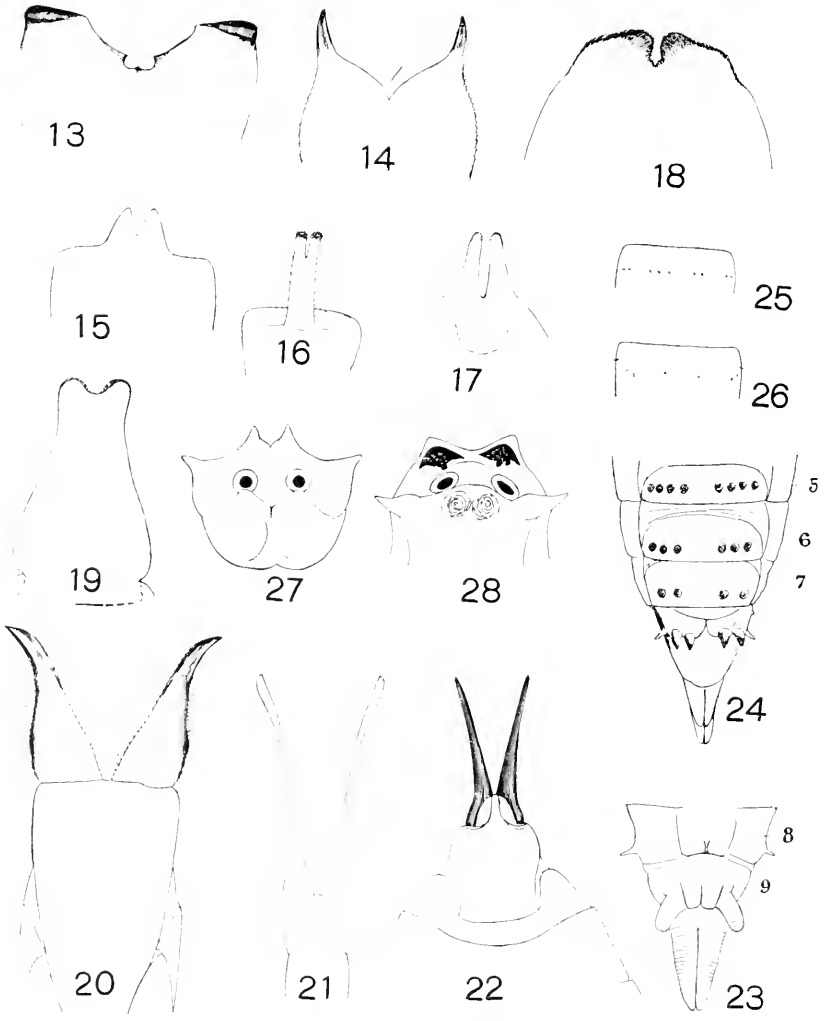
The fully grown larva measures 29–30 mm. in length and about 5 mm. in diameter; the form is plump, color light brownish yellow without conspicuous darker markings; hairs and setae sparse; the dorsa of the thoracic segments with hairs as in Plate 11, Figure 25; the abdominal segments have six bristles in alignment, the intermediate four being almost evenly spaced, the outer one being much the strongest; the fifth and sixth again are weak and situated close to the strong bristles (see Pl. XI, fig. 26). The stigmal field is surrounded by six weak teeth, the dorsal pair closely approximated, the lateral pair being latero-dorsal in position; the ventral pair very broad, the inner face with a broad-triangular black chitinized area. Stigmata large, separated by a distance about equal to the diameter of one stigma, located ventrad of the four dorsal-lying teeth that surround the stigmal field; gills fleshy, not prominent. (See Pl. XI, figs. 27, 28.)

Tricyphona glacialis Alexander, and *Tipula pribilovia* Alexander have previously been recorded by this author. (Proc. Calif. Acad. Sci., Fourth Ser. 11, pp. 183–184, Nov., 1921.)—W. L. M.



DETAILS OF CRANE FLIES (TIPULIDAE).

(Explanation on page 169.)



DETAILS OF CRANE FLIES (TIPULIDAE).

(Explanation on page 169.)

Explanation of Plates X and XI.

Plate X.—Details of Crane Flies (Tipulidae).

Fig. 1. Wing of *Tricyphona hannai*, sp. n.
Fig. 2. Wing of *Tipula whitneyi*, sp. n.
Fig. 3. Wing of *Tipula pribilofensis*, sp. n.
Fig. 4. Wing of *Tipula aleutica*, sp. n.; $R_{1, 2, 3, 4, 5}$=Radial veins; M_1, M_2, M_4=Medial veins; Cu_1, Cu_2=Cubital veins; 2d A=second anal vein.
Fig. 5. Wing of *Tipula alascaensis*, sp. n.
Fig. 6. Hypopygium of *Tricyphona hannai;* dorsal aspect; *pl*=ninth pleurite; *d*=dorsal appendage; *v*=ventral appendage.
Fig. 7. Hypopygium of *Tipula whitneyi;* lateral aspect; 8t, 9t=eighth and ninth tergites; 8s=eighth sternite.
Fig. 8. Hypopygium of *Tipula pribilofensis;* lateral aspect; lettering as in fig. 7; 9 st-pl=ninth sterno-pleurite.
Fig. 9. Hypopygium of *Tipula aleutica;* lateral aspect; lettering as in figs. 7 and 8.
Fig. 10. Hypopygium of *Tipula alascaensis;* lateral aspect; lettering as in fig. 7; 9s, 9pl=ninth sternite and pleurite.
Fig. 11. Outer pleural appendage of *Tipula tenebrosa Coquillett*, lateral aspect.
Fig. 12. Outer pleural appendage of *Tipula cimmeria* Speiser; lateral aspect.

Plate XI.—Details of Crane Flies (Tipulidae).

Fig. 13. Ninth tergite of *Tipula whitneyi;* dorsal aspect.
Fig. 14. Ninth tergite of *Tipula pribilofensis;* dorsal aspect.
Fig. 15. Ninth tergite of *Tipula aleutica;* dorsal aspect.
Fig. 16. Ninth tergite of *Tipula cimmeria;* dorsal aspect.
Fig. 17. Ninth tergite of *Tipula tenebrosa;* dorsal aspect.
Fig. 18. Ninth tergite of *Tipula alascaensis;* dorsal aspect.
Fig. 19. Eighth sternite of *Tipula pribilofensis;* ventral aspect of the median lobe.
Fig. 20. Ovipositor of *Tipula pribilofensis;* dorsal aspect.
Fig. 21. Ovipositor of *Tipula whitneyi;* dorsal aspect.
Fig. 22. Ovipositor of *Tipula alascaensis;* dorsal aspect.
Fig. 23. Pupa of *Tipula whitneyi;* end of the abdomen, dorsal aspect; 8, 9=eighth and ninth segments.
Fig. 24. Pupa of *Tipula whitneyi;* end of the abdomen, ventral aspect; 5, 6, 7=fifth, sixth, and seventh segments.
Fig. 25. Larva of *Tipula* sp.; second thoracic segment, dorsal aspect, showing the distribution of the setae.
Fig. 26. Larva of *Tipula* sp.; fifth abdominal segment, dorsal aspect, showing the distribution of the setae.
Fig. 27. Larva of *Tipula* sp.; stigmal field, caudal aspect.
Fig. 28. Larva of *Tipula* sp.; stigmal field, dorso-caudal aspect.

DIPTERA.

(Except TIPULIDAE, RHYPHIDAE, and CALLIPHORIDAE.)

By J. R. Malloch, *Assistant Biologist, Bureau of Biological Survey.*

(Plates XII–XV.)

The present collection contains a very large number of specimens but is not particularly rich in species. Moreover, there is nothing very remarkable in the material, the only genus that has not previously been recorded from Alaska being *Smittia*, a genus of Chironomidae described from the Arctic regions of Europe (Spitzbergen).

I have taken the opportunity of indicating in the introductory notes to each family what the known larval habits of the species are, considering that this information may have a certain value in a list of this nature even though it does not refer directly to the species in the list.

The arrangement is that of the Aldrich Catalogue, but there are several changes in generic names.

Suborder Orthorrhapha.

Division NEMATOCERA.

Family CHIRONOMIDAE.

The larvae of most of the members of this family are aquatic in habit and those in the present collection are representatives of that section, belonging entirely to the subfamily Chironominae, though it is not improbable that some of them may be terrestrial as is the case with *Camptocladius byssinus* and some others. All of them except *Smittia* may be located generically by the use of the keys in my paper on Illinois Chironomidae subsequently cited. I have made figures of the male genitalia of the species described herein to prevent any misconceptions by future workers on the group as to their identity.

Genus *Chironomus* Meigen.

There is a striking similarity in the species of *Chironomus* in the collection. All are black, have the basal joint of the fore tarsi very little longer than the fore tibiae, and the males of all have the fore tarsi with long, soft hairs. Fortunately, the hypopygia of the males present in their structure good characters for differentiation of the species.

Synopsis of species.

1. Males ..... 2.
   Females ..... 4.
2. Hypopygium with the superior processes indistinguishable, the inferior pair very small, apex of lateral arm obtusely truncate (Pl. XIII, fig. 6) ..... obtusilobus.
   Hypopygium with superior and inferior processes present, the latter well developed, apex of lateral arm pointed or rounded ..... 3.
3. Superior process of hypopygium small, obtuse, a distinct fasciculus of hairs above it under the dorsal plate, the apical process of the latter stout, apex of lateral arm rounded (Pl. XIII, fig. 16) ..... deviatus.
   Superior process of hypopygium large, sickle-shaped, no fasciculus above it, apical process of dorsal plate slender, apex of lateral arm pointed (Pl. XIII, fig. 13) ..... conformis.
4. Small species 3-4 mm. in length; mesonotum with a conspicuous pale spot on anterior lateral angles ..... deviatus.
   Larger species 5–7 mm. in length; thorax black ..... 5.
5. Wings brownish, veins very distinct; posterior branch of radius arcuate at tip ..... conformis.
   Wings whitish, veins indistinct; posterior branch of radius straight or very slightly arcuate ..... obtusilobus.

The males of all three species run down to caption 11 in my key to Group B, Subsection I of *Chironomus*.[2] The structure of the hypopygia readily separates them from the species therein included except in the case of *conformis* which has the hypopygium similar to that of *quadripunctatus;* the latter, however, has yellow legs.

Chironomus obtusilobus, n. sp.

Male.—Black, opaque. Antennal plumes fuscous. Legs fuscous, tibiae and tarsi yellowish or pale brown. Wings whitish, veins rather indistinct, cross vein faintly darkened. Halteres testaceous. Hairs on abdomen and legs pale brown.

Hypopygium as in Plate XIII, Figure 6, the lateral arms rather stouter than normal. Fore tarsi with long hairs, basal joint slightly longer than tibiae (120:113), second joint not greatly longer than third (35:30). Radius almost entirely straight, ending as far before apex of wing as media does behind it.

Female.—Agrees with the male in color. Fore tarsi without long hairs; legs stouter than in male.

Length, 7—8.5 mm.

Type locality.—St. George Island, June 17, 1914 (G. D. Hanna, lot 40), 4 males caught on the wing among bog plants, border of Gull Lake, beside Staraya Artel Rookery. Paratypes from St. Paul Island, 9 specimens, July 22, 1913, Big Lake (A. G. Whitney, lot 92), "collected from our coats as they swarmed past us while driving along the lake"; 18 specimens, same date and place (A. G. Whitney,

[2] Bull. Illinois State Lab. Nat. Hist., vol. 10, art. 6, 1915, p. 417.

lot 91), "swarms of these insects were driven by the breeze southeastward off of the lake. These clouds of gnats noticeable throughout July and August."

Chironomus deviatus, n. sp.

Male.—Black, shining, without pruinescence on thorax. Mesonotum slightly yellowish on anterior lateral angles. Legs fuscous, tibiae and tarsi paler. Wings whitish, veins pale, cross vein not infuscated, a black longitudinal streak on base of wing as in *Camptocladius*. Halteres testaceous. Antennal plumes and hairs on body and legs fuscous.

Hypopygium as in Plate XIII, Figure 16; the fasciculus of hairs below dorsal plate is more characteristic of the hypopygia of *Tanytarsus* than of *Chironomus* but the wings are not hairy. Basal joint of fore tarsi slightly longer than tibia (50:42), second joint distinctly longer than third (29:21); fore tarsi and mid and hind legs with long hairs. Wings narrow; radius ending appreciably farther in front of apex of wing than does media behind it.

Female.—Differs from the male in having the anterior lateral margins of the thorax with a conspicuous yellow or greenish spot, the legs much paler, and the base of the wings noticeably yellowish. Fore tarsi without long hairs.

Length, 3.25–4.5 mm.

Type locality.—St. Paul Island, Laboratory (A. G. Whitney, lot 39), 3 males and 1 female. "From a great many on window; probably hatched from native Sagina sod transplanted to laboratory a few days before."

The specimens taken on this occasion did not represent a single species, as a male of an *Orthocladius* bears the same lot number. I regret that more specimens were not taken, as it is not improbable that there were more than 2 species present.

Chironomus conformis, n. sp.

Male.—Deep black, opaque. Antennal plumes fuscous; thorax with slight indications of 3 longitudinal grayish pruinescent lines; abdomen with faint brownish posterior margins to segments; legs fuscous, tibiae and tarsi yellowish; wings slightly brownish, veins distinct, cross vein darkened; halteres yellowish brown; hairs on body black, on legs brownish.

Hypopygium similar to that of *decorus* Johannsen, the superior process and apical portion of lateral arm as in Plate XIII, Figure 13. Basal joint of fore tarsi very little longer than fore tibia (82 : 78), second joint very much longer than third (52 : 30); fore tarsi and mid and hind legs with very long and rather dense hairs. Radius slightly arcuate apically, ending as far before apex of wing as does media behind it.

Female.—Agrees in color with male. Fore tarsi without long hairs; basal joint about as long as fore tibia.

Length, 8–9 mm.

Type locality.—St. Paul Island, August 16, 1914 (E. A. Preble), 2 males, 1 female; paratypes, 1 male, 1 female, same island, June 5, 1913 (A. G. Whitney, lot 37), laboratory. I have before me a paratype from Admiralty Bay, Alaska, June 27, belonging to the Philadelphia Academy of Natural Sciences. I had purposed describing the species from this specimen but take the present opportunity of doing so in company with this additional material and make the Admiralty Bay specimen a paratype.

Genus *Tanytarsus* Van der Wulp.

There is one species of this genus amongst the present material, *similatus*, which was originally described by the present writer, in the paper cited under the previous genus, from material obtained at Madison, Wisconsin. The species described on a previous page as *Chironomus deviatus* has the hypopygial characters of *Tanytarsus*, but I can not detect any surface hairs on the wings and pending the receipt of better specimens I leave it in *Chironomus*, although inclined to consider it as possibly belonging to the present genus.

Tanytarsus similatus Malloch.

Tanytarsus similatus, Malloch, Bull. Illinois State Lab. Nat. Hist., vol. 10, art. 6, p. 494, 1915.

In my original description of this species I stated that the hypopygium was similar to that of *viridiventris*, differing in the structure of the superior and inferior processes. The dorsal plate of my specimen appeared to have the apical extension broken off and I did not figure it. In the example before me I find that the dorsal plate is the same as in the type and presents an added character for distinguishing the species. (Pl. XIII, fig. 11.)

Locality, St. Paul Island, 1 male and 2 females, July 22, 1913 (A. G. Whitney, lot 93); Big Lake, "Collected at same time as larger ones [*Chironomus conformis*] from lake shore."

Genus *Orthocladius* Van der Wulp.

Most of the specimens of this family in the present collection belong to the genus *Orthocladius*. A few of the examples are in fairly good condition and are identifiable, but the greater portion are poorly preserved and in that condition are impossible of identification, or at least are not in condition that warrants my giving a specific name to them, because of the very large number of extremely closely allied forms occurring in the genus and the liability to error. It is possible for me to identify the following species.

Orthocladius obumbratus Johannsen.

Orthocladius obumbratus Johannsen, Bull. 86, New York State Museum, p. 281, 1905.

This species is represented by a large number of specimens in the collection. Johannsen described the species from examples obtained at Ithaca, N. Y., and Douglas, Alaska. A comparison of the hypopygia of an Ithaca specimen sent me by Prof. Johannsen and one of those from St. George Island shows that they are the same species. I give herewith (Pl. XIII, fig. 10) a figure of the apical prolongation of the dorsal plate of the hypopygium; in *nivoriundus* and most allied species this plate is without conspicuous hairs.

The data on specimens in collection is as follows: St. George Island, 35 specimens June 17, 1914 (lot 37, G. D. Hanna).

Orthocladius nivoriundus Fitch.

Chironomus nivoriundus Fitch, Winter Insects of Eastern New York, p. 274, 1846.

Not so numerously represented as the foregoing.

St. George Island:

1 specimen, June 5, 1913 (lot 39, A. G. Whitney).
1 specimen, June 10, 1914 (lot 11, G. D. Hanna).
8 specimens, June 17, 1914 (lot 37, G. D. Hanna).

Orthocladius sp. I.

A male specimen in rather poor condition has the hypopygium differing from that of *nivoriundus* in having no distinct extension of the dorsal plate. This may be the result of an accident as the normal extension is easily broken.

St. George Island: 1 specimen June 17, 1914 (lot 37, G. D. Hanna).

Orthocladius sp. II.

A male specimen lacking front tarsi and otherwise in poor condition has the hypopygium very different from that of *nivoriundus*. Undoubtedly the example belongs to a distinct species that is probably undescribed.

The extension of the dorsal plate is very long and slender, and the apical shoe-shaped portion of the lateral arm is much stouter than in any species known to me.

St. George Island: 1 specimen, June 14, 1914 (lot 23, G. D. Hanna).

Orthocladius sp. III.

A male specimen lacking the apical portion of the abdomen represents a species unknown to me. Differs from the 4 species already mentioned in having the scutellum yellow apically. The fore tarsi are bare, and very long, the basal joint being four-fifths as long as the tibia.

St. George Island: June 5, 1913 (lot 39, A. G. Whitney).

Orthocladius sp. IV.

Two males of a small species in poor condition. The species resembles *Trichocladius infuscatus* Malloch, but the legs are slightly yellowish.

St. George Island: June 17, 1914 (lot 37, G. D. Hanna).

Genus *Smittia* Holmgren.

The genus *Smittia* has not previously been recorded from America, the only described species having been taken on the islands of Nova Zembla (*longipennis*) and Spitzbergen (*brevipennis*) in the Arctic regions of the Old World. Although the original description of the genus is not very full I have no hesitation in placing the present species in *Smittia*. It is possible, though not at all probable, that the Alaskan species is the same as that described from Spitzbergen, but I am not able to find in the description of the latter confirmation that is necessary to permit me arriving at a decision that they are identical. I am therefore describing the present species as new. I have also taken this opportunity of redescribing the genus and indicating its true position in the Chironominae.

Description of Genus.

Male.—Antenna apparently 10-jointed (2+8), basal and apical flagellar joints elongated, joints 5, 6, and 7 not separated on their entire circumference (Pl. XIII, fig. 7), flagellar hair very short, the longest not exceeding the apical joint in length; palpi 4-jointed, base slightly tuberculate, basal joint about as broad as long and half as long as second, joints 2, 3, and 4 subequal; fore tarsi with the basal joint shorter than fore tibia; hypopygium as in *Orthocladius* (sens. lat.) and *Camptocladius*, the apical portions of lateral arm recurved (fig. 5), venation as in *Orthocladius*.

Female.—Differs from the male in having the antenna (Pl. XIII, fig. 8) 7-jointed (2+5).

Keiffer has indicated that Orthocladiariae may be separated from the group which contains *Chironomus* by the nature of the armature of the apex of the hind tibia. In *Orthocladius* there is a distinct spur, while in *Chironomus* and allied genera there is a comblike series of setulae. In the present species the hind tibial characters and also those of the hypopygium are those of the *Orthocladius* group. The genus as a more specialized form should be placed after that genus in our lists.

Smittia arctica, n. sp.

Male and female.—Black, opaque. Halteres obscurely yellowish. Legs piceous. Wings whitish, veins yellow.

Male.—Antennal sensory organs pale, hairlike (Pl. XIII, fig. 7); eyes bare. Pronotum linear, very slightly notched centrally; meso-

notum with 3 longitudinal series of weak hairs on disc, the central series weakest. Abdomen 1.5 times as long as head and thorax combined; hypopygium as Plate XIII. Figure 5. Basal joint of fore tarsi slightly over half as long as tibia (26:47); legs with very short hairs; claws flattened at apices but without distinct apical incisions; empodium slender, as long as claw, distinctly fringed. Wings not extending to apex of fifth abdominal segment; costa extending to apex (Pl. XIII, fig. 12).

Female.—Antenna as in Plate XIII, Figure 8. Abdomen stout. Basal joint of fore tarsi distinctly over half as long as fore tibiae (15:25); claws acute at apices. Wing veins not so thick as in male.

Length, 1.75–2.25 mm.

Type specimen.—St. Paul Island, May 23, 1914 (A. G. Whitney, lot 143).

Paratypes.—St. Paul Island, 6 males and 7 females, May 23, 1914, from outside of laboratory window (A. G. Whitney, lot 152); 1 female, May 17, 1913 (A. G. Whitney, lot 29); 1 female, July 9, 1913 (A. G. Whitney, lot 67); St. George Island, 2 females, June 16, 1914 (G. D. Hanna, lot 32), taken by sweeping toward East Rookery; and 1 female, June 17, 1914 (G. D. Hanna, lot 37), Staraya Artel Rookery.

The type and lot 67 are on slides, the others are mounted on card points.

In my paper on the Chironomidae of Illinois[3] the genus *Smittia* runs down to *Orthocladius* (sens. lat.) and is readily separated from any of the subgenera therein contained by the very short wings and the number of antennal joints in both sexes.

Family MYCETOPHILIDAE.

The larvae of most of the species of this family feed upon fungi and decaying vegetable matter, some of them occurring in colonies under bark of dead trees or fence posts. The flies are usually difficult to collect except by sweeping amongst overhanging bushes or grasses or at lights, though at times they may be found in numbers on fungi or on the inner sides of windows of out-houses or buildings. There are only seven specimens of the family in the present collection, representing five genera. Unfortunately, a specific identification is not possible in two cases owing to the poor condition of the specimens.

Genus *Macrocera* Meigen.

There are 9 species of the genus *Macrocera* described from North America, none of which have been recorded from Alaska. The only

[3] Bull. Illinois State Lab. Nat. Hist., vol. 10, art. 6, 1915.

example of the genus in the present collection apparently belongs to an undescribed species.

Macrocera beringensis, n. sp.

Male.—Glossy black-brown. Mouth parts and basal 2 antennal joints yellowish; antennal flagellum shining, black. Prothorax, pleural sutures, and scutellum yellowish, remainder of thorax glossy black-brown. Abdomen unicolorous black-brown. Legs testaceous, apices of mid and hind coxae, and the tarsi infuscated. Wings slightly grayish, a large fuscous spot over petiole of media; another between the branches of cubitus touching the posterior branch along its apical half and not extending to anterior branch; a similarly colored, slightly curved, fasciform spot between middle of wing and apex, the posterior extremity of which covers the apical half of anterior branch of cubitus and the anterior one extending to fork of radius; apical spot rather faint. Halteres testaceous, more or less tinged with brown.

Antenna not over 1½ times as long as entire body, flagellum rather thick and from fourth joint to apex distinctly hairy, basal flagellar joint about one-fourth longer than second and slightly longer than third; median ocellus as large as lateral; frons with a distinct median furrow. Hypopygium stout, apex of lateral arms each with a stout black thorn on inner angle. Legs long but not particularly slender; basal joint of fore tarsus two-thirds as long as fore tibia and slightly longer than the remaining tarsal joints combined. Petiole of media very short, about 3 times as long as its own diameter; costa extending almost to apex of wing; its last section about 4 times as long as its penultimate one—the one preceding fork of radius; disk of wings without distinct hairs, veins except the anal one with setulose hairs.

Length, 6 mm.

Type.—St. Paul Island, Summer, 1914 (E. A. Preble).

Genus *Boletina* Staeger.

A single female specimen of a species of this genus is contained in the collection but is in such poor condition that its identity is uncertain. In most particulars it agrees with *beringensis* Coquillett. It is an abnormal specimen in so far as its wing venation is concerned, one wing having the base of the anterior branch of media absent while the other has it present. As this character, the absence or presence of this portion of this vein, is used as a generic one, this departure in the present case is worth recording.

Locality.—St. George Island, June 27, 1914 (G. D. Hanna, lot 49); toward Zapadni.

Boletina obesula Johannsen.

Boletina obesula Johannsen, The Fungus Gnats of North America, Bull. 196, Maine Agr. Exp. Sta., Dec., 1911, p. 276.

Recorded by Cole (Proc. Calif. Acad. Sciences, 4th ser., vol. 11, p. 169, Nov., 1921) from St. Paul Island, the record being based upon one female taken by G. D. Hanna June 21, 1920.

Boletina sp.

One male of an "undescribed species" recorded by Cole as "too poorly preserved for description" in the same paper as above, from St. Paul Island, June 21, 1920, G. D. Hanna (p. 170).

Genus *Rhymosia* Winnertz.

Rhymosia sp.

A female specimen in poor condition, minus legs and antennae. St. Paul Island, August 19, 1914 (E. A. Preble).

Genus *Allodia* Winnertz.

Allodia subelata, n. sp. Pl. XIII, fig. 9.

Male.—Fuscous, opaque; flagellum and legs brown; wings grayish, veins brown; halteres testaceous yellow; hairs yellow, bristles blackish.

Antenna about one and one-third times as long as head and thorax together; frons with the normal soft decumbent hairs, scutellar bristles 4 in number; 3 bristles above base of fore coxa and about 6 at apex of each. Comparative lengths of fore tibia and fore metatarsus 28:23; hind tibial setulae very weak; spurs on mid and hind tibiae long and stout. Hypopygium as in plate 13, figure 9. Furcation of media distinctly beyond apex of cross vein, the latter barely more than half as long as petiole; furcation of cubitus directly below proximal end of cross vein, the angle very acute; anal vein indistinct, subcostal vein very short, ending in radius.

Length, 3 mm.

Type.—St. George Island, June 14, 1914 (G. D. Hanna, Lot. 23); Garden Cove.

This species is closely allied to *elata* Johannsen, differing in venation and hypopygial characters chiefly.

Genus *Exechia* Winnertz.

Exechia casta Johannsen.

Exechia casta Johannsen, The Fungus Gnats of North America, part 4, Bull. 200, Maine Agr. Exp. Sta., p. 74, June, 1912.

One male and 2 females in collection evidently belong to this species. The data on specimens is as follows: St. George Island, June 16, 1914 (G. D. Hanna, Lot 32). Taken by sweeping, toward East Rookery. I have made a drawing of the male hypopygium

(Pl. XIII, fig. 14) which shows some slight differences from that given by Johannsen.

Johannsen's specimens were obtained from the following localities: Black Rock Creek, Dubois (type), Dinwiddie Creek, Hunters Creek, Wyoming, in September.

Family SCIARIDAE.

The species of this family represented in the collection belong to the genus *Sciara*. The members of this genus are remarkably similar in general appearance and it is only by the use of characters of wing venation and of genitalia that they can be differentiated with anything like certainty in the adult stage. The larvae which I have examined likewise very closely resemble each other, and those I have found were invariably feeding upon decaying vegetable matter, manure, or in fungi. One species I have reared from fallen plums. I have recently described the larva of a species that is often found crawling on the surface of the ground in immense numbers in the form of a rope-like mass.[4] A number of other species in the family are known to have the same habit. The imagines, exclusive of the Arctic forms, have been dealt with in an extensive paper by Prof. O. A. Johannsen.[5]

Genus *Sciara* Meigen.

There are representatives of 3 species of this genus in the collection. One of these is, I am confident, identical with one described by Rubsaamen; one is evidently undescribed, while the third is in too poor condition to permit of its exact identity being ascertained.

Sciara glacialis Rubsaamen. Pl. XIII, fig. 3.

Sciara glacialis Rubsaamen, Bibl. Zool., Orig.—Abh. aus sem Sessanmu. d. Zool. Suft. 20, 1898, p. 109.

Sciara humicola Lundbeck, Vidensk. Middel. f. d. Naturhist. Foren. Kjobenhaven, 1898, p. 252.

Hypopygium of male as in Pl. 13, fig. 3. This species is evidently common on St. George Island, as it is represented by 64 specimens in the collection, with data as follows:

3 specimens, June 10, 1914 (lot 11, G. D. Hanna).
3 specimens, June 14, 1914 (lot 23, G. D. Hanna).
32 specimens, June 16, 1914 (lot 32, G. D. Hanna).
1 specimen, June 16, 1914 (lot 36, G. D. Hanna).
22 specimens, June 17, 1914 (lot 37, G. D. Hanna).
3 specimens, June 24, 1914 (lot 46, G. D. Hanna).

Lots 32, 36, and 46 were obtained "toward East Rookery;" lot 11 from near beach at East Landing; lot 23 from Garden Cove; and lot 37 Staraya Artel Rookery.

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[4] Bull. Illinois State Lab. Nat. Hist., vol. 11, art. 4, 1915.

[5] The Fungus Gnats of North America, Part IV, Bull. No. 200, Maine Agr. Exp. Sta., 1912.

Sciara unguicauda, n. sp.

Male.—Brownish black, thorax shining, abdomen opaque. Legs, especially the fore pair, yellowish brown. Wings clear, veins pale brown. Halteres rufotestaceous. Arms of hypopygium reddish.

Face slightly buccate; eyes hairy, disc of mesonotum with short and very sparse hairs. Hypopygium similar to that of *glacialis*, the apical portion of lateral arm stouter, and the terminal thorn very strong. First branch of radius ends distinctly short of furcation of media; costa extends half way from apex of radius to apex of anterior branch of media; petiole of media subequal in length to anterior branch of that vein, the branches not appreciably divergent apically; cross vein over midway from base of first branch of radius; media leaves radius distinctly proximad of midway from base to cross vein; furcation of cubitus slightly proximad of base of media.

Female.—Slightly paler in color than the male. Apical plate of genitalia nearly twice as long as wide, subequal in length to preapical, and distinctly longer than basal one.

Length, 3–4 mm.

Type.—St. George Island, July 8, 1914 (lot 55, G. D. Hanna). Allotype and paratypes, same data. Paratypes, July 4, 1914 (lot 52, G. D. Hanna); toward Zapadni Rookery. Seven specimens.

Sciara sp.

A single male specimen in rather poor condition differs from the other two in structure of the hypopygium (Pl. XIII, fig. 4). In the form of the apical portion of the hypopygium it approaches closely that of *varians* Johannsen, a species described from Lawrence, Kans.; Ithaca, N. Y.; and Moscow, Idaho. The wings are in very poor condition and the specimen is otherwise in such a state that I can not give a definite identification. The data connected with it is as follows:

St. George Island, July 8, 1914 (lot 55, G. D. Hanna).

Genus *Neosciara* Petty.

Neosciara sp.

Cole (Proc. Calif. Acad. Sciences, 4th ser., vol. 11, p. 170, Nov. 1921) records a female specimen " in rather poor condition, so that its identity is not certain " but " near *tridentata* Rubs.", St. Paul Island, June 21, 1920 (G. D. Hanna).

Family BIBIONIDAE.

Genus *Dilophus* Meigen.

Dilophus tibialis Loew.

Diolphus tibialis Loew, H. Diptera Americae septentrionalis indigenae. Centuria, IX, 61, 1869. Complete Work, vol. 2, p. 200. [Sitka.]

A single female, collected on St. Paul Island, June 24, 1916, by G. Dallas Hanna is referred to this species by W. L. McAtee, who notes that it differs from the typical form by absence of yellow on body; when males are available the species may prove to be new.

Division BRACHYCERA.

Family LEPTIDAE.

This family is represented in the present collection by a single species of the genus *Ptiolina*.

The larvae of the known species of the family are largely terrestrial, living in the soil in woods or in decaying tree stumps and feeding upon earthworms and larvae of insects. One genus, *Atherix*, is aquatic in the larval and pupal stages, living in flowing water. The genus *Ptiolina* occurs in the larval stage in Europe in woods, under moss or in the earth. I have taken the imagines only in very marshy spots at rather high altitudes.

Genus *Ptiolina* Zetterstedt.

This genus is separable from *Spania* by the structure of the third antennal joint as pointed out by Verrall.[6] It is highly probable that all of our three North American species previously described belong to this genus instead of *Spania*. The latter occurs in the same situations as *Ptiolina* in Europe, but is much commoner.

Ptiolina arctica, n. sp.

Male and female.—Brownish black, slightly shining. Immature specimens yellowish brown. Wings clear or slightly grayish. Halteres brown or yellowish.

Male.—Eyes large, closely contiguous for a short distance; ocelli situated upon a distinct elevation; space above antennae subtriangular; eyes widely divergent posteriorly on sides of face; basal 2 antennal joints short, subequal, short-haired above, third joint missing; palpi broad, rather hairy. Thorax with rather short and sparse hairs, most noticeable on the anterior lateral and posterior portions; scutellum convex, rounded in outline, surface hairs of moderate length, not dense. Abdomen more conspicuously hairy than thorax; hypopygium chitinised, lateral arms stout, symmetrical, rounded apically, not hairy. Legs moderately stout, their surfaces with short hairs; mid and hind tibae with apical spurs. Venation normal; fork of third vein frequently evanescent at base; branches of media not fused at apex of discal cell; anal cell closed.

Female.—Agrees in color with the male.

[6] British Flies, vol. 5, p. 316, 1909.

Eyes very widely separated; third antennal joint much longer than broad, its apex tapering; style terminal, as long as third joint. Apex of abdomen slightly tapering. Otherwise as male.

Length 7–8 mm.

Type locality.—St. George Island, August 4, 1914 (G. D. Hanna).

This species is larger than any of those previously described from North America. Coquillett has recorded *Spania edeta* Walker, from Alaska. This species is velvety black and has only a length of 4 mm. Neither of Loew's species can be identical with the one here described, differing both in color and venation.

The specimens before me are in poor condition either having been wet or at one time in alcohol, and are much discolored. Some of them were evidently immature when captured. The thorax may be in well preserved examples more or less distinctly vittate as traces of vittae are visible in one or two of those in this collection. The venation is like that of most Leptidae, rather unstable.

The larva of this species has not been described. A vial numbered 14116, containing 2 larvae from the stomach of *Plectrophenax nivalis townsendi*, St. Paul Island, June 19, 1890, is before me and the specimens are, I believe, referable to this species. The description is as follows:

Length, 8–9 mm. White, cephalic parts dark castaneous. Body cylindrical, tapered on prothorax and mesothorax, and flattened on dorsal surface of apical segment. Head of the same general structure as that of *Chrysopila*, differing in having the labrum much broader, blunt at apex, the sides slightly tapered anteriorly, and the dorsum slightly ridged transversely on anterior half; antennae short and stout, not twice as long as thick, terminal joint very minute; between the antennae and the labrum there is on each side a large pale membranous area, the surface of which is granular; maxillae large, almost entirely pale and membranous, palpi much smaller than antennae; mandibles stout, slightly hooked at apex; posterior dorsal arcuate shield about 1½ times as long as broad, rounded posteriorly; internal cephalic rods extending to posterior margin of head. Thoracic and abdominal locomotor organs not easily distinguishable in specimens owing to condition, but evidently consisting of slightly raised transverse areas on venter, similar to those on *Chrysopila*, which are armed with very small, sharp toothlike elevations; apical segment slightly longer than its basal breadth, rounded from near middle, its apex with 2 small upwardly directed, slightly chitinized teeth, which are separated by a distance greater than the height of either tooth, dorsum with 6 longitudinal grooves or furrows which do not extend to apex, and give a ridged appearance to the segment; venter of apical segment with flat elevation extending from base to

near apex, its apical outline in the form of 2 rounded lobes, slightly cephalad of middle of this flat area is the anal opening which is very distinct, and oval in shape; between the apex of the above elevation and extreme apex of segment there is a slight but distinct incision parallel to apical margin of segment.

Family EMPIDIDAE.

The larvae of the great majority of the species in this family are terrestrial and feed upon vegetable matter in the soil or in rotten wood or upon larvae or other small animals. One species has been found in the larval and pupal stages in running water in New York State. The adult females are predaceous but many species are found in large numbers upon flowers of various plants. The two genera represented in the present collection are the largest in point of numbers in the family, and are the most widely distributed and common. Coquillett has described or recorded about 20 species of the genus *Rhamphomyia* and seven species of *Empis* from Alaska.

Genus Empis Linnaeus.

There are four species of this genus in the collection, all in rather poor condition and all represented by females only. With one exception the species in this collection are referable to the group that contains *virgata* Coquillett.

Coquillett[7] recorded *Empis virgata* Coquillett from Alaska and *pellucida*, *fumida*, and *infumata* were described by him at the same time, all being referred to as resembling *virgata* and only the first being described fully, the others being briefly compared with it. I had 4 specimens before me that belong to the same group as *pellucida;* because of the rather meagre descriptions I was unable to satisfactorily identify the species. I was obliged, therefore, to borrow paratypes of Coquillett's species from the United States National Museum for comparison. I have drawn up a key to the species (females), which is presented herewith, using characters not mentioned in the original descriptions.

All of the species are black in color, the legs sometimes brownish in *pellucida*, the mesonotum either trivittate or quadrivittate, the vittæ shining and the intervening spaces grayish pruinose; legs with very few weak spines, not feathered; halteres yellow. There is a very great similarity between the 5 species, and the synopsis now given embodies practically all the essential characters useful for their separation.

[7] Proc. Washington Acad. Sci., vol. 2, p. 408, 1900.

Key to species of virgata *group.*

1. Hind femora with several distinct bristles on antero-dorsal surface of apical third; tibial bristles strong, those on hind tibiæ longer than the diameter of the tibia; notopleural bristles 5 in number, the anterior one weak, the posterior 4 strong, subequal in length and rather closely placed, the series in a straight line; third antennal joint tapering except on a short space at base; fork of third vein about twice as long as the section of costa preceding it ..... fumida Coquillett.

   Hind femora without distinct bristles on apical third of antero-dorsal surface, only the normal short hairs present; hind tibial bristles not longer than the tibial diameter; notopleural bristles rather weak, widely placed and usually 3 in number, fork of third vein not twice as long as section of costa preceding it ..... 2.

2. Fore coxa with very few widely placed hairs on anterior surface, seen from the side only about a dozen visible; hind femora and tibiae slender, the former almost nude on anterior surface; distance between apices of third vein and first branch of media distinctly greater than that between branches of media, measured along margin of wing, because of a distinct deflection of the first branch of media just below fork of third ..... pellucida Coquillett.

   Fore coxae with numerous rather long, soft hairs anteriorly ..... 3.

3. Thorax trivittate, the vittae shining, the spaces between gray pruinose; wings slightly infuscated at apices ..... virgata Coquillett.

   Thorax quadrivittate, occasionally the vittae are not very distinct; wings evenly lutescent or pale brownish, not noticeably darker at apices than elsewhere ..... 4.

4. Proboscis distinctly more than twice as long as height of head; fork of third vein slightly bent in middle, base of cell enclosed by it acute posteriorly. ..... infumata Coquillett.

   Proboscis less than twice as long as height of head; fork of third vein rather abruptly bent at middle, the base of cell enclosed by it obtuse posteriorly. ..... subinfumata, n. sp.

Empis infumata Coquillett.

Empis infumata Coquillett, Proc. Washington Acad. Sci., vol. 2, p. 409, 1900.

Two specimens in rather poor condition, having been wet, obtained June 27, 1914 (lot 49, G. D. Hanna), on St. George Island, are evidently referable to this species. Originally described from Popof Island, Alaska.

Empis subinfumata, n. sp.

Female.—A more robust species than *infumata* with a more intense black coloring, the legs and palpi being entirely black. The thoracic hairs are more conspicuous and the legs are rather stouter. The hind femora and tibia each possess a sulcus on the anterior surface apically, but this may not be evident in fresh, well-matured examples. Other characters are mentioned in key.

Length, 6 mm.

Type locality.—St. George Island, June 16, 1914 (lot 35, G. D. Hanna). One specimen.

Empis sp.

A female taken May 1, 1913 (lot 18, A. G. Whitney) on St. Paul Island, very probably represents a distinct species. It differs from *subinfumata* in having the mesonotum much more distinctly pruinescent and in having 4 notopleural bristles, but is in such poor condition that I do not deem it advisable to describe it as new.

Empis sp.

Cole (Proc. Calif. Acad. Sciences, 4th ser., vol. 11, Nov., 1921, p. 170) records a male of a species "probably undescribed" in "poor condition" from St. George Island, June 30, 1920 (G. D. Hanna).

Possibly one of the species listed above.

Empis frontalis Coquillett.

Empis frontalis Coquillett, Proc. Ent. Soc. Washington, vol. 5, p. 271, 1903.

This species was originally described from specimens obtained on St. George Island by Professor Kincaid and is represented in the collection by 2 females also from that island. The data connected with the specimens are as follows:

June 17, 1914 (lot 49, G. D. Hanna).
August 4, 1914 (G. D. Hanna).

Genus *Rhamphomyia* Meigen.

This genus is represented by one species of which there are 56 specimens in the collection. I can not definitely associate it with any described North American species and describe it herewith.

I have reared one species of this genus from larvae found in rotten tree-stumps.

Rhamphomyia opacithorax, n. sp.

Male.—Black, slightly shining, the thorax almost entirely opaque, because of the dense brownish surface pruinescence. Head entirely black. Mesonotum not vittate, hairs and bristles black. Abdomen not so distinctly pruinescent as thorax, the hairs yellowish or whitish. Legs entirely black, the femora glossy; surface hairs fuscous. Wings whitish hyaline, veins brown, stigma brown. Halteres brown, knobs fuscous.

Eyes contiguous for one-half the length of frons; third antennal joint long, tapering from base to apex; style nearly one-third as long as third joint; proboscis not over 1½ times as long as height of head. Mesonotum with very long upright hairs laterally; acrostichals 2-rowed, very weak; scutellum with 4 bristles. Hairs on abdomen rather long; hypopygium as in Plate XIII, Figure 15. Legs moderately stout; basal joint of fore tarsi slender, not as thick as tibia at apex; hind femora and tibiae slightly thickened, the lat-

ter appreciably so at apices; dorsal surfaces of hind tibiae clothed with rather dense soft hairs which become longer from base to apex; basal joint of hind tarsi thicker than basal joints of other tarsi but slightly thinner than hind tibiae apically, the dorsal surface with long hairs. Greatest length of discal cell equal to length of last section of fifth vein; sixth vein incomplete; veins 1 to 3 more distinct than other veins.

Female.—Differs from the male in having the wings rather uniformly pale brownish, all the veins equally distinct, the hind legs less stout and without long hairs.

Length, 4.25–5.25 mm.

Type locality.—St. Paul Island, July 24, 1914 (lot 195, A. G. Whitney), 56 specimens.

Rhamphomyia sp.

Cole (Proc. Calif. Acad. Sciences, 4th ser., Vol. II, p. 170, Nov., 1921) records the occurrence of the female of a species "very close to *conservativa* Malloch" from St. Paul Island, August 10, 1920 (G. D. Hanna).

Family DOLICHOPODIDAE.

A surprising feature of the present collection is the fact that there is but one species of Dolichopodidae in it. The majority of the members of this family are aquatic, many of the species being confined to the seashore. The single species represented in the material before me belongs to a group that is invariably aquatic in habit, the adults running with facility on the surface of pools of water on or near the seashore. Several species belonging to genera closely allied to *Hydrophorus* are predaceous and in some manner the whole family has been credited by various authors as being predaceous, which is erroneous, the great majority of species in the family feeding upon nectar or other liquids.

Genus *Hydrophorus* Fallen.

Hydrophorus fumipennis Van Duzee.

Hydrophorus fumipennis Van Duzee, Proc. Cal. Acad. Sciences, vol. 11, p. 167, 1921.

This species is represented by 60 specimens taken on St. George Island, by G. D. Hanna, and 1 specimen by the same collector on St. Paul Island, August 16, 1915. The St. George specimens bear dates and lot numbers as follows: 2 specimens, June 4, Lot No. 2; 4 specimens, June 10, Lot No. 11; 9 specimens, June 16, Lot No. 36; 4 specimens, June 17, Lot No. 44. Lot No. 2 was taken in grass and on very wet, soggy ground near Village Landing; Lot No. 11 near beach at East Landing; Lot No. 36 toward East Rookery from Village;

and Lot 44 around a sphagnum bog one-fourth mile west of Village. Specimens from St. George without lot numbers are: 13, September 3, 1913; 9, May 4, 1914; and 19, April 1, 1914, G. D. Hanna.

The species was originally described from St. Paul Island.

Suborder **Cyclorrhapha.**

DIVISION ASCHIZA.

Family PHORIDAE.

The larvae of this family have in the different genera very diverse habits. Some are internal parasites of living insects, larvae, pupae, and imagines, but the great majority are scavengers, feeding upon decaying animal and vegetable matter. A summary of the larval habits appears in my paper on the family printed in 1912.[8]

The only species in the present collection belongs to the genus *Aphiochaeta* and to the group of that genus that feed upon fungi in their larval stages.

Genus *Aphiochaeta* Brues.

Aphiochaeta dubitata Malloch.

Aphiochaeta dubitata Malloch, Proc. U. S. Nat. Mus., vol. 43, p. 480, 1912.

Six specimens with data as follows:

St. George Island.

1 specimen, June 16 (lot 32, G. D. Hanna).
3 specimens, June 17 (lot 37, G. D. Hanna).

St. Paul Island.

2 specimens, August 16, 1915 (G. D. Hanna).

Family SYRPHIDAE.

The larvae of the different genera of Syrphidae have very diverse habits; some are scavengers, others are aphidophagous, while some live in nests of Hymenoptera, assumably feeding upon the detritis of the nests. The two species in the present collection are probably scavengers in an aquatic or semiaquatic habitat in their larval states.

Genus *Helophilus* Meigen.

Helophilus borealis Staeger.

Helophilus borealis Staeger, Kroy. Natur. Hist. Tidskrift, n. ser. 1, p. 359, 1845.

This species which was originally described from Greenland is represented in the collection by one female the data for which is August 1, 1914 (E. A. Preble).

[8] Proc. U. S. Nat. Mus., vol. 43, pp. 411–529, 1912.

Helophilus dychei Williston.

Helophilus dychei Williston (in Hunter), Can. Ent., vol. 29, p. 136, 1897.

This species, which was originally described from specimens obtained at Sitka, Alaska, is represented by 2 males and 1 female in this collection. The data are as follows:

St. George, August 22, 1913 (G. D. Hanna).
St. George, June 14, 1914 (Lot 18, G. D. Hanna).
St. Paul, June 5, 1913 (Lot 38, A. G. Whitney).

The thorax in both specimens is very densely long pilose and the 2 abbreviated discal stripes are very indistinct, almost invisible.

Genus *Pterallastes* Loew.

Pterallastes borealis Cole.

Pterallastes borealis Cole, Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 170, Nov., 1921.

Described from a male and female collected on St. Paul Island, August 20, 1920 (G. D. Hanna). Closely related to *perfidiosus* Hunter.

Genus *Syrphus* Fabricius.

Syrphus contumax Osten Sacken.

Syrphus contumax Osten Sacken, Proc. Boston Soc. Nat. Hist., vol. 18, p. 148, Oct., 1875.

Recorded by Cole (Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 171, Nov., 1921), from St. George Island, June 30, 1920 (G. D. Hanna).

Division SCHIZOPHORA.

Family ANTHOMYIIDAE.

The larvae of the species comprising this family are mostly phytophagous or scavengers, though certain species are recorded as parasitic upon nestlings of some birds, living attached to various parts of their bodies. The few species in the collection before me belong apparently to the group that feeds upon decaying vegetable matter; a closely allied species was reared by me from rotten wood. The family is well represented in North America, but very few collectors know more than a small percentage of the species.

Subfamily PHAONIINAE.

Genus *Phaonia* Robineau-Desvoidy.

This genus is distinguished from others of the subfamily in this paper by having in both sexes a strong bristle beyond middle on the postero-dorsal surface of hind tibia. A comprehensive revision of the genus by the writer is now ready for the press. There is but one species known to me from the Pribilof Islands.

Phaonia minima Malloch.

Phaonia minima Malloch, J. R., Rep. Can. Arctic Exped., 3, Part C, p. 61, 1919.

St. Paul Island, July 19, 1916 (G. D. Hanna).

Genus *Helina* Robineau-Desvoidy.

The name *Helina* has been used by me in all of my recent papers on Anthomyiidae for a segregate of that group listed under the generic name *Mydaea* R-D. by Stein and other authors. The true species of *Mydaea* all have the third wing-vein setulose at base above and below, and the females have the penultimate abdominal sternite with short stout bristles. *Helina* as at present limited has no species that possesses the above combination of characters.

The species *hannai*, of which a full descripition is presented herein, was included in a recently published synopsis of the genus by the writer and a description also included.[9]

Helina borealis Malloch.

Aricia borealis Malloch, J. R., Rep. Can. Arctic Expedition, 3, Part C., pp. 64–5. 1919.

St. Paul Island, Alaska, July 19, 1916 (G. D. Hanna).

Helina hannai Malloch.

Helina hannai Malloch, J. R., Can. Ent., vol. 53, no. 5, p. 109, May, 1921.

Puparium.—Length, 8 mm.; diameter at middle, 2.5 mm. Color, reddish testaceous, distinctly shining. Cephalic extremity rather slender, glossy; anterior margin of first dorsal thoracic segment subcarinate; integument throughout with very minute longitudinal striae, which are not continuous but in the form of short, slightly irregular lines; transverse rugae indistinct anteriorly, except between the last thoracic and first abdominal segments, becoming noticeable between the third and fourth abdominal segments and from that point becoming stronger to apex where they are present in the form of conspicuous raised ridges; lateral fasciform areas distinct, margined throughout their length by a series of microscopic rounded swellings, which series is continued over the venter in the form of a single line along the margin of each segment; each ventral segment has 2 short transverse series of similar raised areas on the disc (dorsal segments glued to card and thus invisible); anal opening rather large, surrounded by a heart-shaped slightly elevated ridge (Pl. XV, fig. 29); anal spiracles consisting of 3 slit-like openings on a slightly raised base (fig. 30).

Imago.—Male. Black, distinctly shining. Head black; orbits with silvery pile; frontal stripe opaque black. Thorax without dis-

[9] Can. Ent., vol. 53, p. 109, 1921.

tinct pruinescence, with a faint bronzy tinge, and indistinctly trivittate anteriorly. Abdomen, when viewed from behind, with distinct brownish pruinescence and continuous dorso-central longitudinal black stripe; in some lights with a slight bronzy reflection. Legs black. Wings slightly fuscous, base yellow; cross veins not infuscated. Calyptrae bright yellow. Halteres brown, knobs black.

Eyes distinctly separated, narrowest part of stripe about one-tenth the width of head at that point; width of frons at base of antennae about one-fourth that of head at that point; orbital bristles strong and of moderate length; third antennal joint over twice the length of second; arista very short haired; eyes with very few microscopic hairs; face slightly receding toward lower margin; cheeks with numerous bristly hairs; proboscis rather thick, of moderate length; palpi slightly dilated apically. Acrostichals irregularly 4-rowed; dorso-centrals 2+4. Abdomen subcylindrical, elongate, slightly narrowed apically; hypopygium small, almost entirely retracted; surface hairs on dorsal segments strong, especially on apical 2 segments. Fore tibia with 2–3 weak bristles on the postero-ventral surface; mid tibia with 2 posterior bristles; hind tibia with 2 antero-dorsal and 2 antero-ventral bristles. Costal spine weak; third and fourth veins slightly divergent apically, the former with 2–3 bristles at base; outer cross vein slightly undulated; last section of fourth vein less than 1.5 as long as preceding section.

Female.—Agrees in color with the male except that the abdomen is less distinctly pruinescent. Frons over one-third the width of head; ocellar triangle produced in the form of a long slender point nearly to anterior margin; upper orbital directed outward, the others inward; cruciate central bristles absent; cheeks higher than in male, each about one-third as high as eye. Abdomen rather broad. In other respects as male. Length, 6.5–7.5 mm.

Four specimens, St. George Island, June 24, 1914 (lot 46, G. D. Hanna), 1 male and puparium, the male in poor condition, June 20, 1913 (lot 41, A. G. Whitney); 1 male, abnormal in having 4 bristles on antero-dorsal surface of hind tibia, June 10, 1914 (lot 9, G. D. Hanna); 1 male and 2 females, June 17, 1914 (lot 42, G. D. Hanna).

The example mounted along with the empty puparium bears no data that throws any light upon the habits of the larva, neither is there any data which indicates the habits of the adults of the other lots.

Helina sp.

A female in very poor condition differs distinctly from the foregoing; I am unable to identify it with any described species. Because of its sex and condition, I refrain from attempting a description of the species.

Locality, St. George Island, July 8, 1914 (lot 55, G. D. Hanna).

Genus *Mydaea* Robineau-Desvoidy.

Mydaea rugia (Walker).

Anthomyia rugia Walker, List of Insects in the British Museum, Diptera, Part 4, p. 923, 1859.

I have recorded this species from St. George Island, July 1, 1920 (Proc. Calif. Acad. Sciences, 4th ser., vol. 11, Nov., 1921, p. 178).

Genus *Melanochelia* Rondani.

The species of this genus resemble those of *Helina* R-D. that have the abdomen with paired dorsal abdominal spots, but they differ in having the arista bare or pubescent. The species form a very homogeneous group and although rather closely resembling the above mentioned group in *Helina*, they seem also to differ largely in habits of the adults. The species of *Melanochelia* are most generally found near streams or on the shores of lakes or of the sea, and many species may be taken upon the exposed surfaces of rocks in stream beds, especially in sunshine, though they are very quick of flight and difficult to detect because their gray and black colors blend very well into the color of the rocks upon which they settle. One species that I have found commonly in Scotland is predaceous upon insects, but the majority of the adults are flower frequenters. The larval habits are not well known but some are feeders upon decaying animal and vegetable matter.

Melanochelia nobilis Stein.

Limnophora nobilis Stein, Berl. Ent. Zeitschr., p. 207, 1898.

There are two males and one female of this species in the material before me. The males, although in rather poor condition, agree in almost every respect with Stein's description. The specimen in the best condition shows indications of thoracic vittae but in all other respects agrees with the original description. The female I am not so certain of but consider it very probably as belonging to *nobilis*.

Localities.—Males, St. George Island, June 17, 1914 (lot 42, G. D. Hanna); female, St. Paul Island, July 21, 1913 (lot 85, A. G. Whitney). Lot 42 was taken on uplands toward Staraya Artel; lot 85 is given as Webster House, Northeast Point.

The original description of this species was made from a male obtained in Alaska. Coquillett subsequently recorded it from Sitka, Seldovia, and Popof Island, Alaska.[10]

Melanochelia sanctipauli Malloch.

Melanochelia sanctipauli Malloch, Proc. Calif. Acad. Sciences, 4th ser., vol. 11, Nov., 1921, p. 180.

Described from St. Paul Island, July 12, 1920 (G. D. Hanna).

[10] Proc. Washington Acad. Sci., vol. 2, p. 445, 1900.

Melanochelia spinicosta Malloch.

Melanochelia spinicosta Malloch, Proc. Calif. Acad. Sciences, 4th ser., vol. 11, p. 181, 1921.

Described from St. Paul Island, and recorded from St. George Island, June 30, July 12, and August 10, 1920 (G. D. Hanna).

Genus *Eriphia* Meigen.

Eriphia cinerea Meigen.

Eriphia cinerea Meigen, Syst. Beschr., 5, p. 206, 1826.

Collected in 1920, by G. D. Hanna and recently recorded for the first time from this hemisphere (Proc. Calif. Acad. Sciences, 4th ser., vol. 11, 1921, p. 178).

Genus *Eupogonomyia* Malloch.

Eupogonomyia pribilofensis Malloch.

Eupogonomyia pribilofensis Malloch, Proc. Calif. Acad. Sciences, 4th ser., vol. 11, p. 179, 1921.

Described from St. Paul Island, June 21, 1920 (G. D. Hanna).

Genus *Hydrophoria* Robineau-Desvoidy.

This genus is represented by a large number of specimens belonging to a single species.

Hydrophoria alaskensis Malloch. (Pl. XV, fig. 34.)

Hydrophoria alaskensis Malloch, J. R., Can. Ent., vol. 52, no. 11, p. 257, Nov., 1920.

St. George Island—

14 specimens, June 8, 1914 (lot 7, G. D. Hanna).
9 specimens, June 10, 1914 (lot 9, G. D. Hanna).
1 specimen, June 16, 1914 (lot 34, G. D. Hanna).
26 specimens, June 16, 1914 (lot 35, G. D. Hanna).
2 specimens, May 6, 1914 (G. D. Hanna).
1 specimen, June 16, 1914 (lot 36, G. D. Hanna).
19 specimens, June 17, 1914 (lot 42, G. D. Hanna).
2 specimens, June 24, 1914 (lot 46, G. D. Hanna).
2 specimens, June 25, 1914 (lot 47, G. D. Hanna).

Lot 7 has the following data: "Found on several species of flowers and on grass. When approached it darts into the grass but never tries to fly away. Uplands." I am unaware of this characteristic in other anthomyids; it may be due to prevailing strong winds. The remaining lots were evidently collected by sweeping and bear no data of interest. The places of collection were mostly "towards East Rookery" and "towards North Rookery" with a reference to "Uplands" towards Staraya Artel in the case of Lot 42. All the specimens were taken on St. George Island. I have recorded the occurrence of this species from St. Paul Island, June 21, 1920, G. D. Hanna (Proc. Calif. Acad. Sciences, 4th ser., vol. 11, 1921, p. 182).

Genus *Hylemyia* Robineau-Desvoidy.

This genus contains a large number of very closely allied species, although the number recorded from North America is comparatively small. I have reared some of the European species from decaying vegetation and from manure, but several occur in the larval stage upon the roots of various plants, wild and cultivated. There is a single species in the present collection which appears to be new to science.

Hylemyia flavisquama, n. sp.

Male.—Black, very slightly shiny. Head black; frontal stripe orange red, orbits blackish brown, distinctly silky; facial orbits and cheeks brown, with silky surface; face blackish brown, surface with brownish pile. Thorax with faint pruinescence, most distinct on 2 narrow lines between the acrostichals and the dorso-centrals, and on the lateral anterior angles. Abdomen with grayish pruinescence; when viewed from behind there is a distinct dorso-central stripe visible which is not disconnected at the abdominal sutures and is laterally extended anteriorly in the form of a narrow stripe along the fore margin of each segment. Legs black. Wings slightly grayish or fuscous. Squamae bright yellow, fringes concolorous. Halteres brown at base, knobs yellow.

Eyes distinctly separated, the narrowest part of frons about one-fifth the width of either eye; above bases of antennae the frons is over one-fourth the width of head at that point; orbital bristles very long though fine, about 6 pairs present on lower orbits in addition to a number of weaker hairs; face in profile protruding beyond eyes about as far as the width of third antennal joint, mouth margin protuberant; antenna of moderate length; arista pubescent; cheeks with numerous long hairs, the upper ones upcurved, those on vibrissal angle strong, the vibrissae noticeably strong; cheeks broader than third antennal joint; proboscis rather long, stout; palpi slender, slightly dilated apically, with a number of weak surface hairs. Thoracic hairs strong; 2 pairs of very strong presutural dorso-centrals; acrostichals 4-rowed anterior to suture. Abdomen equal in length to thorax, rather broad, the surface with conspicuous hairs; hypopygium rather small, without conspicuous lamellae. Fore tibia with a weak bristle at middle on postero-ventral surface (usually with a still weaker one below it), and a short one below middle on antero-dorsal surface, preapical bristle usually duplicated; antero-ventral surface of mid-femur with a graduated series of bristles, the longer ones at the base; mid-tibia usually with the following bristles: 1 antero-ventral, 2 antero-dorsal, 3–4 postero-dorsal, and 2–3 postero-ventral; hind femora with a rather irregular series of strong bristles on the antero-dorsal and antero-ventral surfaces; hind tibia

with antero- and postero-dorsal surfaces armed with series of rather strong bristles; postero-ventral surface with usually 2 weak bristles near base, the uppermost just above middle. Costa with black, setulose hairs; costal spine small; inner cross vein just beyond apex of first vein; outer cross vein almost straight, its upper extremity much nearer apex of wing than its lower; veins 3 and 4 slightly convergent apically; last section of 4 about one and two-thirds times the length of penultimate section.

Female.—Differs from the male in being less intensely black and in having the surface of the body parts more distinctly pruinose; the upper half of the central stripe of frons is velvety black, merging into the bright orange of the anterior portion. The base of the wing is noticeably yellowish.

Frons over one-third the head width; orbits each over half as wide as center stripe; upper 2 (or 3) orbitals directed slightly outward, lower 4 slightly inward; cruciate frontal bristles strong; head much as in the male in other respects except that the hairs on the cheeks are less numerous and much stronger, 2 or 3 slightly upwardly directed bristles being noticeably so. Thorax with less hair than in male; acrostichals irregularly 4-rowed. Legs with a similar armature to those of male, the pair of weak bristles on postero-ventral surface of fore tibiae either absent or represented by very weak hairs.

Length, 3.75–4.25 mm.

Type.—St. George Island, June 14, 1914 (lot 19, G. D. Hanna), vicinity of Garden Cove.

Paratypes:

5 specimens, June 16, 1914 (lot 35, G. D. Hanna).
2 specimens, June 17, 1914 (lot 42, G. D. Hanna).
2 specimens, June 25, 1914 (lot 47, G. D. Hanna).
3 specimens (including allotype), July 4, 1914 (lot 52, G. D. Hanna).
13 specimens, July 8, 1914 (lot 55, G. D. Hanna).

The data contains no information as to habits, the specimens being recorded as from "toward" the various rookeries, and all are from St. George Island.

This species has much the appearance of *Anthomyia radicum* Linnaeus, but differs in having the upper scale of squamae larger than the under one. From *P. badia* Walker it differs in having the acrostichals 4-rowed instead of 2-rowed and in having the squamae yellow instead of whitish.

Hylemyia sp.

A male which is rather smaller than the smallest specimen of the preceding species and differs in having the acrostichals 2-rowed, represents a distinct species, but the condition of the specimen precludes my arriving at a definite identification.

Locality.—St. George Island, June 17, 1914 (lot 44, G. D. Hanna). The specimen was taken with other species "around a sphagnum bog ¼ mile west of Village."

Genus *Fucellia* Robineau-Desvoidy.

This genus has been considered as belonging to the Anthomyiidae by several authorities while others have placed it in the Cordyluridae. However, it is most properly placed in the Anthomyiidae and is distinguished from the genera in that family which have the eyes separated in both sexes by the presence of a pair of cruciate bristles on the center of the frontal stripe.

The genus is separable from Scatophagidae, as are all Anthomyiidae known to me except 4 species, by the area below the prothoracic spiracles, above and in front of the prothoracic and stigmatal bristles, being bare instead of covered, at least in part, with long soft hairs.

Stein[11] in 1910 revised the genus and fully described the known species; Aldrich in 1918[12] again revised the genus for North America and recorded 13 species as occurring in the Western Hemisphere. Of the described species 3 occur in the material before me. Two of these species, *fucorum* and *antennata*, are mentioned by Stein as occurring on St. Paul Island; the third was originally described from Greenland. A fourth species occurring in northern latitudes is *pictipennis* Becker, recorded from Hecla Haven, East Greenland.

The species are invariably found on or near the shore either of the sea or rivers, and generally are common. Their habits are very similar to those of the Cordyluridae, the larvae being recorded as feeding upon decaying drift, though there is no record so far as I know of the imagines being predaceous. I have taken specimens of the genus at considerable distances from the sea on the banks of various rivers and as most entomologists have the impression that the genus is exclusively maritime in habit it seems pertinent to put upon record here the capture by myself of a male of *maritima* at Carmi, Illinois, a town on the Little Wabash River, several hundreds of miles from the sea and nearly 300 miles from Lake Michigan, the nearest large area of fresh water where it also occurs. I have also seen a male of this species taken by R. P. Dow at Claremont, N. H., which is about 90 miles from the sea in a straight line.

Fucellia fucorum Fallen.

Scatomyza fucorum Fallen, Scatomyz., 5, 1819.

This species is widely distributed in the Arctic regions and extends as far south as Friday Harbor. Stein records it from St. Paul Island, and Meidnaja, Bering Straits, in addition to Friday

[11] Wiener Ent. Zeit., vol. 29, p. 11, 1910.
[12] Proc. Calif. Acad. Sci., 4th ser., vol. 8, p. 157, 1918.

Harbor. There are records of the species from as far south as Porto Rico but it is probable that most of these refer to *maritima*. In the present collection the species is represented by 127 specimens with data as follows:

St. George Island:

16 specimens, May 6, 1914 (G. D. Hanna).
2 specimens, June 16, 1914 (lot 34, G. D. Hanna).
5 specimens, June 4, 1914 (lot 1, G. D. Hanna).
50 specimens, June 10, 1914 (lot 9, G. D. Hanna).
1 specimen, June 14, 1914 (lot 19, G. D. Hanna).
1 specimen, July 4, 1914 (G. D. Hanna).

St. Paul Island:

14 specimens, August 1, 1914 (E. A. Preble).
44 specimens, August 19, 1914 (E. A. Preble).
1 specimen, Summer, 1914 (lot 210, A. G. Whitney).
10 specimens, August 16, 1915 (G. D. Hanna).
2 specimens, August 26, 1916 (G. D. Hanna).

Lot 1 contains specimens collected about fox houses and on beach among bowlders; lot 9 contains specimens that are recorded as "very common along the beaches, living upon the decaying marine algae"; lot 19 is from the vicinity of Garden Cove; lot 34, from "toward East Rookery"; the others have no data other than that already given.

One specimen in the last lot in the series listed has 2 large mites attached to the posterior portion of thorax close to base of posterior coxae.

Fucellia ariciiformis Holmgren.

Scatophaga ariciiformis Holmgren, Kongl., Vetenskap. Akad. Forhandlingar, No. 6, p. 103, 1872.
Fucellia ariciiformis (Holmgren) Lundbeck, Vidensk. Meddel. Naturhist. Foren. Kjobenhaven, p. 292, 1900.

This species was originally described from Greenland by Holmgren and afterwards recorded from there by Lundbeck. Stein indicated in his revision of the genus the characters that are available for distinguishing the sexes from those of *fucorum* to which it is most closely related. The male possesses the tuft of short spines at base of hind femora but the tubercle at base of hind femora in *fucorum* is absent in *ariciiformis*. The female differs from that of *fucorum* in having only one antero-ventral midtibial bristle, and the antero-ventral hind tibial bristles very much stronger, more numerous, and carried nearly to base.

There are 4 specimens of the species in the present collection, with data as follows:

St. Paul Island:

1 female, May 23, 1914 (lot 154, A. G. Whitney).
1 female, 2 males, August 16, 1915 (G. D. Hanna).

A series taken on St. Paul Island, August 10, 1920 (G. D. Hanna), has been recorded by Cole (Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 172, 1921).

Fucellia antennata Stein.

Fucellia antennata Stein, Wien. Ent. Zeit., vol. 29, p. 23, 1910.

This species was originally described from Alaska, the localities given being Sitka, St. Paul Island, and Karluk. It differs from all other species in the genus in having the antennae elongated, the apex of the third joint being almost on a level with the upper mouth margin. The male is further distinguished by having the antero-ventral surface of the posterior femora with a series of closely placed bristles extending from slightly before the middle to their apices. The species has much the same habitus as *Amaurosoma*, a genus of predaceous cordylurids, but the fore femora in that genus are usually armed on their antero-ventral surfaces with a group of setulae and the cruciate frontal bristles are absent.

Amongst the material before me there are 29 specimens of *antennata* as follows:

St. Paul Island:

2 specimens, May 23, 1914 (lot 155, A. G. Whitney).
9 specimens, August 1, 1914 (E. A. Preble).
14 specimens, August 19, 1914 (E. A. Preble).
2 specimens, Summer, 1914 (E. A. Preble).
1 specimen, May 16, 1913 (lot 28, A. G. Whitney).
1 specimen, August 16, 1915 (G. D. Hanna).

Only the first and next to the last lots have any information regarding the exact place of capture attached to them. The three specimens in Lot 155 were taken in the Laboratory, as was also that in Lot 28; the latter is pinned with a specimen of *Scatophaga dasythrix*, but the data indicates nothing other than that they were taken at the same time.

Recorded by Cole (Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 172, November, 1921), as a " common species on St. Paul Island, August 10 to 25, 1920 " (G. D. Hanna).

Fucellia pictipennis Becker.

Recorded by Cole (Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 172, November, 1921) from three specimens taken on St. Paul Island, June 21 and August 25, 1920 (G. D. Hanna).

Family SCATOPHAGIDAE.

Some species of the subfamily Scatophaginae are remarkably common, both on the seashore and throughout areas remote from the sea, while others are invariably confined to the seashore or its immediate vicinity. All, however, are very similar in larval habits, feed-

ing upon manure or decaying vegetable matter. The adults are, so far as is known, predaceous, though they are commonly found feeding both on flowers and fresh manure. The larval habits of the species of the subfamily Cordylurinae are not very generally known. Some of them feed upon decaying vegetable matter; I have reared one species from river drift; and one species, *Hydromyza confluens* Loew, feeds in the stems of *Nymphaea advena*, forming gall-like swellings thereon. So far as I know, the adults are predaceous, some of the genera being particularly adapted for this mode of life, the fore legs being armed with strong spines to aid in catching and retaining prey, but even where these spines are present the insects may also be found feeding upon nectar of flowers.

The material belonging to this family contained in the present collection consists principally of Scatophaginae belonging to the genus *Scatophaga*. I have taken pains to dissect the males of the species of *Scatophaga* and figure certain parts with a view to facilitating their identification for future students; this has resulted also in confirming their identity in some cases with species from more temperate latitudes.

Subfamily CORDYLURINAE.

Cordylura beringensis, n. sp.

Male.—Black, slightly shining. Anterior portion of frons reddish, merging into whitish on sides at anterior margin; face and cheeks yellowish white; frons, face, and cheeks with pale gray or whitish pruinescence; antennae black, apex of second joint brown; proboscis and palpi black. Thorax and abdomen with distinct, brownish gray pruinescence. Legs black, tarsi reddish on the ventral surfaces. Wings clear, veins black; calyptrae yellowish white, their fringes white. Halteres pale brown, knobs reddish.

Frons slightly broader than eye, narrowed anteriorly; orbits usually with 6 pairs of bristles, the upper 2 pairs directed outward, the next pair directed forward, and the lower pairs incurved; third antennal joint of moderate length, rounded apically; arista plumose; vibrissae very long; cheeks very narrow; proboscis stout; palpi slender, armed with a pair of long hairlike bristles. Two pairs of dorso-central bristles on thorax anterior to suture; acrostichals 2-rowed; mesopleura with 4–5 moderately strong bristles; sternopleurum with 1 very strong bristle; scutellum with 4 marginal bristles. Abdomen short and stout; hypopygium very large, hairy; fifth ventral segment ending in 2 large rounded lateral lobes. Legs stout, the fore and hind femora especially so; all legs with long and strong bristles; fore and mid femora with long pale hairs on ventral surfaces, the latter with 2–3 strong antero-ventral bristles near apex; hind femora with a very long downward directed hair near

base on ventral surface; hind tibia with 2 antero-ventral, 3 antero-dorsal and 3 postero-dorsal bristles. Apical portion of first wing-vein bristly.

Length, 5 mm.

Type.—St. George Island, June 16, 1914 (lot 35, G. D. Hanna). The type and 2 paratypes were taken "toward East Rookery from Village." Other paratypes as follows:

3 specimens, June 17, 1914, uplands near Staraya Artel (lot 42, G. D. Hanna).

1 specimen, June 17, 1914, near a sphagnum bog, $\frac{1}{4}$ mile west of Village (lot 44, G. D. Hanna).

1 specimen, June 25, 1914, from toward North Rookery (lot 47, G. D. Hanna).

There is a Colorado species which very closely resembles the above. It differs in having the legs with weaker bristles, the wings clearer, the inner cross vein more distinctly beyond middle of discal cell, and the first vein almost bare.

This species has a decided affinity to *proboscidea* Zetterstedt, a species that has a northern range in Europe. It differs, however, in being smaller and in having the abdomen much less conspicuously hairy, as well as in several other minor characters.

Genus *Allomyella* n. n.[13]

Generic characters.—Head about as high as long, face slightly retreating below, cheek of moderate width, eye higher than long, vibrissa weak, below it one bristle; antennae of moderate length, third joint subangulate at apex on upper side, arista bare, occiput with bristles along upper half on eye-margin, and below these another series or irregular group on back of head. Dorso-centrals 5, the other bristles as in *Cordylura;* 1 sterno-pleural; pteropleura with a few hairs. Abdomen at least as long as wings, broad, apical segment short, compressed, but little protruded. Fore tibia with short black setulae on ventral surface. First wing vein bare.

Allomyella brevipennis, n. sp.

Female.—Black, abdomen distinctly shiny. Head black; frons opaque; central stripe brown, paler anteriorly; lower part of face and anterior angles of cheeks yellow; antennae black, second joint slightly reddish apically; arista black; proboscis glossy black; palpi brown at base, yellow apically. Legs black, tibiae and tarsi testaceous yellow, the apices of the latter slightly darkened. Wings slightly brownish, the veins thick and slightly darkened, faintly infuscated along their margins. Calyptrae brown, fringes yel-

[13] The generic name *Allomyia* given by me to this genus in my paper on the Canadian Arctic Diptera is preoccupied by *Allomyia* Felt and the name of my genus accordingly is changed herein.

lowish. Halteres reddish yellow. Hairs and bristles yellow, the stronger bristles on head, legs, and abdomen blackish, but paler in transmitted light.

Frons distinctly broader than eye, very slightly narrowed anteriorly; orbits each with 5 bristles, the 2 upper ones directed outward; arista bare; profile as in Plate XV, Figure 28. Thorax and abdomen with rather numerous surface hairs; pleural bristles not well distinguished from the other hairs, the prothoracic and stigmatal bristles weak. Last abdominal segment distinctly elongated, its lateral margins with a number of long bristles. Legs rather stout; fore femora distinctly incrassated; all femora with rather widely separated hair-like central bristles; fore tibia with 4 bristles, 2 on the dorsal surface (one at middle and one near tip), and 2 slightly below them transversely on posterior surface; hind tibia with the following bristles: 2 on postero-dorsal surface, one at middle and the other at one-fourth from base; 2 on antero-dorsal surface, the upper in transverse line with the upper on postero-dorsal surface, the lower slightly below middle; 2—3 on antero-ventral surface near apex. Wings not extending to apex of abdomen; third and fourth veins divergent, the former ending in apex of wing.

Length, 5.25 mm.

Type.—St. George Island, June 8, 1914 (lot 8, G. D. Hanna).

Subfamily HYDROMYZINAE.

Genus *Pogonota* Becker.

Pogonota kincaidi Coquillett. (Pl. XII, fig.2.)

Pogonota kincaidi Coquillett, Proc. Washington Acad. Sci., vol. 2, p. 455, 1900.

This species is represented by seven specimens, with data as follows: 2 males and 1 female, St. George Island, June 16, 1914 (G. D. Hanna, Lot 36); 1 male and 3 females, August 16, 1915 (G. D. Hanna). The original description was made from a male and female obtained by Prof. T. Kincaid on Popof Island, Alaska, and there are no subsequent records of the species.

Subfamily SCATOPHAGINAE.

Genus *Scatophaga* Meigen.

There is not a published synopsis of the North American species of this genus, and in presenting one covering the species contained in the present collection I hope to accomplish two objects—to make it possible for future students to recognize the forms recorded, and to indicate that, similar though the species appear, there are just as good characters available for their separation as there are in most of the dipterous families and even better than there are in some.

Becker in 1894[14] published the most complete study of the family that has been undertaken up to the present. In the genus *Scatophaga* the synoptic key is very full and quite satisfactory; but few of the species are described fully in the text, the author confining himself to notes upon the species and to indicating their synonymy except in the case of new species. So far as I know, the present paper is the first in which use has been made of the characters of the fifth ventral segment of the abdomen of the males except that by the writer on the Diptera of the Canadian Arctic Expedition. The differences in structure in this segment are very marked in some of the species, as can be seen from an examination of the figures. There are four distinct types of structure of this segment in the species I have examined. The simplest form is represented by 1 species, *crinita*, and has on each lateral angle of the fifth sternite a small rounded prolongation; in 3 species there is a very long prolongation of this segment on each side of the median line; *furcata* has a small, rather knoblike process on each side of the median line on posterior margin of the segment; and *stercoraria* has a similar pair to those of *furcata* in addition to the lateral elongations, presenting the most elaborate structure of any species known to me. *Stercoraria* (Pl. XIV, fig. 17) has been recorded from Alaska, but is unrepresented in the present collection, the figure being introduced here to show the difference in form of the segment. It will be observed that there is a distinct similarity in the male hypopygia of *Scatophaga* and *Coelopa* (Pl. XIV, figs. 23, 24, and 25). I published figures of the fifth sternites of the males of *S. suilla* and *S. lutaria* in my report on the Diptera collected by the Canadian Arctic Expedition, 1919.

Key to species of Scatophaga.

1. Males ---------- 2.
   Females ---------- 6.
2. Mid and hind tibiae with a number of strong, outstanding bristles in addition to the soft hairs ---------- 3.
   Mid and hind tibiae with remarkably long soft hairs, and without strong bristles except at apex and in *crinita* one bristle near apex on posterior surface ---------- 5.
3. Cross veins of the wings not infuscated; legs black, very densely brownish pruinose, bases of tibiae indistinctly reddish; fifth ventral segment of abdomen as in Plate XIV, Figure 21 ---------- islandica.
   Cross veins of the wings conspicuously infuscated; legs either almost entirely yellow, or reddish with black femora ---------- 4.
4. Legs reddish or vinous colored, shining, femora black; hairs on hind tibiae woolly, nearly as long as the bristles, the latter rather slender; fifth ventral segment of abdomen with a long, thornlike projection on each side of the median line (Pl. XIV, fig. 20) ---------- rubicunda.

[14] Berl. Ent. Zeitschr., vol. 39, pp. 77–196.

Legs pale testaceous or yellowish, only the fore femora in part black; hairs on hind tibiae setulose, very much shorter than the bristles, the latter very stout, fifth ventral segment of abdomen with short knoblike process on each side of the median line (Pl. XIV, fig. 22)_____furcata.

5. Legs shining black; abdominal hairs yellow, varying from whitish to orange; mid tibiae with a bristle near apex on the posterior surface; fifth ventral abdominal segment as in Plate XIV, Figure 19_____crinita.

Legs dull black; abdominal hairs black, occasionally a few of those on the ventral surface are yellowish; mid tibiae without bristle near apex; fifth ventral abdominal segment as in Plate XIV, Figure 18_____dasythrix.

6. Pteropleura bare_____ 7.

Pteropleura hairy_____ 9.

7 Cross veins of the wings not infuscated; hairs on dorsum of abdomen black, contrasting sharply with those of venter and lower part of pleura, which are pale yellow and silky; legs black_____crinita.

Cross veins of wings conspicuously infuscated; legs in great part yellow or reddish_____ 8.

8. Large species, averaging 10 mm. in length; legs vinous in color, femora in large part black; all hairs on abdomen fuscous; apical spur on hind tibia very strong and much curved_____rubicunda.

Smaller species, averaging 7–8 mm. in length; legs yellow, fore femora more or less blackened above; hairs on dorsum of abdomen blackish and setulose, those on venter yellow and soft; apical spur on hind tibia of moderate strength and almost straight_____furcata.

9. Frons conspicuously reddish in front; tibiae reddish or brownish; hairs on mesonotum not numerous, setulose, those on hind tibia very much shorter than the intermixed bristles, and setulose; apex of abdomen with normal hairing_____islandica.

Frons not noticeably reddish in front; tibiae black; hairs on mesonotum numerous, long and rather soft, those on hind tibiae soft and slightly curled, some of them as long as the intermixed bristles; apex of abdomen with a noticeable tuft of soft curled black hairs_____dasythrix.

Scatophaga islandica Becker. Pl. XIV, fig. 21.

Scatophaga islandica Becker, Berl. Ent. Zeitschr., vol. 39, p. 175, 1894.

Apical ventral segment of male as Plate 14, Figure 21.

This species was originally described from specimens in the Loew collection from Iceland and Labrador. Coquillett subsequently recorded it from Commander Islands and Alaska.

There are 9 specimens in the present collection from St. Paul Island with data as follows:

4 specimens, August 19, 1914 (E. A. Preble).
1 specimen, August 1, 1914 (E. A. Preble).
4 specimens, August 16, 1915 (G. D. Hanna).

Recorded by Cole (Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 172, Nov., 1921) from St. Paul Island, June 21 and August 10, 1920 (G. D. Hanna).

Scatophaga rubicunda Malloch. Pl. XIV, fig. 20.

Scatophaga rubicunda Malloch, J. R., Can. Arctic Exp., 1913–1918, vol. 3, p. 81c (1919).

Male.—Opaque black-brown. Head concolorous with thorax; frontal stripe orange red, orbits on lower portions grayish; face and cheeks reddish orange, their surfaces covered with grayish yellow pruinescence, antennae brownish black, apex of second joint on inner side reddish; proboscis glossy black; palpi reddish or yellowish. Disc of mesonotum with indications of 6 vittae, a median confluent pair on acrostichal area, a narrow line along the region of the dorso-central bristles and a broader irregular streak laterad of the latter. Hypopygium and apex of last segment reddish. Legs vinous colored, the femora except their apices darkened. Wings slightly grayish, with a yellow tinge along the costal region, the cross veins distinctly infuscated, veins reddish brown. Halteres reddish. Bristles black, the soft hairs fuscous.

Arista bare, swollen at base, apical part very slender; cheek half as high as eye, anterior angle with a group of 8 to 10 long, black hairs; palpi elongate, slightly leaflike. Thorax with long soft hairs, acrostichal bristles not distinguishable from the discal hairs, the dorso-central bristles barely so; pteropleura bare; scutellum with 4 strong marginal bristles and numerous long hairs. Abdominal hairs not so long as in *crinita*, more dense and not "crinkly"; fifth ventral plate as Plate XIV, Figure 20. Legs with long hairs; mid-tibiae with 7 long bristles distinguishable from the hairs, in addition to the apical spines, situated as follows: 2 on the antero-dorsal surface, one above the other, the upper one just below middle; 3 on the postero-dorsal surface, the upper near base; and 2 on posterior surface, in transverse line with those on the antero-dorsal surface; hind tibiae each with 6 bristles in addition to the hairs and apical spurs as follows: 3 strong ones on antero-dorsal surface, the upper one just above middle and the lower one close to tip; and 3 long hairlike ones on postero-dorsal surface, the upper one being about one-fourth from base of tibiae, the next close to middle, and the lowest one very near to apex; apical spurs bent.

Female.—Similar to the male in color. Differs from the male in having the hairs throughout shorter, stronger, and less numerous and the bristles stronger. Length, 9–10 mm.

Type.—St. George Island, June 16, 1914 (lot 34, G. D. Hanna). Paratype, St. George Island, 1 specimen, same data as type. Allotype, St. George Island, one of 2 specimens, June 4, 1914 (lot 1, G. D. Hanna); and 2 specimens June 8, 1914 (lot 8, G. D. Hanna). Lot 34 was collected toward East Rookery from village; lot 1 about fox houses and on beach among boulders along with *S. dasythrix;*

and lot 8, near village, from flowers. Recorded by Cole (Proc. Calif. Acad. Sci., 4th Ser., vol. 11, Nov. 1921, p. 173) from St. George Island, July 1 (G. D. Hanna).

This species differs from *nubifera* Coquillett in being larger and in the chaetotaxy of the mid and hind tibiae. Sometimes the femora are entirely reddish, and very rarely there are two or three long hairs present on center of pteropleura.

Scatophaga furcata Say. Pl. XIV, figs. 22 and 23.

Pyropa furcata, Say, Jour. Acad. Sci. Phila., vol. 3, p. 98, 1823.
Scatophaga squalida Meigen, Syst. Beschr. Zwiefl. Ins., vol. 5, p. 252, 1826.
Scatophaga nigricans (Macquart) Meigen, l. c. vol. 7, p. 342, 1838.
Cordylura fuscipennis Zetterstedt, Ins. Lapp., p. 733, 1840.
Cordylura fuscinervis Zetterstedt, Dipt. Scand., vol. 5, pp. 1973, 1975; 1845.
Scatophaga apicalis Curtis, Appendix to Narrative of 2d Voyage in Search of Northwest Passage, p. 76, 1835.
Cleigastra suisterci Townsend, Can. Ent., vol. 23, p. 153, 1891.

The fifth ventral segment of the male and the hypopygium are shown in Plate 14, figures 22 and 23.

This species was first described by Say from specimens obtained in Missouri. It occurs throughout North America, extending its range well into the Arctic portions, and is quite as common in Europe as in America. There is very considerable variation in size and color in this species, which has probably caused some confusion on the part of different authors. I have dissected many examples of different sizes and of varied shades of color in an attempt to find structural differences but have failed to find any that would justify me in separating even the most extreme forms. I know that the nature of the pabulum of the larvae affects the appearance of the resultant imagines, those that have had an abundance of nutritious food being large, brightly colored, and very hairy, while those that have had a supply of rather dry and poor food are smaller, darker, and less hairy.

The normal food of the larvae of this species is manure.

In the present collection there are 83 specimens with data as follows:

St. George Island.

1 specimen, April 24, 1914 (G. D. Hanna).
1 specimen, May 6, 1914 (G. D. Hanna).
1 specimen, June 16, 1914 (lot 35, G. D. Hanna).
1 specimen, June 17, 1914 (lot 42, G. D. Hanna).
4 specimens, June 24, 1914 (lot 46, G. D. Hanna).
4 specimens, June 25, 1914 (lot 47, G. D. Hanna).
14 specimens, June 27, 1914 (lot 49, G. D. Hanna).
1 specimen, July 4, 1914 (lot 52, G. D. Hanna).
1 specimen, July 8, 1914 (lot 55, G. D. Hanna).

St. Paul Island.

11 specimens, August 16, 1914 (G. D. Hanna).
15 specimens, August 1, 1914 (E. A. Preble).
35 specimens, August 19, 1914 (E. A. Preble).
3 specimens, Summer, 1914 (E. A. Preble).
14 specimens, 1916 (G. D. Hanna).

Only lot 55 is mentioned definitely as having been taken on the shore; the others are recorded as from "toward East Rookery"; "uplands near Staraya Artel"; "toward North Rookery," and "toward Zapadni."

Recorded by Cole (Proc. Calif. Acad. Sci., 4th ser., vol. 11, Nov. 1921, p. 173) from St. Paul Island, June 21 to August 10, 1920, and St. George Island, June 30 (G. D. Hanna).

Scatophaga crinita Coquillett. Pl. XIV, fig. 19.

Scatophaga crinita, Coquillett, Proc. U. S. Nat. Mus., vol. 23, p. 612, 1901.

The fifth ventral abdominal segment of the male is as in Plate 14, Figure 19.

This species was originally described from specimens obtained on Bering Island. The series of specimens in the present collection shows a very considerable variation both in the size of the different specimens and in the color of the hairs on the body, the latter varying from yellowish white to deep orange. As indicated under the previous species there very probably is some connection between these conditions and the nature of the larval pabulum.

There are 89 specimens in the collection with data as follows:

St. Paul Island.

1 specimen, May 23, 1914 (lot 154, A. G. Whitney).
3 specimens, June 11, 1913 (lot 44, A. G. Whitney).
1 specimen, July 3, 1913 (lot 60, A. G. Whitney).
1 specimen, July 22, 1913 (lot 94, A. G. Whitney).
1 specimen, Summer, 1914 (E. A. Preble).
1 specimen, August 16, 1915 (G. D. Hanna).
5 specimens, June-Aug. 1916 (G. D. Hanna).

St. George Island.

2 specimens, Sept. 3, 1913 (G. D. Hanna).
2 specimens, Sept. 6, 1913 (G. D. Hanna).
2 specimens, May 6, 1914 (G. D. Hanna).
3 specimens, June 4, 1914 (lot 1, G. D. Hanna).
1 specimen, June 8, 1914 (lot 8, G. D. Hanna).
1 specimen, June 10, 1914 (lot 9, G. D. Hanna).
6 specimens, June 14, 1914 (lot 18, G. D. Hanna).
1 specimen, June 14, 1914 (lot 19, G. D. Hanna).
16 specimens, June 16, 1914 (lot 34, G. D. Hanna).
9 specimens, June 16, 1914 (lot 26, G. D. Hanna).
1 specimen, June 16, 1914 (no number, G. D. Hanna).

7 specimens, June 17, 1914 (lot 38, G. D. Hanna).
4 specimens, June 24, 1914 (lot 46, G. D. Hanna).
10 specimens, June 27, 1914 (lot 49, G. D. Hanna).
15 specimens, July 4, 1914 (lot 52, G. D. Hanna).
1 specimen, July 8, 1914 (lot 55, G. D. Hanna).

The specimen of lot 60 was taken on Otter Island at the same time as the specimen of *S. dasythrix* bearing the same number. Lots 44 and 94 were taken on peninsulas on St. Paul Island. The specimen bearing the Hanna lot number 8 appears to have been taken on flowers (see also under *S. rubicunda*). Judging from the data pertaining to the collection this species is found both along the shore and on the uplands, many examples being obtained towards East Rookery, at Garden Cove, and towards Zapadni.

Scatophaga dasythrix Becker. Pl. XIV, fig. 18.

Scatophaga dasythrix Becker, Berl. Ent. Zeitschr., vol. 39, p. 173, 1894.

The fifth ventral abominal segment of the male is shown in Plate 14, Figure 18.

This species was originally described from specimens in the collections of Loew and Schnabl, obtained from Bering Straits. Subsequently Coquillett recorded its occurrence on Bering Island.

In the present collection there are 108 specimens with data as follows:

St. George Island.

1 specimen, August 16, 1913 (G. D. Hanna).
2 specimens, May 17, 1914 (G. D. Hanna).
62 specimens, June 4, 1914 (lot 1, G. D. Hanna).
1 specimen, June 10, 1914 (lot 9, G. D. Hanna).
10 specimens, June 16, 1914 (lot 34, G. D. Hanna).
1 specimen, July 4, 1914 (lot 52, G. D. Hanna).

St. Paul Island.

1 specimen, April 13, 1913 (lot 7, A. G. Whitney).
1 specimen, May 16, 1913 (lot 28, A. G. Whitney).
2 specimens, June 24, 1913 (lot 57, A. G. Whitney).
1 specimen, July 6, 1913 (lot 63, A. G. Whitney).
1 specimen, July 6, 1913 (lot 64, A. G. Whitney).
1 specimen, July 6, 1913 (lot 66, A. G. Whitney).
2 specimens, July 18, 1913 (lot 80, A. G. Whitney).
2 specimens, July 22, 1913 (lot 94, A. G. Whitney).
3 specimens, summer, 1914 (E. A. Preble).
2 specimens, August 19, 1914 (E. A. Preble).
1 specimen, August 1, 1914 (E. A. Preble).
2 specimens, August 16, 1915 (G. D. Hanna).
11 specimens, July–August, 1916 (G. D. Hanna).

Otter Island (6 miles from St. Paul Island).

1 specimen, July 3, 1914 (lot 60, A. G. Whitney).

Sealion Rock, or "Sivutch" Island.

10 specimens, June 29, 1914 (lot 182, A. G. Whitney).

This species appears from the number of examples and the recorded data to be the most common of those in the collection. Several examples were taken in copula and three with prey. The prey represents 3 species: *Fucellia antennata*, *Leria fraterna*, and *Leria leucostoma*. The specimens in lot 182 were taken on the grassy summit of Sea-lion Rock at a height of 60 feet.

D. W. Coquillett records from the Pribilofs (in Schwarz, E. A., in The Fur Seals and Fur-Seal Islands of the North Pacific Ocean, Part 3, pp. 550–552, 1899) one species in addition to those listed in the present paper, which, however, may be only nominally distinct: *Scatophaga diadema* Wiedemann.—W. L. M.

Family HELOMYZIDAE.

The species of Helomyzidae are usually found upon carrion or decaying vegetable matter, though certain species of the genus *Leria* have been recorded as frequenting caves where they feed upon fungi and droppings of bats. The species recorded as frequenting caves are not specialized in any manner that adapts them to this habitat and are found in other situations also. A species of the genus *Heteromyza* that has been found in caves, I have found on carrion in an open field in Scotland. The members of the genus *Eccoptomera* are found in the larval and pupal stages in underground nests of moles, and I have found the imagines there also, but I have sometimes taken the latter by sweeping the undergrowth in Scotch woods.

The family is not well represented by species in the material before me but there are a large number of specimens.

A single male of each species in the collection was taken as the prey of *Scatophaga dasythrix*. These are recorded under that species.

Aldrich and Darlington have published an extensive paper on the family.[15]

Genus *Leria* Robineau-Desvoidy.

Leria fraterna Loew.

Scoliocentra fraterna Loew, Berl. Ent. Zeitschr., p. 27, 1863.

Leria fraterna (Loew), Coquillet, Proc. Wash. Acad. Sci., vol. 2, p. 457, 1900.

Leria fraterna Aldrich and Darlington, Trans. Amer. Ent. Soc., vol. 34, p. 79, 1908.

This species, which was originally described from Sitka, Alaska, by Loew, is represented by 147 specimens in the present collection from the following localities:

St. George Island.

31 specimens, April-May, 1914 (G. D. Hanna).
23 specimens, June 4, 1914 (lot 1, G. D. Hanna).
6 specimens, June 8, 1914 (lot 8, G. D. Hanna).

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[15] Trans. Amer. Ent. Soc., vol. 34, 1908.

18 specimens, June 16, 1914 (lot 34, G. D. Hanna).
1 specimen, June 16, 1914 (lot 35, G. D. Hanna).
3 specimens, June 14, 1914 (lot 19, G. D. Hanna).
1 specimen, June 27, 1914 (lot 49, G. D. Hanna).
2 specimens, July 4, 1914 (lot 52, G. D. Hanna).
6 specimens, June 24 ,1914 (lot 46, G. D. Hanna).
1 specimen, June 14, 1914 (lot 23, G. D. Hanna).
3 specimens, June 17, 1914 (lot 42, G. D. Hanna).
1 specimen, June 10, 1914 (lot 9, G. D. Hanna).

St. Paul Island.

5 specimens, May 17, 1912 (M. C. Marsh).
13 specimens, May 16, 1913 (lot 26, A. G. Whitney).
2 specimens, May 16, 1913 (lot 24, A. G. Whitney).
6 specimens, May 19, 1913 (lot 132, A. G. Whitney).
8 specimens, May 23, 1913 (lot 156, A. G. Whitney).
1 specimen, May 23, 1913 (lot 154, A. G. Whitney).
1 specimen, July 11, 1913 (lot 70, A. G. Whitney).
2 specimens, Aug. 1, 1914 (E. A. Preble).
6 specimens, summer, 1914 (E. A. Preble).
1 specimen (see under *Scatophaga dasythrix*, lot 64, A. G. W.).

The collections were made in various portions of the islands, some of them about fox houses and on beaches, while others were made amongst grass and herbage. No indication is given as to more exact habitats.

Aldrich and Darlington give the following localities for this species:

Moscow, Idaho.
St. Anthony Park, Minn.
Montreal, Canada.
Ungava Bay, Labrador.
Hudson Bay Territory.

It has also been recorded by Coquillett as occurring in Alaska, British Columbia, and on Mount Washington, N. H. A female specimen in the collection of the Illinois State Laboratory of Natural History does not differ materially from the specimens before me; the data on this specimen is Algonquin, Ill., March 21, 1894.

Leria leucostoma Loew.

Blepharoptera leucostoma Loew, Berl. Ent. Zeitschr., p. 28, 1863.

This species, which also was originally described from Alaska by Loew, is represented by 18 specimens, as follows:

St. George Island.

2 specimens, September 2, 1913 (G. D. Hanna).
2 specimens, April 12, 1914 (G. D. Hanna).
1 specimen, June 16, 1914 (lot 35, G. D. Hanna).
2 specimens, June 8, 1914 (lot 8, G. D. Hanna).
5 specimens, July 4, 1914 (lot 52, G. D. Hanna).
1 specimen, June 27, 1914 (lot 49, G. D. Hanna).

St. Paul Island.

August 19, 1915 (G. D. Hanna).
June 29, 1914 (lot 182, A. G. Whitney).
July 6, 1914 (lot 66, A. G. Whitney).
July 27, 1914 (E. A. Preble).
August 1 and 19, 1914 (E. A. Preble).
(See under *Scatophaga dasythrix*, lot 63, A. G. W.)

Aldrich and Darlington record this species from Hampton, N. H.; White Mountains, N. H.; and Mount Constitution, Wash.; Coquillett has recorded it from Alaska and White Mountains, N. H.

Leria pectinata Loew has been recorded by Coquillett from the Pribilofs (in Schwarz, E. A., in The Fur Seals and Fur Seal Islands of the North Pacific Ocean, pt. 3, 1899, pp. 550–552).

Leria crassipes Loew has been recorded by Cole (Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 173, Nov., 1921), from St. Paul Island, July 4 and August 10 (G. D. Hanna). However, it is doubtful if this species occurs in North America; the specimens recorded are almost without doubt *leucostoma* Loew.

Leria sp.

A female recorded by Cole (Proc. Calif. Acad. Sci., 4th Ser., vol. 11, p. 173, Nov., 1921), as "near *iners* Meigen" from St Paul Island, June 10 (G. D. Hanna).

Family BORBORIDAE.

The species comprising this family live in the larval state in manure, fungi, carrion, and decaying vegetable matter. One species has been recorded as living in ants' nests and another in water collected in epiphytic bromeliads. From the data accompanying the specimens in the present collection I assume that the species conform to the most general mode of life, i. e., pass the larval stage in decaying vegetable matter or in manure.

Genus *Borborus* Meigen.

This genus is represented by two species: *annulus* Walker and *subapterus* n. sp. The former has the normal borborid habitus but the latter has the wings much abbreviated and is thus readily separated from any described species occurring in North America. To facilitate the identification of *annulus*, which is rather poorly described by Walker, it is redescribed herewith.

Cole records (Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 173, Nov., 1921), two species of this family from the Pribilof Islands, "one a *Copromyza* (*Borborus*) and the other a *Leptocera*, but the specimens are in poor condition for identification."

Borborus annulus Walker.

Borborus annulus Walker, List Ins. Brit. Mus., Diptera, pt. 4, p. 1129, 1849.

Male and female.—Black, shining, with a slight olivaceous tinge. Head black, frontal triangle and orbits slightly shining, brownish pruinescent, center stripe opaque black, anteriorly reddish, face brown, reddish or yellowish at base of vibrissae, distinctly brownish pruinescent; antennae black or slightly brownish. Mesonotum with yellowish pruinescence which does not obscure the shining black ground color. Abdomen glossy black. Legs black, yellow on apices of coxae, trochanters, extreme bases of femora, bases of tibiae (broadly), apices of tibiae (narrowly), and entire tarsi. In addition to these yellow markings there is generally a similarly colored narrow band near the apices of the middle and hind femora which is not mentioned in the original description. Wings slightly yellowish, veins brown, crossveins broadly infuscated. Halteres brownish yellow.

Frons as broad as its length at center; orbits each with two slender bristles directed outward over eyes; center stripe with numerous setulose hairs, especially on anterior portions of opaque areas; antennae of moderate size, third joint rounded anteriorly; arista with sparse but distinct pubescence, entire length of arista about twice that of anterior width of frons; face concave in profile, distinctly produced between antennae and with a rounded central keel; labrum distinctly protruded; proboscis large and fleshy; vibrissa long, buccal bristle shorter than vibrissa, upwardly directed. Mesonotum with 3 pairs of dorso-centrals and between these 4 longitudinal rows of short setulose hairs; scutellum with 4 marginal bristles. Abdomen broad and short, first visible segment elongated; male hypopygium of moderate size, protuberant, its surface with numerous short hairs. Legs rather long, fore and mid femora slightly thickened and perceptibly bent; mid femora with 3 bristles near apex on the anterior surface; mid tibiae with a series of 6–7 short bristles from base to apex on antero-dorsal surface; hind tibiae with an outstanding setulose hair on the antero-ventral surface beyond middle, a distinct but slender preapical dorsal bristle and a rather weak apical thornlike spur; basal joint of hind tarsi thickened and about two-thirds as long as second. Distance from humeral cross-vein to end of first vein about one-third as long as next costal division and slightly longer than third; inner cross-vein slightly before middle of discal cell; last section of fourth vein slightly longer than preceding section; outer cross-vein upright; fifth vein not extending to margin of wing. Length 3.5–4 mm.

Originally described from "York Factory and St. Martin Falls," Canada. Aldrich states that the last named locality is now known

as Martin's Falls and is located "in longitude 86.30, latitude 51.30, in other words, about 200 miles north of the northern arch of Lake Superior" (Cat. Dipt. N. Amer., p. 66). Coquillett has since recorded the species from Popof Island, Alaska, and Schwarz lists it from Pribilof Islands. The species is represented in the material before me by 32 specimens with data as follows:

St. George Island.

2 specimens, April 17, 1914 (G. D. Hanna).
13 specimens, June 4, 1914 (lot 2, G. D. Hanna), Taken on very wet soggy ground near Village landing.
3 specimens, June 14, 1914 (lot 23, G. D. Hanna), Garden Cove.
4 specimens, June 16, 1914 (lot 36, G. D. Hanna), Toward East Rookery from village.
2 specimens, same date as last (lot 35, G. D. Hanna).

St. Paul Island.

3 specimens, May 16, 1913 (lot 27, A. G. Whitney), taken in Company House bathroom.
4 female specimens, May 23, 1914 (lot 153, G. D. Hanna), from privy.
2 specimens taken in the summer of 1914, one marked lot 210, A. G. Whitney, and other collected by E. A. Preble.

Borborus subapterus, n. sp. Pl. XV, fig. 27.

Female.—Black, shining; venter of abdomen and stems of halteres brown. Wings brown. Frons distinctly longer at center than its greatest width; frontal triangle and orbits shining, center stripe opaque; each orbit with 2 long slender bristles which are very slightly outwardly directed; center stripe with hairs much as in *annulus;* antennae rather above the average size, third joint disclike; arista very slender, distinctly but sparsely pubescent, entire length of arista about 1½ times that of anterior width of frons; hairs on basal joint of antenna long and fine; face concave in profile, distinctly keeled; labrum much protruded, vibrissa very long and slender; buccal bristle short and hairlike, upwardly directed. Mesonotum with numerous rather long discal hairs which obscure the 3 pairs of dorso-centrals; scutellum with 4 weak marginal bristles. Basal abdominal segment not noticeably elongated; all segments with very few short hairs. Legs slightly elongated; fore and hind femora noticeably stronger than mid pair; mid tibiae with 3 bristles, a pair about one-fourth from apex, one of which is on the antero-ventral and the other on the postero-ventral surface, and one on the dorsal surface near apex; hind tibiae with weak, hairlike preapical bristle, and weak, almost straight, apical spur; basal joint of hind tarsi much dilated and over two-thirds as long as second; surfaces of all legs with numerous soft hairs. Wings abbreviated, extending to middle of fourth abdominal segment; venation as in Plate XV, Figure 27. Length 3.5 mm.

Male.—Agrees with the female in color and general structure. Differs in having the abdomen robust, and obtusely rounded at apex, with the hypopygium of moderate size.

Type locality.—St. George Island, June 16, 1914, "toward East Rookery from village." (Lot No. 36, G. D. Hanna.) Two paratypes, St. George Island, along Garden Cove Creek (G. D. Hanna).

Borborus pedestris Meigen, a European species, has the wings much shorter than the present species, scarcely longer than the scutellum, and differs also in color. *Leptocera nivalis* Haliday, a species belonging to an allied genus and also European, occurs in winter generally and has the faculty of leaping exceptionally developed.

Genus *Leptocera* Olivier.

This genus is listed as *Limosina* Macquart by Aldrich. *Leptocera* is, however, an older name for the same genus and must replace it in our lists as indicated by Coquillett in his paper on "The Type-species of North American Diptera."[16] *Leptocera* was erected in 1813 and *Limosina* in 1835. There is a single species represented in the present material.

Leptocera limosa Fallen.

Copromyza limosa Fallen, Dipt. Suec., Heteromy, 8, 6 (1820).

Three specimens that evidently belong to this species were taken by G. D. Hanna on St. George Island; two bear the label Lot No. 2, and one Lot No. 11, the former being taken along with *Borborus annulus*, June 4, 1914, "on wet soggy ground near the Village landing," and the latter, June 10, 1914, "near beach at East landing."

Bremi found the larvae in confervae in Europe (Schiner).

Aldrich records the species in his Catalogue from New Jersey, White Mountains, N. H., and Montreal, Canada. I have taken the species in Illinois and it is probably of general occurrence in the United States.

Family PHYCODROMIDAE.

The members of this family resemble very closely the genus *Borborus* in general habits and have, by some of the older authors, been treated as belonging to the same family under the name Copromzidae. In addition to resembling them in appearance they also have very similar habits, feeding mainly upon decaying vegetable matter, but I have never found species of *Coelopa* away from the seashore or the shores of a tidal river while *Borborus* and other genera of that family may be met with in almost any locality where a suitable pabulum is obtainable. *Coelopa* is the only genus so far recorded

[16] Proc. U. S. Nat. Mus., vol. 37, p. 559, 1910.

from North America. Of the three species recorded two are considered as identical with two of those occurring in Europe and those are the species represented in the present collection.

Genus *Coelopa* Meigen.

Coelopa frigida Fallen. Pl. XII, fig. 1.

Copromyza frigida Fallen, Dipt. Suec., Hydrom., p. 6, 1820.
Coelopa frigida Zetterstedt, Dipt., Scand., vol. 6, p. 2472, 1847.
Coelopa simplex Haliday, Ent. Mag., vol. 1, p. 167, 1833.

This species is represented by 28 specimens in the collection. The data upon the labels are as follows:

St. Paul Island.

7 specimens, August 19, 1914 (E. A. Preble).
1 specimen, August 1, 1914 (E. A. Preble).
5 specimens, summer, 1914 (E. A. Preble).
2 specimens, summer, 1914 (lot 210, A. G. Whitney).
1 specimen, May 23, 1914 (lot 156, A. G. Whitney).
3 specimens, August 16, 1914 (G. D. Hanna).

St. George Island.

2 specimens, June 16, 1914 (lot 35, G. D. Hanna).
1 specimen, June 17, 1914 (lot 42, G. D. Hanna).
3 specimens, June 14, 1914 (lot 19, G. D. Hanna).
3 specimens, May 6, 1914 (G. D. Hanna).

Coelopa eximia Stenhammer. Pl. XIV, fig. 25.

Copromyza eximia Stenhammer, K. vetensk, Akad. Handl., p. 318, 1854.
Coelopa frigida Haliday, Ent. Mag., vol. 1, p. 167, 1833.

This species is represented by 13 specimens in the collection. All were taken on St. Paul Island and bear the following data:

1 specimen, May 23 (lot 154, A. G. Whitney).
2 specimens, August 1 (E. A. Preble).
2 specimens, August 19 (E. A. Preble).
1 specimen, summer, 1914 (lot 210, A. G. Whitney).
4 specimens, August 16, 1915 (G. D. Hanna).
2 specimens, August 16, 1915 (G. D. Hanna).
1 specimen, July 7, 1917 (G. D. Hanna).

There has been considerable confusion in this genus because of misidentification by various authors in the early part of the nineteenth century. Schiner probably had his synonymy more exact than any previous author and his names have been accepted by the present writer.

Coquillett recorded *frigida* and *nitidula* Zetterstedt from Alaska.[17] This *nitidula* is the species I record as *eximia*. Hagen has recorded *frigida* from Massachusetts,[18] and Coquillett has recorded it from

[17] Proc. Washington Acad. Sci., vol. 2, p. 460, 1900.
[18] Can. Ent., vol. 17, p. 140, 1885.

the Commander Islands.[19] Cole records (Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 174, Nov. 1921), *C. parvula* Haliday from St. Paul Island, June 8 and 21, 1920 (G. D. Hanna). This also is the species listed here as *eximia.*

A key for the separation of the three North American species is given herewith as there is no previous synopsis available to students which includes all three.

Key to North American species of Coelopa.

1. Males ..... 2.
   Females ..... 4.
2. Legs without strong bristles, covered with long woolly hairs, those on hind tibiae very conspicuous; cheeks rather densely covered with soft hair, not bristly ..... eximia.
   Femora and tibia with numerous strong bristles; cheeks with numerous bristles which are shorter posteriorly ..... 3.
3. Mid tibiae with numerous strong bristles on entire surface except ventrally, the ventral surface with moderately long soft hairs; hind tibiae with slightly stronger bristles than mid pair; bristles on hind femora extending to base ..... frigida.
   Mid tibiae with very long woolly hairs especially on ventral surface, only 2–3 bristles present on apical half of anterior surface; hind tibiae with very conspicuously stronger armature than mid pair, the bases of bristles slightly tuberculate; bristles on hind femora confined to apical half (Cresson, Calif.) ..... vanduzeei.
4. Fore and hind femora and tibiae with conspicuous bristles ..... vanduzeei.
   Fore and hind femora and tibiae without conspicuous bristles ..... 5.
5. Cheeks and fore femora with uniform soft hairs ..... eximia.
   Cheeks bristly; fore femora with soft hairs, conspicuous among which are several longer, moderately strong bristles on the antero-dorsal surface ..... frigida.

Family SCIOMYZIDAE.

There is one species in the collection that in certain respects resembles some of the species in the family Helomyzidae, but which because of the absence of the vibrissae and of the costal spines must be placed in the Sciomyzidae. It agrees with no described genus in the latter family, so that I am forced to erect a new genus for its reception.

The larvae of the Sciomyzidae, so far as I know them, are aquatic or live in damp earth, usually on the margins of streams or ponds, and feed upon decaying vegetable matter. There is nothing in the records pertaining to the present material that indicates the larval habits of the species, as they bear only the date of collection.

Genus *Pseudosciomyza*, n. gen.

Generic characters.—Frons broad; orbits with 3–4 bristles; post vertical bristles divergent; second antennal joint much shorter than

[19] Rept. on Fur Seals and Fur Seal Islands, pt. 4, p. 345, 1899.

third; third joint distinctly longer than broad (arista missing). face receding toward mouth margin; eye small, round, barely highe. than cheek. Thorax with the following bristles: 1 humeral, 2 noto pleural, 1 presutural, 2 pairs dorso-central, 1 prealar, and 2 postalar scutellum with 4 bristles; propleurum with a bristle; stigmatal bristle absent; mesopleura unarmed; sternopleura with numerous long hairs none of which can be considered as bristles. Legs hairy, without distinct bristles except those at apices of mid and hind tibiae, the former stronger than the latter and noticeably curved. Costa unspined; inner cross vein before apex of first vein, sixth vein reaching margin of wing. Genotype, the following species.

Pseudosciomyza hannai Cole.

Dryomyza hannai Cole, Proc. Calif. Acad. Sci., vol. 11, p. 174, 1921.

Male.—Brownish black, subopaque, head yellowish brown; vertex and occiput with dense grayish pruinescence; frons orange brown, darker posteriorly; orbits pruinescent; face and cheeks testaceous yellow; third antennal joint slightly brownish. Thorax with rather dense yellowish gray pruinescence. Abdomen more brownish than thorax, the surface slightly shining and with but little pruinescence; apices of segments narrowly yellowish. Legs reddish brown; femora slightly darkened. Wings faintly yellowish, noticeably so on each side of humeral vein and between apices of auxiliary vein and first; cross veins with very indistinct yellowish marginal suffusion. Halteres pale yellow.

Frons slightly over half the width of head; orbits slightly differentiated, each with 3–4 bristles which are directed slightly outward; center stripe with numerous black, setulose hairs; antennae rather short, not descending much below level of eyes; face slightly carinate. upper mouth margin arched; labrum small, protruded tongue-like; proboscis fleshy; palpi rather broad, hairy; disc of thorax with numerous long setulose hairs among which it is difficult to distinguish the bristles; sternopleurum with long hairs on its entire surface. Abdomen with long and rather strong hairs on all segments; hypopygium rather large, knob-like. Legs stout, the femora noticeably so, hairy; tarsal claws long. Wings elongate, their length exceeding that of insect from head to tip of abdomen, and equal to 3 times their greatest width; first costal division about 1.5 that of second, the two combined exceeding in length that of third; second vein ending well in front of wing tip; third vein ending very close to apex of wing; inner cross vein about three sevenths from apex of discal cell; last section of fourth vein about 1.5 that of penultimate section.

Female.—See Cole's description (op. cit.).

Length, 5 mm. St. Paul Island, 4 specimens, August 19, 1914 (E. A. Preble); 1 specimen, August 1, 1914 (E. A. Preble).

This genus has the clypeus well developed and protuberant, and because of this character, runs to the subfamily Dryomyzinae in Melander's recent key to the genera of Tetanoceridae[20]. It is separable from *Helcomyza* Curtis by the absence of costal spines and the mid tibial bristling and from the other two genera by the lack of posterior bristles on mid tibiae, and bristling of scutellum and dorsum of thorax.

This genus and species have been in manuscript since 1915, but the species was described by Cole from material collected on St. Paul Island August 20, 1920. The author of the species indicated that its position in the genus *Dryomyza*, in which he placed it, was doubtful, which is correct.

Family TRYPETIDAE.

The species comprising this family are phytophagous in the larval stage; feeding in stems, roots, leaves, flowers, or fruits, and giving little or no indications of their presence, while others make their presence evident by the formation of galls upon the roots or stems, or by causing large blotches upon the leaves within which they feed. There is in the collection before me one species which appears to be undescribed. Loew has recorded *Spilographa flavonotata* Macquart, and *Tephritis angustipennis* Loew from the Yukon River, Alaska; and Coquillett in addition to describing *Trypeta flavcola* from Commander Islands has recorded species from Canada and northern and western States of the Union, some of which may occur in Alaska, but it is very improbable that any of them will be found on the islands covered by the present investigation because of their connection with certain food plants which do not occur on these islands.

Genus *Acidia* Robineau-Desvoidy.

The genera *Acidia* and *Spilographa* are in my opinion not validly separable. The only difference between the genotypes, which I have examined, lies in the arrangement of the thoracic dorsocentral bristles. In *Acidia* the four bristles in front of the scutellum are more nearly in a transverse line than they are in *Spilographa*. The very faint distinction between the wing markings of the two so-called genera is too trivial to warrant their generic separation.

I retain the generic name *Spilographa* in the references to species in the following paragraph as it is under that name that the species have been recorded in the literature.

The European *Spilographa alternata* Fallen lives in rose hips, some of the genus live in fruits of *Berberis*, while *S. zoe* Meigen and *S.*

[20] Ann. Ent. Soc. Amer., vol. 13, p. 307, 1921.

artemisae Fabricius in the larval stages mine in leaves of *Artemisia* and allied plants. The North American species *electa* Say, is found in the larval stage in berries of *Solanum carolinense*. The larval habit of the species before me is not known but it is undoubtedly a phytophagous species.

Acidia uncinata Coquillett. Pl. XV.

Puparium (Pl. XV, fig. 37).—Length 4.5 mm., diameter at middle 2.25 mm. Color, pale yellowish white, slightly shining. Surface of segments very minutely transversely rugulose, appearing except under a high magnification as entirely smooth. Dorsal thoracic segments as in Plate XV, Figure 33, the second and third with small scalelike setulae on their anterior margins arranged in short, slightly curved, transverse series. All segments each with a slightly irregular transverse series of very small, rounded, raised areas which are rather widely separated and each of which is armed at apex with a weak hair. Apex of abdomen as in figure 35; spiracles slightly elevated, each with 3 rather conspicuous, black, slits (Pl. XV, fig. 35).

Imago.—Male: Brownish testaceous, shining. Head including antennae and palpi pale yellowish testaceous, center stripe of frons opaque, darker than face, lower orbits subopaque, upper orbits and triangle shining. Thorax and abdomen distinctly shining, the former with slight yellowish pruinescence; humeri paler than disc of thorax; postnotum with a large blackish spot on each side. Legs yellowish testaceous. Wings with blackish or brownish markings as follows: A brown spot beyond humeral vein, a similarly colored spot filling the space between apex of auxiliary vein and apex of first vein and extending posteriorly as far as second vein but not connecting on the disc with the fusiform spot covering the inner cross vein, the latter extending in an almost straight line to costa, filling the entire cell to apex of second vein and distinctly indicated along the anterior margin of the cell between second and third veins, apex of wing infuscated, outer cross vein enclosed in a brown suffusion. Hairs and bristles black.

Upper frontal orbits elongated, their lower extremities extending beyond apex of ocellar triangle; lower orbits each with 3 bristles; eye about 1.5 times as high as long; cheek about one-sixth the height of eye. Thoracic chaetotaxy normal. Fore femora with ventral bristles, the other pairs unarmed; hind tibiae without dorsal setulae, only a few weak hairs present. First and third wing-veins setulose, the latter with setulae extending well beyond inner cross vein; apex of third vein very noticeably curved backward; inner cross vein at less than one-third from apex of discal cell.

Length, 4.75 mm.

Locality.—St. Paul Island, 1 male, spring 1913 (A. G. Whitney, Lot 35); 1 male and empty puparium, May 23, 1914 (A. G. Whitney, Lot 163); and 1 puparium, fall 1913 (A. G. Whitney, Lot 103). Recorded by Cole (Proc. Calif. Acad. Sci., 4th ser., vol. 11, Nov. 1921, p. 175) from St. Paul Island, August 10 and 12, 1920 (G. D. Hanna). Originally described from Fort Wrangel, Alaska.

Lot 35 in list is given as "Found dead on moss and liverwort specimens from Tolstoi Hill." Lot 163, "Grassy bankside near Village wells. One cocoon and fly. These yellow, ribbed cocoons found everywhere in lower part of moss beds and among their roots; a moist location." Lot 103 "On *Coelopleurum*. These pupae common everywhere under and amid thick damp moss on tundra all through the summer season."

The cocoons referred to are the puparia of this trypetid. It seems remarkable that the puparia should be so very common as stated above and that only 2 flies are in the collection.

The puparium of this species has a very well defined lateral fusiform area, a character that one might in a measure associate with the family Ortalidae if Bank's paper on the larvae of Diptera were used as a guide to the identity of this stage.[21] It is therefore pertinent to point out that the paper in question provides only characters for the identification of such species as might reasonably be expected to occur in the stomach of man as accidental introductions with food and is not intended to cover the entire Muscoidea. A number of species in Ortalidae have no clearly defined lateral fusiform areas and the anal stigmatical areas are not noticeably elevated, while some Trypetidae have both distinct lateral fusiform areas and more or less elevated anal stigmatical areas.

Family SEPSIDAE.

The members of this family so far as they are known live in decaying animal or vegetable matter or in preserved foods or meats. The only genus represented in the present collection is *Piophila*.

Genus *Piophila* Fallen.

Of the species in this genus one at least is of economic importance because of its common occurrence in cheese and preserved meats. The larvae are able to leap short distances and the species is popularly known as the Cheese Skipper (*Piophila casei*). This species, which probably originated in Europe, has been found in human graves and is distributed throughout the whole of Europe, and North America from Alaska to Mexico. Several other European species occur in North America. One of the species in the present collec-

[21] U. S. Dept. Agric., Bur. Ent., Tech. Ser. 22, 1912.

tion was found in the skull of a dead seal, and in this connection it may be of interest to record that several species are found in carcasses of dogs and other animals that are not uncommon on the shores of rivers, especially near the sea, in Britain. One species I have taken in such situations I have met with nowhere else.

Piophila anomala, n. sp. Pl. XV.

Larva.—Not preserved. Cephalopharyngeal skeleton as in Plate 15, Figure 36; dissected from puparium.

Puparium (Pl. XV, fig. 31).—Length, 3.5–4 mm. Reddish brown, slightly shining. Surface with fine transverse rather irregular rugae (fig. 31). Anterior respiratory organs very small. Segmentation rather indistinct. Posterior spiracles with 3 rather indistinct slitlike openings; apex as in Plate XV, Figure 32. The entire body without distinguishable hairs or setulae.

Imago.—Male and female.—Glossy black. Head, with the exception of the upper portion of frons, the occiput and posterior portion of cheeks, reddish yellow; palpi yellow; third antennal joint brownish. Legs black, yellow on extreme bases and apices of all femora, the bases of all tibiae and basal 3 joints of mid and hind tarsi. Wings clear, veins yellowish. Calyptrae whitish. Halteres yellow.

Male.—Frons distinctly narrowed anteriorly; orbits each with 2 bristles, the anterior one weaker than the posterior; disc of frons with a few weak hairs; second antennal joint with a rather long apical dorsal hair, third joint rounded; arista indistinctly pubescent; vibrissa as long as arista; cheek nearly half as high as eye. Mesonotum with 2 dorso-centrals; scutellum with 4 bristles. Hypopygium small. Legs rather stout, fore tarsi not appreciably thickened. Venation normal.

Female.—Agrees in color with the male. Ovipositor long and slender.

Length, 3.75 mm.

Type.—St. George Island, July 4, 1914 (Lot 52, G. D. Hanna); toward Zapadni Rookery. Allotype and puparium, St. Paul Island (Lot 176, A. G. Whitney). The data attached to this lot is as follows: "Near Village. One fly and several pupa cases. The pupa cases were found June 14 in the interstices of the nasal bones of a fur seal skull on the 'killing field.' From these one fly hatched out June 20." Paratypes, St. George Island, 2 specimens, August 4, 1914 (G. D. Hanna); St. Paul Island, 1 specimen, August 19, 1914 (E. A. Preble).

This species differs essentially from others in the genus in having the frontal orbits each with 2 distinct bristles. *P. casei* Linnaeus usually has the frons much darker and only exceptionally have the

orbits any hairlike setulae. The disc of thorax in *anomala* is glossy black, with a slight bluish tinge, and the surface has rather uniform short hairs. In this respect the species agrees closely with *nigriceps* Meigen, but the latter has the face blackened and the scutellum flattened and transversely rugulose. The scutellum in *anomala* is convex and smooth. *P. casei* differs from both *anomala* and *nigriceps* in having the thorax subopaque, with 3 slight longitudinal grooves in which there are a series of short hairs, the remainder of disc being bare and with a slight olivaceous tinge.

The foregoing notes are drawn from a comparison with North American specimens of *casei* and *nigriceps* named by Coquillett. I have no European examples of the species.

Since the completion of the manuscript of this paper a revision of the family has appeared by A. L. Melander and A. Spuler.[22] The species described herein will run down to *oriens* Mel. and Spul. in their key to species of *Piophila*, but the legs are differently colored in my species, the fore coxae in *anomala* being mostly black and the mid and hind tibiae largely blackened, whereas in *oriens* the fore coxae and mid tibiae are entirely yellow and the hind tibiae and the tarsi less broadly blackened, all of the mid tarsi and the basal 4 joints of the hind pair being yellow.

There is a narrow dorso-central stripe on abdomen of *anomala* which is transversely rugose; no mention is made of this in description of *oriens*.

Cole records *Piophila oriens* (Proc. Calif Acad. Sci., 4th ser., vol. 11, Nov. 1921, p. 176) from St. Paul Island, August 10, 1920 (G. D. Hanna). *Oriens* was described from New York and Massachusetts.

Piophila sp.

A female taken by G. D. Hanna, June 16, 1914 (lot 36), on St. George Island, differs from the foregoing in having the antennae black; the cheeks higher, rugose posteriorly; the humeri and center of scutellum slightly reddish; and the legs darker. Unfortunately there is but one poorly preserved example, so I refrain from giving it a name.

In several respects the specimens agree fairly well with the description of *pilosa* Staeger, a species recorded from Greenland. The male of *pilosa* is distinguished from allied species by the rather conspicuous short pilosity, which is especially noticeable on the abdomen, and by the black antennae and very dark legs. The female is less noticeably pilose. *Nigerrima* Lundbeck, a species described from Greenland, differs from all others so far described in being entirely black.

[22] Bull. 143, Washington Agri. Exp. Sta., 1917.

Family EPHYDRIDAE.

The species of this family are aquatic in habit, the larvae being found in liquids or in mud. Some few species are met with in the larval stage as miners in stems or leaves of aquatic or marsh plants. The species in the present collection are similar to those that frequent moist ground, and in all probability the larvae will be found in the wet mud or water about which the adults occur. Many of the species are flower frequenters in the adult stage.

Genus *Scatella* Robineau-Desvoidy.

This genus contains a large number of species which are met with even more commonly in the Old World than in the New. The great majority of the species so far described have the wings either with dark spots on a clear ground or clear spots on a dark ground. The species in the present collection differs from these groups in having the wings unspotted. *Scatella setosa* Coquillett and *S. stagnalis* Fallen, the two species recorded from Alaska, belong to the group with clear spots on the wings.

Scatella brunnipennis, n. sp.

Male and female. Subopaque brown. Face, yellowish brown, much paler than frons, the latter greenish anteriorly in well preserved specimens, cheeks and lower part of back of head slightly gray dusted. Thorax slightly shining on disc anteriorly in well preserved specimens with bluish or greenish luster, entirely opaque on pleura; mesonotum without distinct vittae, abdomen brown, slightly shining at base, becoming glossy on second segment and noticeably polished towards apex, the whole with a distinct bronzy reflection. Legs, brownish black, femora with slight grayish pruinescence. Wings subfuscous, unspotted; veins, dark brown. Halteres brown or yellow.

Frons seen from above over 3 times as wide as either eye; 2 strong orbital bristles on each side; center stripe above and orbits with a number of short setulose hairs; third antennal joint barely longer than broad; arista short, scarcely exceeding length of antenna, its pubescence very short; face very decidedly convex, with numerous short bristles, those on mouth margin and on a line with eye margin but some distance from it, most distinct; no string bristle on cheek. Humeral area with a few setae; notopleural bristles 2 in number; dorso-centrals 3, the anterior and middle pairs less widely separated than posterior pair, acrostichals in 2 regular, complete rows; dorso-central line filled in between bristles with short setulae; mesopleura

with 1 strong bristle and a number of hairs, those on posterior margin directed backward and those on upper margin directed upward; sternopleurum with 1 strong bristle; scutellum subtriangular, flattened on disc, anterior pair of bristles not very much shorter than posterior pair. Abdomen with sparse, short, surface hairs. Legs normal. Wings slightly longer than entire insect; distance from humeral vein to end of first vein barely more than one-fourth as great as next costal division; both costal breaks distinct; venation similar to that of *stagnalis*.

Length, 2–3 mm.

Type locality.—St. Paul Island, August 16, 1915, 60 specimens (G. D. Hanna). Other paratypes as follows:

St. Paul Island.

11 specimens, August 1, 1914 (E. A. Preble).
15 specimens, August 19, 1914 (E. A. Preble).

St. George Island.

8 specimens, June 4, 1914 (lot 2, G. D. Hanna).
1 specimen, June 16, 1914 (lot 32, G. D. Hanna).

This species strongly resembles *quadrisetosa* Becker, differing, however, in the yellow instead of gray face and the absence of the strong metallic color of the lower part of the frons. *Quadrisetosa* is a Norwegian species that has not been recorded from this side of the Atlantic, except by Cole (Proc. Calif. Acad. Sci., 4th ser., vol. 11, Nov. 1921, p. 176) and of his specimens, which came from St. Paul Island June 21 and August 10, 1920 (G. D. Hanna) he says they "seem to answer the description of this form."

Genus *Parydra* Stenhammer.

A genus which is well represented in Europe and North America; the larvae live in stagnant water, and the adult flies are found in marshy situations.

Parydra metallica Cole. Pl. XV, fig. 26.

Parydra metallica Cole, Proc. Calif. Acad. Sci., 4th ser., vol. 11, p. 176, Nov. 1921.

This species was in manuscript for several years in this paper, but has been described by Cole as above.

It is an aberrant species and may reasonably be removed from *Parydra*, but I do not consider it pertinent to do so in this paper.

Originally described from St. George Island, June 28, 1920 (G. D. Hanna). In the present collection it is represented by three specimens from the same island, June 4 and 16 (lots 2 and 36, G. D. Hanna).

Family DROSOPHILIDAE.

The known larvae of the species of this family feed upon decaying vegetable matter, exuding sap of trees, in fermenting liquids, and rarely in leaves of living plants.

There is a single species in the present collection.

Genus *Drosophila* Fallen.

Drosophila graminum Fallen.

Drosophila graminum Fallen, Geomyzides, p. 8, 1823.

A female of this species taken on St. Paul Island, August 16, 1915 (G. D. Hanna), has the thoracic stripes well defined and in every respect agrees with the dark forms occurring in the United States.

Family AGROMYZIDAE.

There is but a single species of this family in the collection. It belongs to the genus *Phytomyza*, the species of which are, so far as known, phytophagous in the larval stage, usually mining in the leaves of various plants, or living in the froth of Cercopidae.

Phytomyza obscurella Fallen.

Phytomyza obscurella Fallen, Phytomyzides, 4, 1823.

I have considerable doubt about the identity of this species. Melander has had an opportunity of comparing Alaskan and European examples of this species and considers the forms *ilicicola* Loew and *nigra* Meigen as varieties of *obscurella*, listing both as occurring in Alaska. The recorded food plants of the varieties suggest confusion of species—*ilicicola* on holly, *obscurella* on honeysuckle and elder, and *nigra* on *Primula veris* and *Heracleum sphondylium*. In view of the facts that I have no European examples of *obscurella* for comparison and that I have no record of the food plant of the Alaskan species and have not had opportunity to compare the larvae and pupae of the different forms, I leave the matter as it is, merely calling attention to the element of doubt in the matter of the recorded occurrence of *obscurella* in Alaska and the sinking of *ilicicola* and *nigra*, as varieties of *obscurella*.

There are 7 examples that I place under this species name provisionally. The data are as follows:

St. George Island.

3 specimens, June 16, 1914 (lot 32, G. D. Hanna).
4 specimens, August 16, 1915 (G. D. Hanna).

Agromyza parvicella Coquillett.

This species was originally described from St. Paul Island,[23] but no specimens were found in the present collection.

Immature Stages of Diptera.

Suborder Orthorrhapha.

Division NEMATOCERA.

Family CHIRONOMIDAE.

There are a few specimens of larvae of Chironomidae in alcohol, brief descriptions of which are appended.

Genus *Chironomus* Meigen.

Chironomus sp. I.

Length, 10–12 mm. Color in life red. Head about 1½ times as long as broad, tapered anteriorly, eye spot duplicated; antennae 5-jointed, basal joint about 4 times as long as its diameter, second joint as long as diameter of basal, third joint about as broad as long, much shorter than fourth and subequal in length to apical joint; labrum with 4 long hairs on each side of center anteriorly, the downward projecting margin with fine teeth; transverse comb consisting of 9 rather large rounded teeth; mandibles with 3 large dark teeth and a subapical dorsal and median paler pair; labrum similar to that of *decorus* Johannsen. Anal ventral blood gills absent; anterior and posterior pseudopods well developed; dorsal anal papillae large; each armed with about 6 long hairs.

St. Paul Island, 11 specimens, August 10, 1913 (lot 98, A. G. Whitney).

The data for this lot are as follows:

About 10 larvae from mud of dried-up pond where *Leucosticte* had been scratching for them. This pond about one-quarter mile long and 18 inches deep was dry from August 5 to mid-September. During this time its whole mud bottom was scratched over by turnstones to get at these larvae which were abundant. Color of the larvae ruby-red.

Genus incertus.

There are several larvae in the collection that I do not know the genus of. They differ from any larva known to me in having the apical abdominal segment armed with several concentric series of stout hooks, the area so armed being but slightly elevated and resembling that present on larvae of Simuliidae. The head, however, is of the normal Chironomid type and there is no possible doubt as to its relationship with that family. The head is short and broad, slightly tapering anteriorly; the antennae are of moderate length, the basal joint short and stout, not twice as long as its diameter, the

[23] Coquillett, D. W., Journ. New York Ent. Soc., vol. 10, p. 189, 1902.

second very slender, about one-third as thick as basal and about one-third longer than it, apical portion consisting either of one joint or 2 very closely fused, the length of which is about equal to the diameter; apex of basal joint with a stout process which tapers appreciably apically and is as long as second joint; mandibles with 5 teeth; labium with a large rather irregularly rounded central tooth and a much smaller rounded one on each side; labrum with 2 pairs of stout protruded ventral processes.

Length, 4–6 mm.

St. Paul Island.

7 specimens, March 23, 1913 (lot 5, A. G. Whitney).
1 specimen, April, 1913 (lot 10, A. G. Whitney).

The specimens in lot 5 were found in the bottom of a bag in which willows and mosses had been collected. It is possible that this is the larva of *Smittia* but more data are necessary before a reliable opinion can be expressed.

Family LIMNOBIIDAE.

Among the alcoholic material in the collection there is a larva that has puzzled me considerably. The head is complete and in most respects resembles that of members of the Mycetophilidae, having the typical very short antennae, apically subtruncate. toothed mandibles, and tapering dorsal cephalic plate. Were I judging from the head alone I should undoubtedly place the species in the Mycetophilidae but the respiratory system to all appearance is confined to prothoracic and anal spiracles, the apical abdominal segment has 4 distinct finger-like protuberances, and the whole of the body is covered with soft decumbent hairs, characters that associate it in my mind with Trichocera of the Limnobiidae, usually considered a subfamily of the Tipulidae.

In the absence of pupae and imagines of this species it is not possible for one to place it definitely, as our knowledge of the early stages of the order, although increasing slowly, is not such that we can identify more than a mere fraction of the species in the larval stage.

St. Paul Island: 1 specimen, March 23, 1913 (lot 5, A. G. Whitney).

Found along with some chironomid larvae in the bottom of a bag in which willows and mosses had been collected.

Suborder **Cyclorrhapha.**

Division SCHIZOPHORA.

Family CALLIPHORIDAE.

A single example of a large calliphorid puparium is in the collection. As no examples of the adults of this family are before me I

can not attempt to associate it with any species. Muscids are treated in the paper following.

Length, 11.5 mm. Reddish testaceous. Cephalic and caudal extremities slightly tapering; segments well differentiated; anterior margins of segments with very short spines; lateral fusiform area narrow; spiracles with straight slits which open almost directly laterad, disclike basal elevation not distinguishable; margin of spiracular area elevated so that the spiracles are in a cavity; spiracular field with 12 distinct tubercles on margin, 6 above, the largest being the inner and outer pair in top row and the 2 outer on each side of bottom row; anal opening with a large conical protuberance on each side.

St. Paul Island: May 1, 1913 (lot 17, A. G. Whitney).

EXPLANATION OF PLATES XII–XV.

Plate XII.—Flies (Cyclorrhapha).

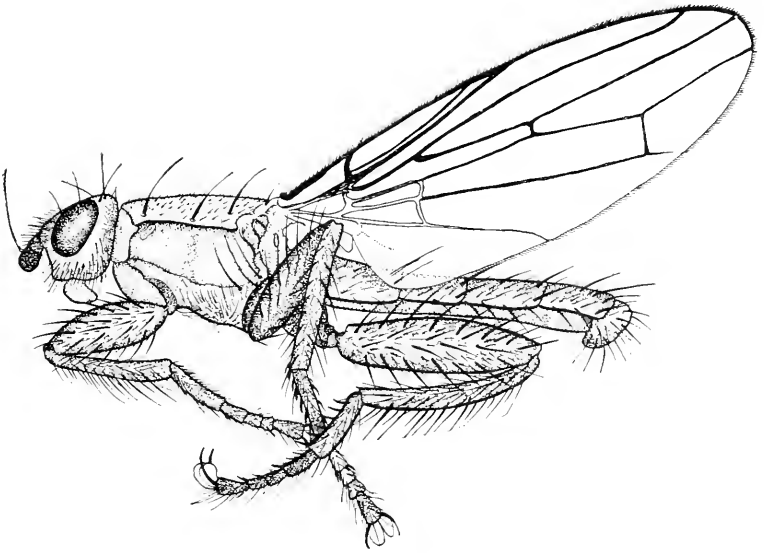
Fig. 1. *Coelopa frigida* (male). Fig. 2. *Pogonota kincaidi* (male).

Plate XIII.—Details of Flies and Midges (Nematocera and Brachycera).

Fig. 3. *Sciara glacialis*, hypopygium of male, apical portion of one side.
Fig. 4. *Sciara* sp. Same as Figure 3.
Fig. 5. *Smittia arctica*, hypopygium of male, one side.
Fig. 6. *Chironomus obtusilobus*. Same as Figure 5.
Fig. 7. *Smittia arctica*, antennae of male.
Fig. 8. *Smittia arctica*, antenna of female.
Fig. 9. *Allodia subelata*, hypopygium of male, one side.
Fig. 10. *Orthocladius obumbratus*, hypopygium of male, apex of dorsal plate.
Fig. 11. *Tanytarsus similatus*. Same as Figure 10.
Fig. 12. *Smittia arctica*, wing of male, with more enlarged section of costa.
Fig. 13. *Chironomus conformis*, hypopygium of male, superior process and apex of lateral arm.
Fig. 14. *Exechia casta*, hypopygium of male, one side.
Fig. 15. *Rhamphomyia opacithorax*, hypopygium of male, lateral view.
Fig. 16. *Chironomus deviatus*, hypopygium of male, one side; *a*, apex of superior process.

Plate XIV.—Details of Flies (Cyclorrhapha).—Figures 17–21, apical ventral abdominal plate of males; Figures 23–25, hypopygia.

Fig. 17. *Scatophaga stercoraria.*
Fig. 18. *Scatophaga dasythrix.*
Fig. 19. *Scatophaga crinita.*
Fig. 20. *Scatophaga rubicunda.*
Fig. 21. *Scatophaga islandica.*
Fig. 22. *Scatophaga furcata.*
Fig. 23. *Scatophaga furcata.*
Fig. 24. *Scatophaga stercoraria.*
Fig. 25. *Coelopa eximia.*



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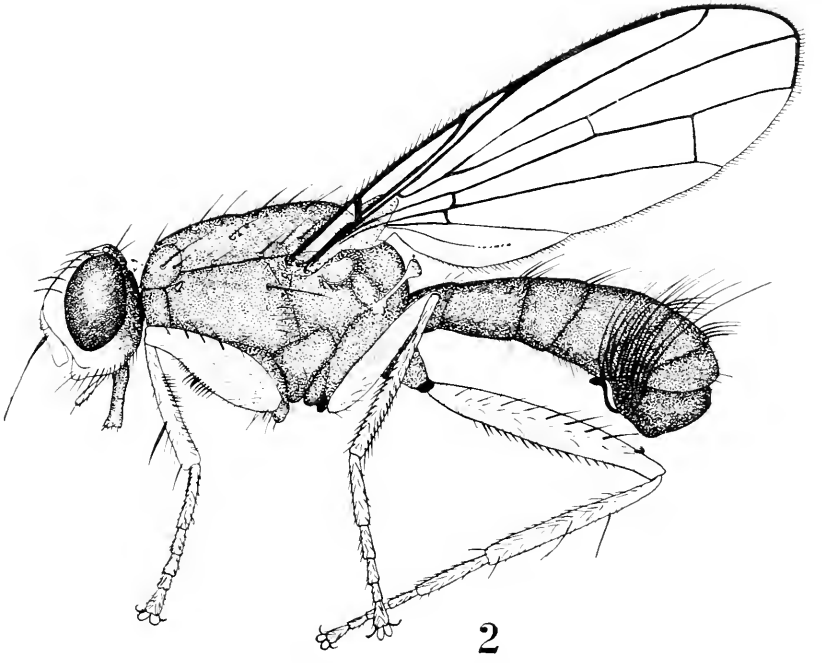

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FLIES (CYCLORRHAPHA).

Fig. 1. Coelopa frigida, male. Fig. 2. Pogonota kincaidi, male.

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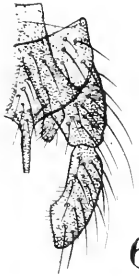

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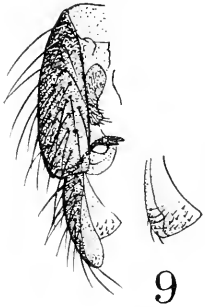

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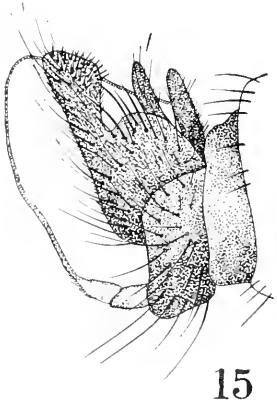

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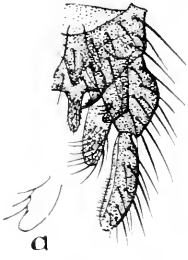

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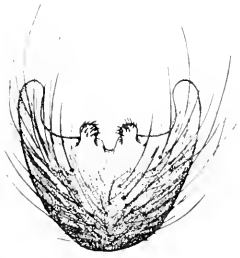
DETAILS OF FLIES AND MIDGES (NEMATOCERA AND BRACHYCERA).

(Explanation on page 226.)



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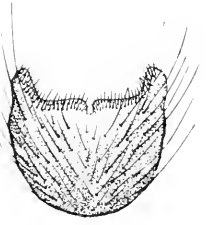

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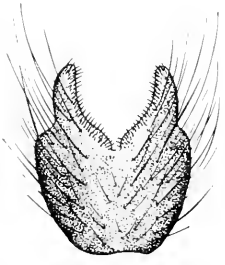

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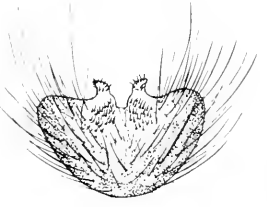

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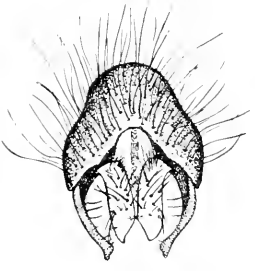

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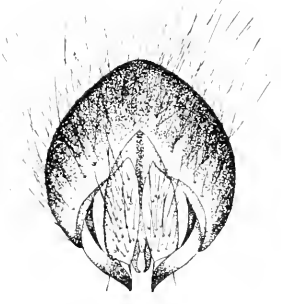

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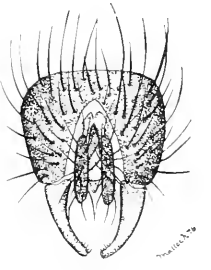

25

DETAILS OF FLIES (CYCLORRHAPHA).

(Explanation on page 226.)

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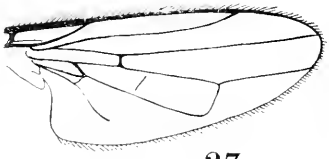

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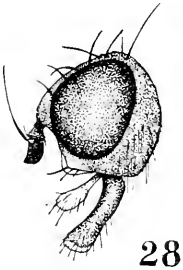

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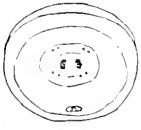

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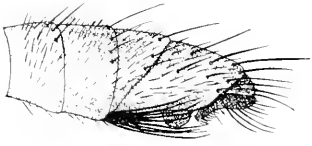

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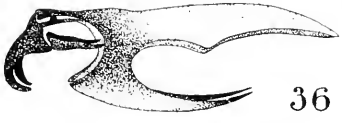

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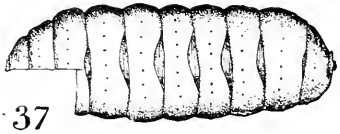

37

DETAILS OF FLIES (CYCLORRHAPHA).

(Explanation on page 227.)

Plate XV.—Details of Flies (Cyclorrhapha).

Fig. 26. *Parydra metallica*, head.
Fig. 27. *Borborus subapterus*, wing.
Fig. 28. *Allomyella brevipennis*, head.
Fig. 29. *Helina hannai*, anal opening of puparium.
Fig. 30. *Helina hannai*, apex of puparium, end view.
Fig. 31. *Piophila anomala*, puparium, dorsal view.
Fig. 32. *Piophila anomala*, end view.
Fig. 33. *Acidia uncinata*, puparium, dorsal view of thoracic segments and respiratory organs; *a*, opening of latter enlarged; *b*, spines of segments, enlarged.
Fig. 34. *Hydrophoria alaskensis*, abdomen of male, lateral view.
Fig. 35. *Acidia uncinata*, apex of puparium, end view, and spiracular slits enlarged.
Fig. 36. *Piophila anomala*, larval head parts.
Fig. 37. *Acidia uncinata*, puparium, lateral view.

DIPTERA.

Suborder Cyclorrhapha.

Division SCHIZOPHORA.

Family CALLIPHORIDAE.

By W. R. Walton, *In Charge Cereal and Forage Insect Investigations, Bureau of Entomology.*

Cynomyia hirta Hough.

This species was originally described from St. Paul Island by Hough. It has also been recorded from Popof Island and Kodiak, Alaska, by Coquillett. It closely resembles *C. mortuorum* Linn. of Europe, but is evidently distinct.

The specimens before me exhibit a considerable variation in size, i. e., 10–16 mm. They were collected on both St. George and St. Paul Islands from June 24 to August 26.

Calliphora vomitoria Linnaeus.

This species has been recorded by Coquillett as occurring in Alaska as follows: Sitka, Kukuk Bay, Popof Island, and Seldovia. This is the species mentioned in the list of Diptera as *Calliphora obscoena* Esch. in the report on the Fur Seal Islands.

It inhabits also northern Europe, Canada, and the northeastern portion of the United States. Specimens were collected on both St. George and St. Paul Islands, from July 3 to September.

The tachinid *Muscopteryx obscura* was described by D. W. Coquillett (New Diptera from North America, Proc. U. S. Nat. Mus., vol. 25, p. 116, Sept. 12, 1902) from St. Paul Island, and afterwards made the type of a new genus, *Alaskophyto*, by C. H. T. Townsend (Can. Ent., vol. 47, no. 9, p. 285, Sept. 1915).—W. L. M.

Cole records (Proc. Calif. Acad. Sci., 4th Ser., vol. 11, p. 171, 1921) *Didyma pullata* van der Wulp from St. Paul Island. There is no such species, but evidently *pullula* van der Wulp is intended. Van der Wulp's species, which is not a *Didyma*, is recorded from Mexico; and Coquillett's record of it from Alaska is erroneous. In all probability, therefore, the species does not occur in the Pribilofs.—J. R. M.

HYMENOPTERA.

By HENRY L. VIERECK, *Assistant Biologist, Bureau of Biological Survey.*

In the following list, records of the species with a reference letter[24] are taken from published reports and those without a reference letter are here published for the first time. Where the type locality of a species is in these islands the species is preceded by an asterisk (*).

Suborder Chalastogastra.

SUPERFAMILY TENTHREDINOIDEA.

Family XYELIDAE.

Megaxyela?

Determined by S. A. Rohwer. One head from St. Paul Island, from the stomach of *Arquatella ptilocnemis*, No. 14119.

Family TENTHREDINIDAE.

*** Amauronematus isolatus** Kincaid.(*b*)

Determined by S. A. Rohwer. ♀, St. Paul Island, June, 1913. A. G. Whitney, Lot 55.

***Amauronematus whitneyi** Rohwer.

Type.—St. Paul Island, Bering Sea, April 15, 1914. 1 ♀, A. G. Whitney, Lot 122.

Amauronematus sp.

Determined by S. A. Rohwer. Probably the same as the preceding. St. Paul Island, May 27, 1915, from the stomach of *Stercorarius longicaudus* (No. 135031, Biological Survey stomach collection).

Pachynematus gotarus Kincaid.

Determined by S. A. Rohwer. 3 ♀ 4 ♂, St. George Island, June 27, 1914 (G. Dallas Hanna), 2 ♂, both Lot 49; and 2 ♀, one, Lot 49; one, Lot 21.

Pachynematus sp.

One male "does not seem to be described." Determined by S. A. Rohwer. St. George Island, June 14, 1914 (G. Dallas Hanna).

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[24] The reference letters have relation respectively to (*a*) Ashmead, W. H., Hymenoptera of Alaska, Proc. Washington Acad. Sci., vol. 4, pp. 117–274, May 29, 1902; and (*b*) Kincaid, T., Tenthredinoidea of the Expedition, same journal, vol. 2, pp. 341–346, Nov. 24, 1900. The sawflies here listed with Rohwer as author were described in Proc. U. S. Nat. Mus., vol. 57, pp. 212, 216, 1920.

Pteronidea melanostoma Rohwer.

Type.—St. George Island, Bering Sea, June 14, 1914. 1 ♀ G. D. Hanna (Lot 21; Lot 12 according to original description).

Dolerus konowi MacGillivray.

Determined by S. A. Rohwer. St. Paul Island, summer, 1914. A. G. Whitney, Lot 202, 1 ♀.

Dolerus sp.

Determined by S. A. Rohwer. 1 ♀, St. Paul Island, summer, 1914. (E. A. Preble.)

Suborder Clistogastra.

Superfamily ICHNEUMONOIDEA.

Family VIPIONIDAE.

***Apanteles (Protapanteles) alticola** Ashmead. [a]

***Apanteles (Protapanteles) congestiformis**, n. sp.

Type locality.—St. Paul Island, May 29, June 20, 1913 (A. G. & E. G. Whitney, lot No. 50), cocoons collected May 29, 1913.

Female.—Length 2.5 mm. Related to *A.* (*P.*) *carduicola* (Packard) and may prove to be at most a race of *A.* (*P.*) *congestus* (Nees.), from which it differs in its mostly black fore femora. Shiny, partly polished, partly pale sericeous; head above mostly polished, indistinctly sculptured, face almost polished, finely indistinctly punctured, without a median welt, labrum blackish, basal half of mandibles black, the apical half mostly reddish, antennae black throughout except for the pale joint between the pedicel and flagel, palpi dark stramineous; thorax mostly closely punctured, the punctures shallow and adjoining or nearly adjoining, scutel almost impunctate, polished, sparsely punctured, posterior half of mesopleura mostly polished, impunctate, wings with a faint brownish tinge, almost colorless, stigma brownish stramineous, veins dull stramineous with a smoky tinge, transverse cubitus a little longer than the first abscissa of the radius, tegulae black, legs black or blackish except for the distal trochanter of the fore legs, the apical fourth of fore tibiae and all of the remaining tibiae and most of the tarsi which are rather pale brownish stramineous, end joints of the tarsi blackish as are the penultimate and antepenultimate tarsal joints of the fore and mid legs, metapleura with the anterior half mostly polished, the posterior half not nearly so coarsely reticulated as propodeum; propodeum shiny, rather coarsely reticulated and with a distinct median longitudinal carina; abdomen with its first and second plates more or less sculptured, the first plate finely wrinkled, partly indistinctly punctured, partly longitudinally striate, second plate not so definitely

sculptured, the succeeding tergites highly polished, abdomen black throughout, ovipositor hardly exserted.

Allotopotype.—Essentially as in the type, except that the legs are black or blackish throughout except for the yellowish annulus near the base of the tibiae. Cocoons imbedded in a mass of pale lemon-tinted floss.

Family ALYSIIDAE.

***Gyrocampa alaskensis** Ashmead.(a)

Family BANCHIDAE.

Enizemum tibiale (Cresson).(a)

Family BRACONIDAE.

Ichneutes reunitor Nees.

Two specimens from St. George Island, June 14, 16, 1914, (G. Dallas Hanna, lots 22 and 36.)

Family ICHNEUMONIDAE.

***Monoctonus paulensis** (Ashmead) (a) (=*Aphidius*).

Many specimens from St. George Island. One, April 7, 1914 (emerged apparently from an empty aphid skin preserved with this specimen) (A. G. Whitney, lot 120); the remaining specimens were collected June 4, 10, 16, 1914, and are labeled, respectively, G. Dallas Hanna, lots 2, 11, 28, and 32.

***Aphidius propinquus** Ashmead(a)=(*A. frigidus* Ashmead).

Five specimens from St. George Island, June 10, 16, 1914, August 16, 1915 (G. Dallas Hanna, lots 11, 12, and 32).

***Praon alaskensis** Ashmead.(a)
***Catastenus alaskensis** Ashmead.(a)
Catastenus trifasciatus Ashmead.(a)
Mesochorus frontalis Ashmead.(a)
Campoplegidea laticinctus Cresson.(a)
***Hypocryptus variegatipes** Ashmead.
Cteniscus clypeatus Cresson.(a)
***Polyblastus glacialis** Ashmead.(a)
Mesoleius stejnegeri Ashmead.(a)
***Calliphrurus minor** Ashmead.(a)
***Calliphrurus affinis** Ashmead.(a)
***Calliphrurus clypeatus** Ashmead.(a)
***Tryphon alaskensis** Ashmead.(a)
Stenomacrus borealis Ashmead.(a)
Stenomacrus sp.

Two specimens from St. George Island, June 16, 17, 1914 (G. Dallas Hanna, lots 32, 37).

Stenomacrus sp.

One specimen from St. George Island, July 8, 1914 (G. Dallas Hanna, lot 55).

*Orthocentrus nigritus Ashmead.[a]

Atmetus insularis Ashmead.[a]

Deleter flavifrons Ashmead.[a]

*Neuroteles dubiosus Ashmead.[a]

*Hypoleptus alaskensis Ashmead.[a]

*Synoplus pleuralis Ashmead.[a]

*Synoplus brevipennis Ashmead.[a]

*Lissonota alaskensis Ashmead.[a]

*Gelis obesus Ashmead=(*Pezomachus*).

Gelis sp.

One female from St. Paul Island, August 31, 1914, from the stomach of *Pisobia aurita* (No. 134907, Biological Survey stomach collection).

*Gelis nigrellus Ashmead[a]=(*Pezomachus*).

Atypical females representing at most perhaps only a dark variety of this species were collected as follows: St. George Island, June 8, 10, 1914 (G. Dallas Hanna, Lot Nos. 8 and 11, respectively); St. Paul Island, August 16, 1915 (G. Dallas Hanna).

Gelis sp.

One female from St. Paul Island, August 31, 1914, from the stomach of *Pisobia aurita* (No. 134907) represents a species presumably related to *G. posthumus* Foerster.

*Mesoleptus kincaidi Ashmead[a]=(*Exolytus*).

Mesoleptus niger Ashmead[a]=(*Exolytus*).

*Mesoleptus perplexus Ashmead[a]=(*Exolytus*).

*Xestophyes nigripes Ashmead[a]=(*Xestophya*).

St. Paul Island, Summer, 1914 (A. G. Whitney, Lot 205).

*Xestophyes polita Ashmead[a]=(*Xestophya*).

*Polyrhembia sanctipauli Ashmead[a]=(*Exolytus*).

Two specimens from St. Paul Island, August 31, 1914, from the stomach of *Heteroscelus incanus* (No. 134917, Biological Survey stomach collection).

Polyrhembia sp.

Three specimens from St. Paul Island, August 31, 1914, from the stomach *Pisobia aurita* (No. 134907, stomach collection).

Seleucus sp.

One female from St. Paul Island, August 27, 1914, from the stomach of *Arquatella philocnemis* (No. 126723, stomach collection). Apparently not represented in any published key to species of this genus.

Bachia nigra Ashmead.[a]

Bachia sp.

One female from St. Paul Island, summer 1914. (E. A. Preble.) Presumably related to *Phygadeuon longigena* Thomson.

Scinacopus sp.

One male and its cocoon from St. Paul Island, near Polovina Lake, March 29, 1914 (A. G. Whitney, Lot 115), "Pupa in brown papery cocoon brought home in bunch of lichens and hatched out in vial." Presumably related to *Phygadeuon perfusor* (Gravenhorst).

Zaphleges sp.

One male from St. Paul Island, August 16, 1915 (G. Dallas Hanna). Also presumably related to *Phygadeuon perfusor* (Gravenhorst).

***Plesignathus rubrocinctus** Ashmead[a] = (*Plesiognathus*).

Plesignathus sp.

One female from St. George Island, September 6, 1913 (G. Dallas Hanna). Presumably related to *Phygadeuon vagans* Gravenhorst.

Plesignathus sp.

One male from St. George Island, September 6, 1913 (G. Dallas Hanna). Presumably related to *Phygadeuon brachyurus* Thomson.

***Bathymetis simulator** Ashmead.[a]

Bathymetis quadriceps Ashmead.[a]

***Bathymetis confusa** Ashmead.[a]

***Bathymetis simillima** Ashmead.[a]

St. Paul Island, August 16, 1915 (G. Dallas Hanna); St. George Island, August 4, 1914 (G. Dallas Hanna.)

Bathymetis rubrocincta Ashmead.[a]

***Bathymetis simulans** Ashmead.[a]

***Bathymetis imitator** Ashmead.[a]

***Bathymetis nigricornis** Ashmead.[a]

***Stiboscopus mandibularis** Ashmead.[a]

***Stiboscopus alaskensis** Ashmead.[a]

***Stiboscopus sanctipauli** Ashmead.[a]

Stiboscopus sp.

One male from St. Paul Island, August 16, 1915 (G. Dallas Hanna). Presumably related to *Phygadeuon liosternus* Thomson.

*Pezoporus trifasciatus Ashmead[a]=(*Microcryptus*).

Stibeutes nigrita Ashmead.[a]

*Isochresta unicincta Ashmead.[a]

*Theroscopus rufipes Ashmead.[a]

*Habromma nigrum Ashmead.[a]

*Aclastus rufipes Ashmead.[a]

Acrolyta aciculata Ashmead.[a]

Caenomeris? sp.

One female, St. Paul Island, August 16, 1915 (G. Dallas Hanna). Presumably related to *Aclastus minutus* (Bridgman.)

*Spinolia minuta Ashmead.[a]

*Centeterus dorsator Ashmead.[a]

Amblyteles (Pterocormus) alpestriformis, n. sp.

Type locality.—St. Paul Island, Telegraph Hill, June 22, 1913; spring and summer of 1915 (A. G. Whitney, Lot Nos. 54, 174, 208). Presumably related to *P. alpestris* (Holmgren).

Female.—Length 9 mm.; colored somewhat like *Pterocormus? disparilis* (Cresson), from the original description of which it differs as follows: Head reddish, except for the cheeks, malar space, and antennal basin, all of which are mostly black; mandibles reddish, blackish at base and apex; palpi fuscous; antennae blackish, except for the basal fourth, which is mostly reddish, without an annulus; apical third of antennae with the joints slightly faceted above; thorax with its tegulae stramineous, without a yellow line before and beneath; scutel and postscutel reddish; wings subhyaline, brownish; veins and stigma pale brownish stramineous; legs mostly reddish; coxae and trochanters mostly black; hind coxae reddish above; end joint of tarsi brownish; propodeum slightly concave posteriorly, without lateral angles; propodeal carinae well defined; areola wider in front than behind, nearly quadrate, slightly rounded, emarginate behind; areola rather indefinitely, coarsely sculptured; abdomen finely reticulated, its punctures mostly from adjoining to two puncture widths apart; second tergite apically, fifth basally, and third and fourth tergites broadly down the middle, black; second and third tergites without yellow spots; sixth and seventh tergites with a median yellow spot; post-petiole dullish, finely sculptured, almost impunctate.

Other locality.—St. George Island, August 4, 1914 (G. Dallas Hanna).

Amblyteles (Pterocormus?) cervulus Provancher.[a]

SUPERFAMILY CYNIPOIDEA.

Family FIGITIDAE.

Alloxysta alaskensis Ashmead.[a]

Alloxysta sp.

From St. Paul Island, August 15, 1914 (No. 126733).

***Tetrarhapta alaskensis** Ashmead.[a]

St. Paul Island, August 16, 1915 (G. Dallas Hanna).

SUPERFAMILY CHALCIDOIDEA.

Family MYMARIDAE.

Anaphes sp.

Two specimens of a species 924 μ long and apparently related to *A. hercules* Girault, the largest North American species. St. George Island, Staraya Artel Rookery, June 17, 1914 (G. Dallas Hanna, Lot 37).

Family PTEROMALIDAE.

***Eutelus confusus** Ashmead.[a]

"**Habrocytus capreae** Swederus."

This is probably what is intended by *Tridymus capreae* L. in Schwarz's report (Fur Seals and Fur Seal Islands, Part 3, p. 550, 1899).

Asaphes sp.

St. Paul Island, August 16, 1915 (G. Dallas Hanna).

Pterosema sp.

One male from St. Paul Island, Tolstoi Hill, spring 1913, "probably about May 20," from pupae in grass stems growing in shelter of rock crevices, emerged in warmth of laboratory (A. G. Whitney, Lot 33).

Family MISCOGASTERIDAE.

Stictomischus sp.

One female from St. Paul Island, August 16, 1915 (G. Dallas Hanna).

***Terobia vulgaris** Ashmead.[a]

SUPERFAMILY SERPHOIDEA.

Family CERAPHRONIDAE.

***Lygocerus alaskensis** Ashmead.[a]

Family BELYTIDAE.

*Zelotypa scutellata Ashmead.[a]

Zelotypa sp.

From St. Paul Island, August 15, 1914 (No. 126733).

Family SERPHIDAE.

*Serphus nigripes Ashmead.[a]

St. Paul Island, August 16, 1915 (G. Dallas Hanna).

Serphus sp.

St. George Island, August 4, 1914 (G. Dallas Hanna).

SUPERFAMILY APOIDEA.

Family APIDAE.

Bremus (Bremus) kincaidi Cockerell.

Many females and workers from St. Paul Island, as follows: Females, October 11, 1912 (A. G. Whitney, Lot 2); May 31, June 5, 1913 (A. G. Whitney, Lots 113 and 36, respectively); workers, July 23, 1913 (A. G. Whitney, Lot 95).

In the report on G. D. Hanna's 1920 Pribilof collection, A. D. MacGillivray describes (Proc. Calif. Acad. Sci., Fourth Ser., 11, pp. 188–192, Nov., 1921) 6 new species of sawflies under the following names: *Pontania sucta, P. stipata, P. subatrata, P. sublorata, Pachynematus venustus,* and *P. vernus.*—W. L. M.

ARACHNIDA.

By NATHAN BANKS, *Museum of Comparative Zoology. Harvard University.*

(Plate IX, figs. 1–7—see p. 158.)

Suborder **Acarina.**

Family BDELLIDAE.

Bdella frigida Banks.

St. George Island, July 9.

Cyta brevirostris Koch.

St. Paul Island, April.

Family ERYTHRAEIDAE.

Erythraeus tonsus Koch.

St. Paul Island, July 19, on *Lathyrus maritima.*

Family PARASITIDAE.

Parasitus borealis Koch. (Pl. IX, figs. 5 and 7.)

St. Paul Island, May 16 and 19; May 23, on flies; June 26.

Macrocheles arcticus Kramer and Neuman.

St. Paul Island, May 23, in moss; September 13, on chickweed.

Family IXODIDAE.

Ceratixodes putus Cambridge.

St. Paul Island, July 4, on *Rissa t. pollicaris*, also May 17 and June 30; and St. George Island, Aug. 4.

Family ORIBATIDAE.

Galumna lucens Koch.

St. Paul Island, July 17, on chickweed; Sept. 13, on chickweed.

Oribatella borealis Banks.

St. Paul Island, July.

Notaspis serrifrons, n. sp. (Pl. IX, fig. 2.)

Yellowish, cephalothorax subtriangular, with large submedian lamellae, each ending in a long bristle, a pair of short apical bristles, superior bristles long and fine; pseudostigmatic organ short and capitate; the front margin of cephalothorax has a row of about

15 sub-equal teeth. Abdomen nearly globose, without hairs; ventral apertures nearly circular, the genital fully twice its length in front of the twice larger anal aperture; coxal plate with two lines each side; legs short, with simple hairs.

Length .5 mm.

From St. Paul Island, July (Whitney).

Scutovertex nigrofemoratus Koch.

Numerous specimens from St. Paul Island, Aug. 16.

Hermannia reticulata Thor.

St. Paul Island, July.

Nothrus sp.

Young from St. Paul Island, June.

Lohmannia scabra Koch. (Pl. IX, fig. 4.)

St. Paul Island, April 5; October on *Erytrichium chamissonis*.

Family TYROGLYPHIDAE.

Dermacarus sp. (Pl. IX, fig. 1.)

Hypopi from St. Paul Island, July 5, on *Sorex pribilofensis*.

Tyroglyphus whitneyi, n. sp. , (Pl. IX, fig. 6.)

Hypopus.—Very similar to *T. lundbecki* Trag. from Greenland. The body, however, is not, or is only a trifle broader at humeri than at the hind coxae. The hind legs are situated only a little in front of the sucker-plate, and when extended behind reach fully to tip of the body. The plate is similar to that of *T. lundbecki* except that the median pair of suckers are very much larger than the others, in fact more than twice as large as any others. (Pl. IX, fig. 6.)

Length, .2 mm.

From St. Paul Island, on *Bombus*, May 31 (Whitney coll.).

Family LISTROPHORIDAE.

Myocoptes musculinus Koch.

St. Paul Island, November 16, on house mouse.

Family ANALGESIDAE.

Analges sp.

Females from St. Paul Island, April, without host.

Suborder **Phalangida**.

Family PHALANGIIDAE.

Leptobunus borealis Banks.

Common on both St. Paul and St. George Islands from the first of June till fall.

Suborder **Araneida.**

Family AGELENIDAE.

Tegenaria derhami Scopoli.

St. Paul Island, May 11, and "Summer"; St. George Island, June 27.

Family THERIDIIDAE.

Bathyphantes pogonias Kulczynski.

From St. Paul Island, July 3.

Microneta ululabilis Keyserling.

St. George Island, June 17 and September.

Erigone arctica White.

Several from St. Paul Island, summer.

Erigone psychrophila Thorell.

Several from St. George Island, July 4.

Erigone sp.

Two females from St. George Island, July 4, and August 4, another from St. Paul, August 17.

Hilaira glacialis Thorell. (Pl. IX, fig. 3.)

From St. Paul Island, May 19; I give a figure of the male palpus.

Lepthyphantes sp.

One female St. George Island, August 4.

Ixodes arcticus, a tick parasitic upon the fur seal, was described from the Pribilof Islands by Herbert Osborn (The Fur Seals and Fur-Seal Islands of the North Pacific Ocean, Part 3, pp. 553–554, 1899).

Opinions differ as to the limits of the spider family Linyphiidae, and Dr. R. V. Chamberlin has published a paper on the "Linyphiidae of St. Paul Island, Alaska" (Journ. New York Ent. Soc., vol. 29, no. 1, pp. 35–43, pls. 3–4, March, 1921), in which he records 11 species. Five of these are described as new, in addition to 3 new genera.

These spiders are herewith listed:

Cornicularia clavicornis Emerton.
Erigone sibirica Kulczynski.
Oedothorax septentrionalis Kulczynski.
Oedothorax nesides Chamberlin.
Aigola Chamberlin.
Aigola pauliana Chamberlin.
Aigola tuberella Chamberlin.
Anitsia Chamberlin.
Anitsia abjecta Chamberlin.
Arctilaira Chamberlin.
Arctilaira bellans Chamberlin.
Tmeticus armatus Banks.
Microneta heathi Chamberlin.
Bathyphantes brevipes Emerton.

—W. L. M.

[For Plate IX (Arachnida) and explanation of plate, see page 158.]

CHILOPODA.

By RALPH V. CHAMBERLIN, *Museum of Comparative Zoology, Harvard University.*

No diplopod has been found on the Pribilof Islands and it is not likely that any occurs there naturally. Four species of chilopods, however, are natives of the islands, two of these being apparently abundant. One of these, the geophiloid *Linotaenia*, is widespread in North America from middle latitudes in the United States northward through Canada to Alaska and the adjacent islands, and, if not identical with, is certainly extremely close to, the widespread Eurasian species *Linotaenia attenuatus* (Leach). The northern specimens present certain differences from southern forms in both hemispheres as pointed out below. The lithobiid is apparently Asiatic in origin and does not conform generically to any truly North American genus as conceived by the writer. The other two species, both geophilomorphous forms, appear to be much less common. *Pachymerium ferrugineum* is a form widespread throughout the Eurasian and North American regions, having a range very similar to that of the Linotaenia; but the fourth species, the Escaryus, is thus far known from only a single specimen taken on St. Paul Island.

Lithobiomorpha.

Family LITHOBIIDAE.

Ezembius, gen. nov.

Body conspicuously narrowed cephalad; the first dorsal plate narrower than the head but wider than the second plate.

Head with marginal interruptions. Antennae short; articles normally twenty.

Ocelli in several series; single ocellus little if any larger.

Prosternal teeth 2+2 or 3+3; sinus V-shaped; ectal spines bristle-like.

Coxal pores circular; 3, 3, 3, 3, to 6, 7, 7, 6 in number.

None of the posterior coxae laterally armed; but two or more pairs commonly dorsally armed. Anal legs each with two tarsal claws. Ventral spines of anal legs normally 0, 1, 3, 2, 0; dorsal 1, 0, 3, 1, 0. Dorsal spines of penult legs 1, 0, 3, 1, 1. Tibiae of all legs excepting the anal dorsally armed, commonly the tibae of the first two pairs bearing a single spine, the others caudad to the antepenult pair bearing two spines.

Tarsi in fully grown specimen more or less clearly divided.

Neither anal nor penult legs of male with a definitely developed process or lobe.

Claw of female gonopods short, trilobed, the lobes normally short and inconspicuous or the lobes obsolete and the claw entire or subentire; basal spines 2+2, slender.

Small and medium sized species.

Genotype.—Lithobius stejnegeri Bollman.

Among other species apparently congeneric with this type form is a group of Siberian species embracing, e. g., the following described by Stuxberg: *ostiacorum*, *princeps*, *sulcipes* (see below), and *scrobiculatus*.

Ezembius stejnegeri (Bollman).

Lithobius stejnegeri Bollman, Bull. U. S. Nat. Mus., 46, p. 199, 1893.
Lithobius sulcipes Bollman, loc. cit., p. 199, 1893.
Monotarsobius arcticus Attems, Arkiv. for Zool., V. no. 3, p. 19, 1909.
Lithobius (*Archilithobius*) *haasei* Attems, 1909, op. cit., p. 22, 1909.
Lithobius sulcipes Chamberlin, Canad. Ent., p. 260, 1911.

Of this species there are in the collection sent me for study by the Bureau of Biological Survey eight specimens from St. Paul Island, four of these being adult males, two adult females, and two young females in the *immaturus* stage, apparently differing by one moult. There are also five adults from St. George Island (collected Aug. 4, 1914, by E. A. Preble). I have also studied several specimens of this form secured on St. Paul Island in 1910 by Prof. Harold Heath. In addition to the specimens from the Pribilof Islands, I have examined and compared material from Bering Island, the type locality, Copper Island, Popof Island, and other islands of the region. More recently I have received from the Bureau several additional specimens collected in the group by G. Dallas Hanna.

After a careful study I am unable to detect more than one species in the material from these localities, and am convinced that the *sulcipes* of Bollman, certainly the *Monotarsobius arcticus* of Attems, and the *Lithobius* (*Archilithobius*) *haasei* of Attems, all described from Bering Island, are one and the same as *E. stejnegeri*, which in turn may prove to be identical with *L. sulcipes* Stuxberg (1875), and likely with the much earlier *L. sibiricus* of Gerstfeldt (1858), later fixed by the description of Haase (1880). In the present note, however, I have given above only the synonymy of forms described or recorded from the islands in or adjacent to Bering Sea, and reserve the question of the Siberian species until more abundant material from that region can be studied. The *M. arcticus* of Attems is separated from *stejnegeri* for the single stated reason that the ventral spines of the anal legs of the latter species are given as 1, 3, 2, 6 instead of 1, 3, 2, 0, as in *articus*. The 6 in the first formula, as might

have been surmised, is clearly a misprint for 0, the types of *stejnegeri* all having the formula for anal legs 1, 3, 2, 0, so that there remains no evident ground whatsoever for maintaining *arcticus*. Attems refers his specimens to Monotarsobius; but the tarsi in the larger specimens of the species are quite clearly biarticulate, though in smaller individuals the division in the anterior tarsi may not be distinct or may be but partial. *Lithobius* (*Archilithobius*) *haasei* Attems was apparently based upon larger specimens of the same species. For this form the prosternal teeth are given as 3+3, a number occurring quite commonly in larger individuals from all the localities above mentioned, while the number may be 3 on one side and 2 on the other. The extra teeth appear on the border of the median sinus and are at first smaller than the others. The claw of the female gonopods is typically tripartite; but the lobes are short and often are nearly or quite obliterated as such, leaving the claw subentire or entire.

Geophilomorpha.

Family LINOTAENIIDAE.

Linotaenia chionophila (Wood).

? *Geophilus acuminatus* Leach, Trans. Linn. Soc. Lond., XI, p. 386, 1814.
Strigamia chionophila Wood, Journ. Phil. Acad., V, p. 50, 1862.
Scolioplanes acuminatus Attems, Archiv. for Zool., V, no. 3, p. 25, 1909.
Linotaenia chionophila Chamberlin, Canad. Ent., p. 260, 1911.

Of this species I have examined 22 females and 29 males collected on St. Paul Island in 1910 by Prof. Harold Heath. Specimens from Bering Island studied by Attems are by him recorded as *Scolioplanes acuminatus* (Leach), a species well known in Europe. A specimen from the same island is listed by Bollman as *L. chionophila* (Wood). Specimens from Popof and Kadiak Islands and from Sitka and Lower Inlet are likewise referable to Wood's species. There is no room for doubt that this northern form is the typical *chionophila*, of which the type specimen, a female, was taken at Fort Simpson on the Red River of the North [Fort Simpson is on Mackenzie River, near Lat. 62° E. A. P.]. If Graf Attems is right in his identification of the specimens from Bering Island, as there is not much room to doubt, then the European form is one and the same as the North American, and *attenuatus* of Leach must replace *chionophila* of Wood as the specific name. In view of the different mode in number of pairs of legs and a few other minor points, however, I believe it as well to keep Wood's name for the present and until the forms have been more intensively studied as to variation and distribution, especially since such difficulty is often met in separating closely allied species of *Linotaenia*.

Of the 22 females from St. Paul Island 16 have 45 pairs of legs and 6 have 43. Wood's type has 43 pairs. Of the 29 males from St. Paul Island 27 have 43 pairs of legs, one has 45 pairs, and one has but 41 pairs. Attems states that among his specimens from Bering Island one male had 41 pairs and one 45 pairs, the others having 43. Thus it would seem that the numbers of pairs of legs in the male is almost constant at 43, individuals with 41 or 45 being occasional; while in the female the modal number is 45, variation to 43 being frequent.

In the case of the European specimens of *L. attenuatus*, the number of pairs of legs is nearly always smaller. In Austria-Hungary Latzel found among 60 specimens studied that all the males had 39 pairs while in the females the number was either 41 or 43. Meinert gives the number of pairs of legs as constantly 41, but gives the number in the female as 41 or 47 pairs, one specimen having the latter number. In "Die Myriopoden Stiermarks" Attems states that all the males studied by him from that country had 39 pairs of legs, excepting one which had 41, while all the females had 41. The same author, however, found among specimens from Transylvania four males with 37, two males with 35, and five with but 33 pairs of legs; and of females nine with 39, one with 37, and seven with 33 pairs of legs. It will be noted then that in European specimens of *L. attenuatus* the most usual number of pairs of legs in the male is 39 and that in some regions this number seems to be nearly fixed; but that in other places variation below this number may be frequent or the rule. Similarly the modal number for the female is 41, but variation is more frequent than in the male, the number sometimes being 43, or, in sections where the variation in the number in the male in the minus direction is frequent, falling to 37 and even to 33.

In the United States specimens of *L. chionophila* differ from the northern specimens and agree with the European *L. attenuatus* in having the number of pairs of legs in the male most frequently 39. In the female the number varies from 41 to 37. Of 22 females from Ithaca, N. Y., I find six to have 41 pairs, eight to have 39, and eight to have 37 pairs.

It may be noted that the number of coxal pores in specimens of *attenuatus* from Europe and specimens of *chionophila* from the United States averages considerably higher than in the specimens from the Pribilof and other islands of the region. Of the 22 females from St. Paul Island, eight have on each side six pores, five have five, five have seven, three have eight, and one has nine; of the males, sixteen have six pores, ten have five, two have seven, and one has eight. The mode is thus six pores on each side.

Family GEOPHILIDAE.

Pachymerium ferrugineum (C. L. Koch).

Geophilus ferrugineus C. L. Koch, Deutschl. Crust., Myr., u. Arachn., Hft. 3, Tab. 2, 1835.
Pachymerium ferrugineum C. L. Koch, System der Myr., p. 187, 1847.
Mecistocephalus ferrugineus Newport, Cat. Myr. Brit. Mus., p. 81, 1856.
Mecistocephalus foveatus McNeill. Proc. U. S. Nat. Mus., vol. 10, p. 333, 1887.
Geophilus attenuatus Cook (*nee* Say), Proc. U. S. Nat. Mus., vol. 18, p. 59, 1895.

One specimen of this form was secured on St. Paul Island by the Harriman Expedition. It is probably not uncommon on the Pribilof Islands, since it is common both on the Asiatic and North American mainlands. It is a widespread and abundant species both in Europe and Asia and in North America.

Family SCHENDYLIDAE.

Escaryus albus Cook.

Esaryus albus Cook, Harriman Alaska Expedition, vol. 8, p. 77, 1904.

The type of this species, taken on St. Paul Island, is the only specimen thus far known.

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FIGGINS PIKA (OCHOTONA PRINCEPS FIGGINSI).

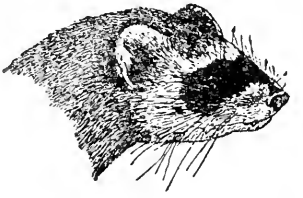
From photograph taken at Venango Mine, near Irwin, Colo., by Edward R. Warren.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 47

[Actual date of publication, August 21, 1924]



REVISION OF THE AMERICAN PIKAS

(Genus OCHOTONA)

By Arthur H. Howell, Assistant Biologist
Division of Biological Investigations
Bureau of Biological Survey

WASHINGTON
GOVERNMENT PRINTING OFFICE
1924

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., October 25, 1923.

SIR: I have the honor to transmit herewith, with the recommendation that it be published as No. 47 in the series of the North American Fauna, a report of a study, which constitutes a revision, of the American forms of the pikas, or "rock conies" (genus *Ochotona*), by Arthur H. Howell, assistant biologist of this bureau. The report is based chiefly on material in the collection of the Biological Survey, gathered during many years of investigations of the native mammals of North America. Pikas inhabit rocky country, mainly in mountainous regions, and in America are found in such situations in the western part, ranging from Alaska to California and New Mexico. The publication of the report will furnish needful information to mammalogists and to biological students generally concerning the number of forms and the habits, geographic distribution, and relationships of these interesting mammals.

Respectfully,

W. C. HENDERSON,
Acting Chief of Bureau.

Hon. HENRY C. WALLACE,
Secretary of Agriculture.

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REVISION OF THE AMERICAN PIKAS.

(GENUS OCHOTONA).

By ARTHUR H. HOWELL.

INTRODUCTION.

Pikas, or "conies,"[1] as they are more frequently called in America, are small, tailless, rabbitlike mammals, which on account of their shyness and the inaccessible nature of their haunts are comparatively little known. (See frontispiece.) They are widely distributed in Asia and extreme eastern Europe, where the genus, *Ochotona*, is represented by three, or possibly four, subgenera and a large number of species;[2] in the Western Hemisphere they are found only in western North America, from Alaska to southern California and northern New Mexico. In this region are found three species—*Ochotona princeps*, *O. collaris*, and *O. schisticeps*, with numerous subspecies.

DISTRIBUTION AND HABITAT OF PIKAS IN AMERICA.

Pikas occur in western North America, chiefly in the mountains, from the Mount McKinley Range of central Alaska and the Ogilvie Mountains of central Yukon south interruptedly to the southern Sierra Nevada in California (headwaters of Tule River), the Toyabe Mountains in central Nevada, the Parowan Mountains in southern Utah, and the Jemez and Pecos River Mountains in northern New Mexico; east to the Macmillan Mountains, Yukon, Mount Inglesmaldie (near Banff), Alberta, Belt Mountains, Montana, Big Horn Mountains, Wyoming, and Pikes Peak, Colorado; and west to the Chigmit Mountains, Alaska, and the Olympic Mountains, Washington (reported, but no specimens known).

As shown by the accompanying map (fig. 1), pikas are absent from wide areas within the boundaries of their general range. In the United States this absence is explained by the presence of extensive plains and deserts unsuited to their habitat, but in central and northern British Columbia a broad gap is found between the ranges of *Ochotona collaris* and *O. princeps* in a region seemingly well adapted to their occupation.

[1] The name "cony" is applied both to the English rabbit (*Oryctolagus cuniculus*) and to the daman, or Syrian hyrax (*Procavia syriaca*); the name "pika," which has been in common use in Europe for the members of the genus *Ochotona* for many years, is much to be preferred; the latter name is from the vernacular of the Tunguses—a tribe living in northeastern Siberia—who, according to Pallas (Reise, vol. 2, p. 701, 1773), call this animal "peeka."

[2] For the subgeneric groups, see Lyon, M. W., Smiths. Misc. Coll., vol. 45, p. 438, 1904; Thomas, Oldfield, Proc. Zool. Soc. London, 1908, p. 982.

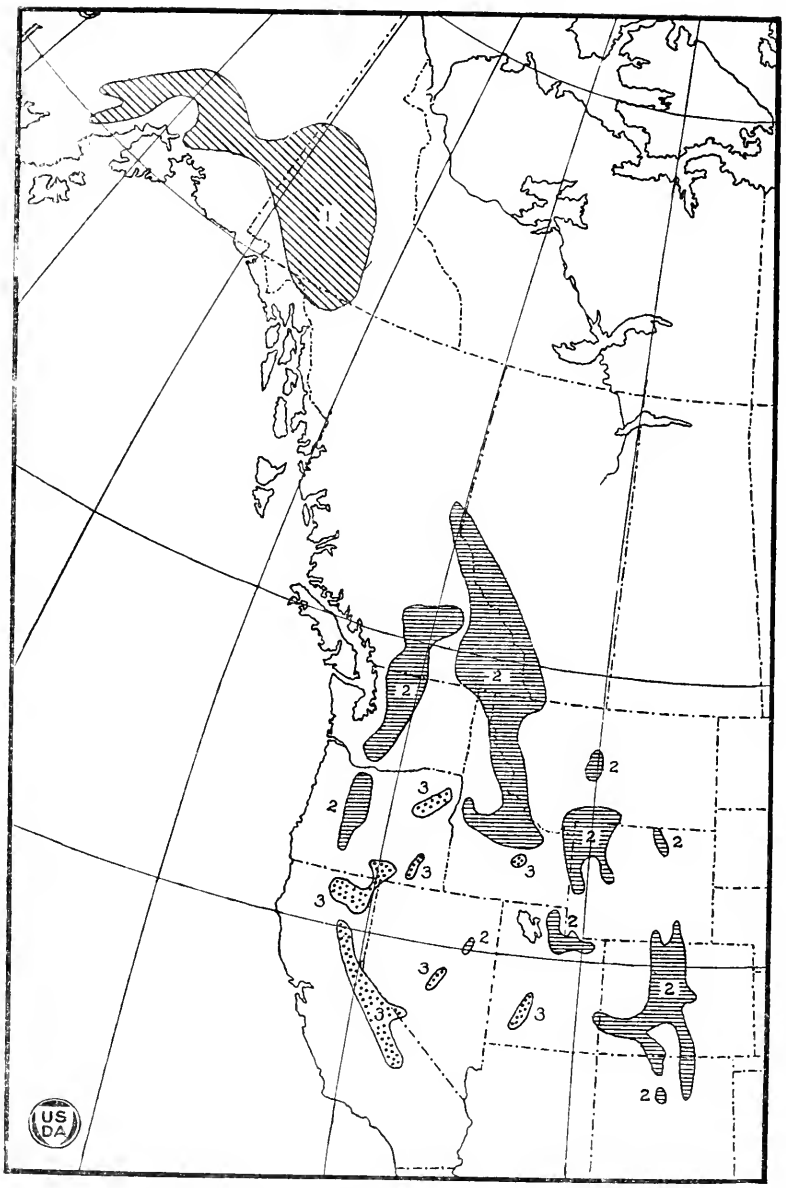

FIG. 1.—Distribution of the American species of *Ochotona* (subgenus *Pika*)—in the western United States, Canada, and Alaska. 1. *O. collaris*. 2. *O. princeps*. 3. *O. schisticeps*.

During a journey in 1910 through Canada, from Telegraph Creek, on the Stikine River, southeastward to Peace River, by way of the headwaters of the Finlay River and Fort Grahame, Edward A. Preble, of the Biological Survey, failed to find any evidence of the presence of pikas in those parts. He was informed, also, by Dan Brown, who accompanied him on the trip, and who has lived and traveled for a number of years as a hunter and prospector in this region and furthermore is well acquainted with the pikas in Alaska, that these ani-

mals are apparently absent from the Dease River country of northern British Columbia, the area drained by the Muddy (or Kachika) and the upper tributaries of the Stikine. Interrogation of a number of intelligent Indians in this region plainly showed that they did not know the animal. It is not impossible that some form of the genus may occur locally in the coast mountains of British Columbia, thus in part bridging the gap between the ranges of *O. collaris* and *O. princeps*.

The American pikas are practically confined to a single type of habitat—piles of broken rock. (Pl. II, fig. 1.) Quite rarely they have been found living in piles of lumber or slabs (Silverton, Colorado) or in log jams in streams (Goose Prairie and Easton, Washington). Their selection of rock slides for homes results in their restriction chiefly to mountain sides, but at least two races (*Ochotona schisticeps taylori* and *O. s. goldmani*) are found on the plains, living in piles of lava rock (Madeline Plains, California; Jacob Ranch, 20 miles northeast of Adel, Oregon; and the Snake River Desert, Idaho). Usually they occur only at rather high altitudes, chiefly at or above timberline, but, given proper conditions, altitude apparently has little to do with their distribution, since they are known to range from a few hundred feet above sea level (North Bend, on Fraser River, British Columbia) up to 13,600 feet (Wheeler Peak, New Mexico).

In rock slides the pikas live in families or loose colonies, finding an abundance of food in the herbage and shrubbery growing near at hand, and enjoying protection from their enemies in the interstices of the slides.

HABITS.

Pikas are chiefly diurnal, but are frequently heard calling during the night in their retreats among the rocks. They are very active and agile, running with great facility over the rough rocks among which they live, often making short leaps from rock to rock, their furry soles doubtless making them very sure footed. They do not ordinarily climb except into low shrubbery; but they have been observed to walk out on low horizontal limbs of aspens to cut the leaves. The gait of the pika has been described as "a slightly hopping run" (Osgood); Grinnell and Storer state that the hobbling gait reminds one somewhat of the hopping of a brush-rabbit [*Sylvilagus bachmani*].

During sunny days, pikas often sit hunched up and motionless for considerable periods in some protected place where they can command a wide view, and if danger threatens be ready instantly to seek the shelter of their rock slide. These observation posts are usually marked by accumulations of excrement "of an oblately spherical shape, like those of a rabbit but much smaller, and by whitish stains due to the action of the liquid excrement on the granite."[3] The animals are untidy in their habits, often dropping their excrement promiscuously on their "haystacks."

Pikas are usually shy and difficult to approach except by stealth, but at certain times and places they are quite unsuspicious. In the Pecos River Mountains, New Mexico, Vernon Bailey was able to

[3] Grinnell and Storer, Sierra Club Bull., vol. 10, no. 2, p. 163, 1917.

observe and photograph them at a distance of a few feet; one individual in its haste to move a bunch of "hay" even collided with his boot.

Little is known of the pikas' habits in winter, but the fact that they store food indicates that probably they do not hibernate but remain more or less active in their retreats among the rocks while the mountains are covered with snow. E. R. Warren mentions having seen one abroad in Colorado in January;[4] and J. Alden Loring reports having heard several near Chama, New Mexico, on December 23, 1893.

Ordinarily the American pikas do not dig burrows, but on Mount Rainier, Washington, Merriam found a colony living in burrows under large rocks, and in the same region observed a few of their burrows among dwarf fir trees at some distance from a mass of slide rock. Apparently nothing is known as to the kind of nests that pikas construct, but doubtless in the shelter of the rock slides some form of nest is used for breeding purposes.

The young, usually three or four, or rarely five, in number, are brought forth from late in May or early in June to early in September. Two young specimens from Mullan, Idaho, collected June 9 and 10, appeared to be several weeks old and must have been born in May.

VOICE.

The notes of the pika are variously described as a bleat, or bark, somewhat ventriloquial in character. Grinnell and Storer describe the ordinary call as a moderately loud two- or three-syllabled utterance with a nasal intonation. Osgood characterizes the note of the Alaska species as a "sharp metallic bark"; Vernon Bailey describes that of *Ochotona p. uinta* and of *O. p. lemhi* as a nasal squeak, somewhat resembling the bleat of a very young lamb; and Thomas Drummond compares the cry of *O. princeps* to that of a rabbit when hurt. Several observers have testified to marked variation in the notes of the different species of pikas. Merriam, describing the notes of one seen in Yosemite National Park, California, says:[5] "He uttered a rather sharp, harsh cry, something like *kăh-kăh*, usually repeated twice but sometimes three times, very different from the high-pitched *eet-eet* of the Idaho species [*lemhi*] and less shrill than the whistling cry of some of the others." Writing of pikas as observed on Mount Rainier, Washington, Merriam also says:[6] "In addition to their usual 'bleat' one of them in a den of rocks very near me made a low, chattering cry suggestive of a wren and seemingly made at or for the benefit of another." Merritt Cary, writing of a colony observed on a cold and windy day in the Big Horn Mountains, Wyoming, says:[7] "Their alarm notes were seldom heard, but a low-pitched, semirasping, mewing note was occasionally uttered by one of the little fellows as it sat on a sharp-pointed crag in the midst of the slide rock, each note being accompanied by a forward movement of the head."

[4] Warren, E. R., Mammals of Colorado, p. 55, 1910.
[5] Merriam, C. Hart, MS. notes, July, 1903.
[6] Merriam, C. Hart, MS. notes, August, 1897.
[7] Cary, Merritt, MS. notes, May, 1910.

FIG. 1.—PIKA IN ROCKSLIDE, REDNELL BASIN, GUNNISON COUNTY, COLORADO.

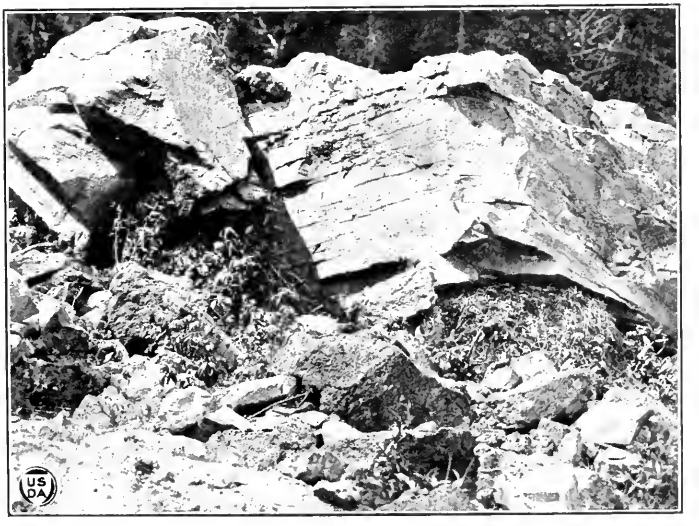

FIG. 2.—HAYSTACK OF PIKA, TRAPPERS LAKE, GARFIELD COUNTY, COLORADO.

From photographs by Edward R. Warren.

FOOD.

The most characteristic habit of the pikas is that of storing food for winter use. In late summer and early fall the animals industriously gather the stems, leaves, and flowers of a variety of plants growing in or near their home rock slides and pile these cuttings in miniature "hay stacks" on shelving rocks, in spaces between rocks, or more rarely under logs or stumps in the slide, where they are exposed to the air but well protected from rain by overhanging rocks. These stacks average about the size of a bushel measure and sometimes attain a height of 2½ feet. (See Pl. II, fig. 2.) The "hay" is gathered by the pikas often at a distance of several hundred feet from their den and carried in their mouths in small bundles, which are deposited on the stack. Beaten paths often lead from one stack to another or from the feeding grounds to the den. The animals evidently exercise some discrimination in selecting the species of plants desired, and different colonies vary in their choice, some selecting chiefly one or two varieties, others a considerable number. In the Lemhi Mountains, Idaho, Merriam found their chief food plant to be a species of avens (*Geum rossii*).[8]

A stack examined by Bailey in New Mexico contained 34 recognizable species of plants, the most common being nettles, chokecherry, gooseberry, currant, raspberry, rose, snowberry, syringa, lupine, aspen, and phacelia. Other plants commonly utilized by pikas are goldenrod, fireweed (*Epilobium*), lupine, aster, avens (*Geum*), gentian, Indian tobacco (*Antennaria*), thistles, beardtongue (*Pentstemon*), bearberry (*Arctostaphylos*), heather (*Bryanthus*), knotweed (*Polygonum*), saxifrage, huckleberry, cinquefoil (*Potentilla*), yarrow (*Achillea*), phlox, ferns, and a variety of grasses and sedges. In Yellowstone Park, Wyoming, Bailey examined a pika's haystack in which grass formed about half the total material and blueberry bushes about a fourth.

In some localities pikas seem to have a preference for the leaves of trees and shrubs. In the Natchez River Valley, Washington, Merriam found their "hay" composed almost entirely of the branches of chokecherry (*Prunus demissa*) about a foot and a half long, with some branches of the service berry (*Amelanchier*), a little aspen (*Populus*), much wild rose, *Spiraea* of two species, raspberry, currant, and a few herbaceous plants.

In the Gros Ventre Mountains near Jackson Hole, Wyoming, Wetmore found the pikas' "hay" made up largely of leaves of elders, which in some cases had been cut off as high as 2½ feet above the ground, some of the shrubs being nearly stripped of their leaves. On the lava beds of Oregon, sagebrush is sometimes used for the hay. In Alaska Osgood found most of the common plants in the pika haystacks, *Dryas* being most frequently utilized.

PELAGE AND MOLT.

The pelage of the pika is dense, soft, and silky, and in winter moderately long; the feet and toes are well haired, the soles and palms with dense furry pads. The basal portion of the body hairs is a uniform dark neutral gray or a deep neutral gray (Ridgway,

[8] North Amer. Fauna No. 5, p. 73, 1891.

"Color Standards," Pl. LIII); the terminal or subterminal portion varies from smoke-gray through many different shades of buff and cinnamon to tawny; the tips of many of the hairs on the dorsal area are fuscous or blackish, differing quantities of this color, with variations in the shade of the subterminal portion, producing many color tones.

All the American species except *Ochotona collaris* have two annual molts, and in most of the races the winter and summer pelages differ decidedly in color. In some species the midsummer molt begins early in July (rarely early in June) with certain individuals, and is frequently completed by the 20th of that month; in others this molt frequently does not begin until the middle or last of August and is not complete until well into September. In the Sierra Nevada races of *O. schisticeps* this molt apparently occurs considerably later than in most of the other forms.

The new pelage usually appears first on the head, the molt progressing evenly backward over the shoulders and back and on the sides to the line of the belly; occasionally the molt is irregular, the new hair appearing in isolated patches on the head, shoulders, and back; the underparts are renewed last.

The midsummer pelage is worn a comparatively short time—probably not over two months and apparently often much less than that—for in some species the winter pelage begins to appear early in September, and by the last of that month the fall molt is practically complete. This molt apparently progresses in practically the same way as the midsummer molt. In the fresh winter pelage the fuscous or blackish tips of the hairs on the back are usually prominent; later in the season these tips wear away to some extent, leaving the animal with a more grayish tone in midwinter than in early fall.

The winter pelage wears away slowly and evenly; specimens taken in May or June show only moderate wear, but when the midsummer molt is delayed until late in July or into August the animals often present a greatly worn, faded, and patchy appearance.

The most northerly ranging American species—*O. collaris*—apparently has but a single annual molt, which extends from late in July to early in September. No specimens of *collaris* taken later than September 1 and 2 are available, but specimens taken on those dates had nearly acquired the fresh pelage, which has every appearance of being the same as that of specimens taken late in April.

The progress of the molts is described in greater detail under the different species.

MATERIAL EXAMINED.

The present revision is based on a study of 1,315 specimens; of these approximately two-thirds are contained in the United States National Museum, chiefly in the Biological Survey collection; the remainder have been borrowed from other American museums and from private collections.[9]

[9] For the loan of this material the author desires to extend thanks to the owners and custodians, as follows: H. E. Anthony, of the American Museum of Natural History; Dr. Glover M. Allen and Samuel Henshaw, of the Museum of Comparative Zoology, Harvard University; Dr. Wilfred H. Osgood, of the Field Museum of Natural History; Dr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia; Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology, University of California; J. D. Figgins, of the Colorado Museum of Natural History; Dr. R. M. Anderson and P. A. Taverner, of the Victoria Memorial Museum; F. Kermode, of the Provincial Museum, Victoria, British Columbia; Stanley G. Jewett, of Portland, Oregon, and E. R. Warren, of Colorado Springs, Colorado.

EXPLANATION OF CRANIAL MEASUREMENTS.

In the study of the skulls of this genus, the following measurements were taken in millimeters:

Occipito-nasal length.—Greatest length from posterior border of occiput to anterior tip of nasals.

Zygomatic breadth.—Breadth across zygomata at posterior border of orbits.

Breadth of braincase.—Breadth across parietals at posterior border of auditory meatus.

Interorbital breadth.—Least breadth of frontals between the orbits.

Width of palatal bridge.—Antero-posterior length of bony palate, from posterior border of palatal foramen to anterior border of interpterygoid fossa.

Length of nasals.—Greatest length (measured with vernier calipers) from plane of posterior border to anterior tip.

Genus OCHOTONA Link.

Lepus Pallas, Reise, vol. 2, p. 701, 1773 (part). Not *Lepus* Linnaeus, 1758.
Ochotona Link, Beyträge Naturg., vol. 1, pt. 2, p. 74, 1795. Type, *Ochotona minor* Link=*Lepus ogotona* Pallas=*Lepus dauuricus* Pallas.[10]
Pika Lacépède, Tabl. Mamm., 1799, p. 9. Type, *Pika alpinus*=*Lepus alpinus* Pallas.
Lagomys G. Cuvier, Leçons Anat. Comp., vol. 1, tabl. I, 1800 (not *Lagomys* Storr, 1780).
Ogotoma Gray, Ann. Mag. Nat. Hist., 3d ser., vol. 20, p. 220, 1867. Type, *Ogotoma pallasii*=*Lagomys ogotona* Waterhouse (not *Lepus ogotona* Pallas).[10]
Conothoa Lyon, Smiths. Misc. Coll., vol. 45, p. 438, 1904 (subgenus). Type, *Ochotona roylii* Ogilby.

Generic characters.—Form compact; tail very short—practically obsolete; limbs short, the hind legs but little longer than fore legs; soles and palms densely furred; toes 5 in front, 4 behind, armed with curved, slender claws; a naked pad at base of each toe. Ears moderately large, suborbicular, haired on both surfaces; eyes rather small; fur soft and moderately dense. Mammae 4 or 6: Pectoral, $\frac{1}{1}$ or $\frac{2}{2}$; inguinal, $\frac{1}{1}$.

Braincase rather flat—not inflated; rostrum relatively narrow, the nasals broader anteriorly than posteriorly or of equal width; postorbital processes lacking; interorbital constriction pronounced; bony palate relatively short; antero-inferior angle of zygoma with pronounced spinous process; malar bone greatly prolonged posteriorly, reaching nearly to the auditory opening; maxillary bones usually without fenestration; ascending ramus of mandible relatively wide, with the condyle well developed; anterior face of ascending ramus without the groove found in the Leporidae; the coronoid process consisting of a small tubercle, often nearly obsolete; a smaller tubercle often appearing lower down on the ascending ramus, near the last molar; angular process of mandible relatively long, slender, and recurved, the angle of the jaw pronounced; mental foramen situated on the side of the horizontal ramus, beneath the last lower molar.

Dental formula: I, $\frac{2}{1}$; C, $\frac{0}{0}$; PM, $\frac{3}{2}$; M, $\frac{2}{3}$; third upper molar lacking; molars with simple enamel pattern, the reentrant angles without crenation; second upper premolar decidedly smaller than third, with a reen-

[10] Cf. Thomas, Proc. Zool. Soc. London, 1908, p. 109.

trant angle on anterior face; second (last) upper molar with a projecting enamel loop on intero-posterior border; last lower molar simple (not double); cutting edge of first upper incisor V-shaped.[11]

HISTORY AND NOMENCLATURE.

The pikas were first made known to science in 1769, when Pallas published the description of a species from eastern Russia and southern Siberia under the name *Lepus pusillus*.[12] During the next few years the same author described several additional species from Asia and gave full accounts of their habits and anatomy.[13]

In 1795, Link separated the pikas from the hares under the generic name *Ochotona*[14]—evidently derived from the Mongolian vernacular, which Pallas gives as "*ochodona*" or "*ogotona*."[15] Link's name, however, was overlooked or disregarded by his contemporaries, and Cuvier's name *Lagomys*, proposed for the genus in 1800,[16] was currently used for almost a century, until Thomas, in 1896,[17] showed that it was preoccupied by *Lagomys* Storr, 1780, and furthermore was antedated by *Ochotona* Link.

In 1799, Lacépède introduced the name *Pika* in conjunction with one of the Siberian species, *alpinus*;[18] the name is antedated, of course, by *Ochotona*, but, as shown by Lyon,[19] it is available as the name for the subgenus containing all the American species.

In 1867, in a paper on the skulls of hares and pikas, Gray proposed a new generic name, *Ogotoma*, for the species described by Waterhouse under the name *Lagomys ogotona*, naming it *Ogotoma pallasii*.[20] Gray's name *Ogotoma* has recently been revived by Thomas in a subgeneric sense.[21]

In 1904 Lyon published an important paper on the "Classification of the Hares and Their Allies," in which he described in detail the osteology of the pikas and proposed a new subgeneric name, *Conothoa*, based on *Ochotona roylii* Ogilby, from central Asia.[22]

The first American species to be described was Richardson's *Lepus (Lagomys) princeps*, 1828, based on specimens collected by Thomas Drummond, in the Rocky Mountains of Canada, near the sources of the Athabaska River. In 1863 Lord proposed a second species, *Lagomys minimus*, based on specimens taken by himself on the international boundary in southern British Columbia. This name, however, was placed in synonymy by later authors until revived by Bangs in 1899. Thus *princeps* remained for over 60 years the only recognized American species.

In 1889 Merriam named a new species, *schisticeps*, from the Sierra Nevada, and in 1893 Nelson described the Alaskan species under the name *collaris*. In 1899 Bangs described two new forms—*saxatilis*,

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[11] For a fuller discussion of the osteological differences between *Ochotona* and the Leporidae, cf. Lyon, Smiths. Misc. Coll., vol. 45, pp. 384-385, 1904.
[12] Pallas, P. S., Nov. Comm. Acad. Sci. Petropolit., vol. 13, p. 531, 1769.
[13] Pallas, P. S., Reise, vol. 2, p. 701, 1773, and vol. 3, p. 692, 1776; Nov. Spec. Quad., Glires, p. 59, 1778.
[14] Link, D. H. F., Beyträge, vol. 1, pt. 2, p. 74, 1795.
[15] Pallas, P. S., Reise, vol. 2, p. 701; vol. 3, p. 692.
[16] Cuvier, F., Leçons d' Anat. Comp., vol. 1 (Tab.), 1800.
[17] Thomas, O., Proc. Zool. Soc. London, 1896, p. 1026.
[18] Lacépède, B. G. E., Tabl. Mamm., p. 9, 1799.
[19] Lyon, M. W., Smiths. Misc. Coll., vol. 45, p. 332, 1904.
[20] Gray, J. E., Ann. and Mag. Nat. Hist., 3d ser., vol. 20, p. 220, 1867; cf. Thomas, Proc. Zool. Soc. London, 1908, pp. 109-110.
[21] Thomas, Oldfield, Proc. Zool. Soc. London, 1908, p. 982.
[22] Lyon, M. W., Smiths. Misc. Coll., vol. 45, p. 438, 1904.

from Colorado, and *cuppes*, from southeastern British Columbia—and in 1905 Allen described *cinnamomea*, from southern Utah. In 1912 five new species were proposed—*figginsi* by Allen, from Colorado; *uinta* and *levis* by Hollister, from Utah and Alberta, respectively; and *taylori* and *albatus* by Grinnell, both from California. A species from New Mexico, *nigrescens*, was described by Bailey in 1913, and two new races from California, *muiri* and *sheltoni*, by Grinnell in 1916 and 1918, respectively. In 1919 the present author described nine new forms from various parts of Canada and the United States—*brunnescens*, from Washington; *fumosa* and *jewetti*, from Oregon; *fuscipes*, from Utah; *incana*, from New Mexico; *lemhi*, from Idaho; *lutescens*, from Alberta; *nevadensis*, from Nevada; and *ventorum*, from Wyoming.

Two new races are described in this paper—*brooksi*, from British Columbia, and *goldmani*, from Idaho—bringing the total number of recognized American forms to 26. Further collecting in previously unworked regions will doubtless reveal a number of additional species or subspecies.

Subgenus PIKA Lacépède.

Subgeneric characters.[23]—Skull very flat; interorbital region rather broad (not elevated and not much constricted, as in *Ogotoma*); maxillary orifice roundly triangular (much as in *Ogotoma*, less elongated than in *Ochotona*); incisive and palatal foramina separate (as in *Ogotoma*).

Remarks.—The subgenus *Pika* includes all the American species and is found also practically throughout the range of the genus in Asia and eastern Europe.

List of American Species and Subspecies, with Type Localities.

Ochotona princeps princeps (Richardson)	Headwaters of Athabaska River, near Athabaska Pass, Alberta.
princeps lutescens Howell	Mount Inglesmaldie, near Banff, Alberta.
princeps levis Hollister	Chief Mountain [Waterton] Lake, Alberta.
princeps lemhi Howell	Lemhi Mountains, west of Junction, Idaho.
princeps ventorum Howell	Fremont Peak, Wind River Mountains, Wyoming.
princeps uinta Hollister	Uinta Mountains, near head of east fork Bear River, Utah.
princeps nevadensis Howell	Ruby Mountains, southwest of Ruby Valley Post Office, Nevada.
princeps figginsi J. A. Allen	Pagoda Peak, Rio Blanco County, Colorado.
princeps saxatilis Bangs	Montgomery, near Mount Lincoln, Park County, Colorado.
princeps incana Howell	Pecos Baldy, New Mexico.
princeps nigrescens Bailey	Jemez Mountains, New Mexico.
princeps cuppes, Bangs	Monashee Divide, Gold Range, British Columbia.
princeps fenisex Osgood	"Ptarmigan Hill," near head of Ashnola River, Cascade Range, British Columbia.
princeps brooksi, nobis	Sicamous, British Columbia.
princeps brunnescens Howell	Keechelus, Kittitas County, Washington.
princeps fumosa Howell	Permilia Lake, west base of Mount Jefferson, Oregon.

[23] The characters of the subgenus *Ochotona*, as given by Lyon (Smiths. Misc. Coll., vol. 45, p. 438, 1904) are in reality those of the subgenus *Ogotoma* Gray, as has been pointed out by Thomas (Proc. Zool. Soc. London, 1908, p. 982).

List of Species, with Type Localities—Continued.

Ochotona collaris (Nelson).....Near head of Tanana River (about 200 miles south of Fort Yukon), Alaska.
schisticeps schisticeps (Merriam).....Donner, California.
schisticeps taylori Grinnell.....Warren Peak, Warner Mountains, Modoc County, California.
schisticeps goldmani, nobis.....Echo Crater, Snake River Desert (20 miles southwest of Arco), Idaho.
schisticeps jewetti Howell.....Head of Pine Creek, near Cornucopia, Baker County, Oregon.
schisticeps muiri Grinnell and Storer..Ten Lakes, Yosemite National Park, California.
schisticeps albata Grinnell.....Cottonwood Lakes, near Mount Whitney, Inyo County, California.
schisticeps sheltoni Grinnell.....White Mountains, near Big Prospector Meadow, Mono County, California.
schisticeps cinnamomea J. A. Allen....Beaver Mountains, Utah.
schisticeps fuscipes Howell.....Parowan Mountains, Iron County, Utah.

Key to the American Species.

a^1 Underparts creamy white, without buffy wash; an indistinct grayish "collar" on shoulders.....**collaris.**
a^2 Underparts washed with buff; no grayish "collar" on shoulders.
  b^1 Palatal bridge narrow (average about 1.6 mm.).....**schisticeps.**
  b^2 Palatal bridge broader (average about 2.3 mm.).....**princeps.**

Descriptions of American Species and Subspecies.

OCHOTONA PRINCEPS (RICHARDSON).

[Synonymy under subspecies.]

General characters.—Coloration grayish or cinnamon-buff, more or less mixed with fuscous, the general tone varying from pale smoke-gray, mouse-gray, or drab to wood brown, cinnamon-buff, or cinnamon-drab; in summer more buffy, ochraceous, or tawny and more varied with blackish or fuscous. Skull relatively long and narrow, with narrow interorbital constriction; nasals usually rather long; palatal bridge wide; interpterygoid fossa U-shaped, with the sides usually parallel (occasionally somewhat spatulate in *brooksi*, *uinta*, and *lemhi*).

Color.—Upperparts pinkish buff, pinkish cinnamon, vinaceous-cinnamon, cinnamon-buff, ochraceous-tawny, or clay color, more or less mixed with fuscous or blackish; hinder back sometimes washed with smoke-gray; sides pinkish buff, pinkish cinnamon, vinaceous-cinnamon, cinnamon-buff, or ochraceous-tawny; ears hair-brown, deep mouse-gray, chaetura drab, chaetura black, or fuscous black, margined with buff or buffy white: feet creamy white, pinkish buff, light pinkish cinnamon, or cinnamon-buff; soles buffy white, hair-brown, drab, chaetura drab, or fuscous; palms buffy white, light drab, hair-brown, or pale olive-buff; underparts white, pinkish buff, pinkish cinnamon, vinaceous-cinnamon, or cinnamon-buff.

Geographic distribution.—Rocky Mountain region, from east-central British Columbia (headwaters of South Pine River) south to the Pecos River Mountains and Jemez Mountains, New Mexico, La Sal Mountains, Utah, and Ruby Mountains, Nevada; east to the Belt Mountains, Montana, Big Horn Mountains, Wyoming, and Pikes Peak, Colorado; also the Cascade Mountain system, from southern British Columbia south to the vicinity of Crater Lake, Oregon. (Fig. 2.)

Remarks.—The first described American species of pika has an extensive range in the Rocky Mountain region and is separable into at least 16 races. Typical *princeps* apparently ranges continuously along

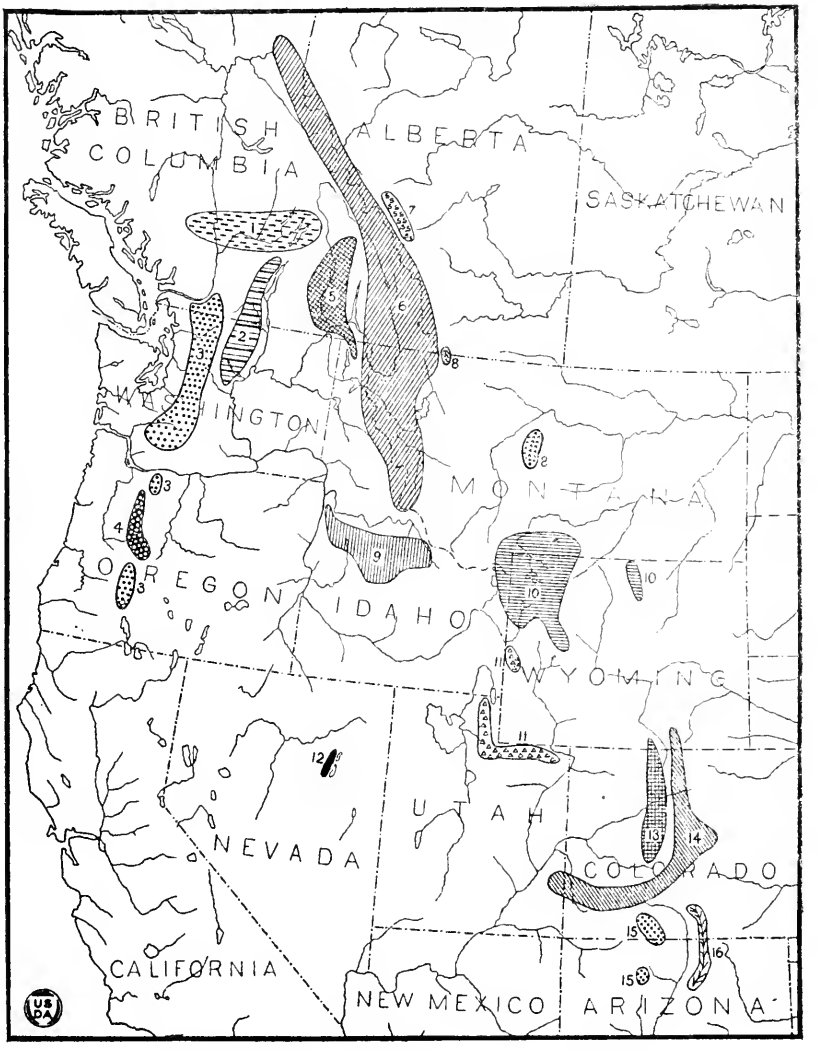

FIG. 2.—Distribution of the subspecies of *Ochotona princeps*.

1. *O. p. brooksi.*
2. *O. p. fenisex.*
3. *O. p. brunnescens.*
4. *O. p. fumosa.*
5. *O. p. cuppes.*
6. *O. p. princeps.*
7. *O. p. lutescens.*
8. *O. p. levis.*
9. *O. p. lemhi.*
10. *O. p. ventorum.*
11. *O. p. uinta.*
12. *O. p. nevadensis.*
13. *O. p. figginsi.*
14. *O. p. saxatilis.*
15. *O. p. nigrescens.*
16. *O. p. incana.*

the higher ridges of the main divide from northern Alberta to southern Montana. A dark race (*cuppes*) occupies most of southeastern British Columbia, on the western slopes of the main range, and a very pale form (*lutescens*) is found on the outlying ranges of Alberta, east of the main divide. In central and western Montana, *levis*, paler than typical *princeps* but not so pale as *lutescens*, is found in the Belt Mountains and at Waterton Lake. In central Idaho, another small, pale race occurs. In western Wyoming and northeastern Utah two rather large, richly colored forms (*ventorum* and *uinta*) connect typical

princeps with the Colorado and New Mexico races; in this region the easterly races (*saxatilis* and *incana*) are paler than the more westerly races (*figginsi* and *nigrescens*). The Ruby Mountains form, although widely isolated, is apparently closely related to *uinta* and has no close relationship with the form in the Toyabe Mountains—*O. schisticeps cinnamomea*. In southern British Columbia *cuppes* grades into *fenisex*, a paler form occupying the mountains lying to the west of the Okanagan Valley, and the latter passes into the darker race, *brunnescens*, of the main Cascade Range. In central British Columbia occurs a form (*brooksi*) darker than *fenisex* and somewhat resembling *brunnescens*. The darkest form of all, *fumosa*, is found on the west slopes of the Cascade in Oregon and in the mountains around Paulina Lake.

OCHOTONA PRINCEPS PRINCEPS (Richardson).

Rocky Mountains Pika.

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

Lepus (*Lagomys*) *princeps* Richardson, Zool. Journ., vol. 3, p. 520, 1828; Fauna Boreali-Americana, p. 227, 1829.
[*Ochotona*] *princeps* Trouessart, Cat. Mamm. Viv. Foss., p. 648, 1897.

Type locality.—Headwaters of Athabaska River, near Athabaska Pass, Alberta.[24]

Geographic distribution.—Rocky Mountains, from eastern British Columbia (headwaters South Pine River) and western Alberta (Muskeg Creek) south along the main divide to eastern Idaho and western Montana (Bitterroot Mountains). (Fig. 2, p. 11.)

Characters.—Size medium; skull relatively narrow with rather long nasals, narrow interpterygoid fossa, and moderately wide palatal bridge; winter pelage uniform buffy drab or mouse-gray; summer pelage clay color or pinkish cinnamon, heavily shaded with blackish.

Color.—*Winter pelage* (October): *Cinnamon phase*: Upperparts mixed light pinkish cinnamon and fuscous, sometimes washed on hinder back with blackish, shading on lower sides to light pinkish cinnamon; ears chætura black or chætura drab, margined with light buff; feet pinkish buff; soles hair-brown; palms light drab; underparts whitish, moderately washed with pinkish buff or cinnamon-buff. *Drab phase*: Similar to the cinnamon phase but dorsal surface strongly washed with light smoke-gray, especially on hinder back. *Summer pelage*: Upperparts between pinkish cinnamon and clay color, richest on head and shoulders, heavily shaded, particularly on middle and hinder back, with black or fuscous-black: sides of head and neck clay color or pinkish buff, shading on sides of body to light pinkish cinnamon; underparts dull whitish, moderately washed with light pinkish cinnamon or pale cinnamon-buff; ears and feet as in winter pelage. *Young* (specimens from Upper Stillwater Lake, Montana, July 2 and 3, apparently less than a month old): Upperparts fuscous-black, shaded with light buff; sides washed with light pinkish cinnamon; ears blackish mouse-gray, margined with buffy white; feet soiled whitish, washed with pale pinkish buff; soles mouse gray; palms soiled whitish; underparts whitish, washed with pinkish buff.

[24] See remarks on pp. 13–14.

Molt.—The progress of the molts and the pelage changes are well shown by a series of specimens from the vicinity of Henry House, Alberta. A specimen taken July 3 shows the midsummer molt beginning on the face, head, and middle of fore back behind the ears, the rest of the upperparts being in moderately worn, grayish winter pelage; the underparts are worn and the pelage thin, with only a slight wash of light buff in the median line; in another taken July 17 the new pelage covers the entire head and shoulders and reaches nearly to the middle of the back: the entire underparts are densely clothed with what appears to be a new pelage heavily washed with buff; one taken July 13 has the summer pelage nearly complete, covering the whole dorsal surface except the rump and a patch on one side of the hinder back; the ventral surface is also nearly completely renewed; a specimen taken September 10 has the summer pelage greatly worn on the back and sides, though but little on the belly; in one taken the same date, the winter pelage has covered the head, shoulders, and back for two-thirds of the distance from nose to tail, but has not reached the lower sides; this pelage does not differ greatly from the fresh summer pelage but is somewhat more grayish or vinaceous and less buffy; in a specimen taken September 29 the winter pelage covers the whole dorsal surface and the sides, though the pelage on the underparts is not completely renewed; this specimen is decidedly more grayish than that taken on September 10, and the fuscous or blackish hairs are much less prominent; specimens taken October 17 and 18 are in full winter pelage, with drab or cinnamon tones prevailing.

Farther south the midsummer molt may in individual cases begin early in June, though as a rule it occurs in Montana from late in June to early in August. Two specimens from the Bitterroot Mountains, near Florence, Montana, June 7, show the summer pelage just appearing in patches on the shoulders and around the eyes.

Skull.—Relatively long and narrow with narrow interorbital region; nasals of moderate length; palatal bridge rather wide; interpterygoid fossa rather narrow, the sides nearly parallel.

Measurements.—Average of 20 adults (10 males, 10 females) from vicinity of Henry House, Alberta: Total length, 191.6 (181–204); hind foot, 30.5 (29–33). *Skull*: Average of 10 adult males from vicinity of type locality (Henry House, Grand Cache River, and Smoky River, Alberta): Occipito-nasal length, 43.5 (41.9–45.2); zygomatic breadth, 21.4 (21–22); breadth of braincase, 18 (17.2–19.1); interorbital breadth, 5.4 (4.5–5.7); width of palatal bridge, 2 (1.6–2.3); length of nasals, 14.4 (13.4–15.4). Average of 8 adult females from same localities: Occipito-nasal length, 42.5 (41.1–45); zygomatic breadth, 21.3 (20.8–21.9); breadth of braincase, 17.8 (17.1–18.6); interorbital breadth, 5.5 (5–5.8); width of palatal bridge, 2.1 (1.8–2.7); length of nasals, 14 (13.1–14.7).

Remarks.—The Rocky Mountain pika was the first American species to be discovered and for many years (from the time of its description in 1828 until 1889) was the only currently recognized species.

Richardson, who described the form, stated that "Drummond killed several [pikas] near the sources of the Elk [=Athabaska]

River,"[25] and Preble considers that these specimens were undoubtedly the basis of Richardson's description.[26] The type locality, therefore, may be definitely fixed as the source of the Athabaska River, near Athabaska Pass. The splendid series collected by Loring in 1895 and 1896 in the region just north of the type locality (from Henry House to Muskeg Creek and Smoky River) has been of the greatest value in studying the group and working out the pelage changes and range of variation in the species.

Intergradation with *lutescens* is indicated by several specimens from Rocky Pass, Alberta, which are somewhat paler than typical *princeps*.

Although no specimens are available from the region between Jasper Park, Alberta, and northern Montana, doubtless the species ranges continuously along the higher ridges. Specimens from Glacier Park and the Bitterroot Mountains, Montana, are typical. A series from Mullan, Idaho, and Silver [=Saltese], Montana, agrees with *princeps* in external characters, but several of the skulls show approach to *lemhi* in the narrowing of the nasals posteriorly. A series from Thompson Pass, Montana, approaches *cuppes* in having the underparts somewhat darker (more ochraceous).

The northern limits of the range of *princeps* are not definitely known. S. Prescott Fay and C. R. Cross, jr., in August, 1914, noted the species near the head of Wapiti River, and again near the head of the east branch of South Pine River, northern British Columbia, but reported the animals very scarce in this region, and did not secure specimens.

Richardson mentions[27] having received specimens obtained by Mr. MacPherson from the "River of the Mountains" [=Liard]—probably from the vicinity of Fort Nelson—and later B. R. Ross reported the species common among the mountain ranges of the Liard River.[28] No specimens have been examined, however, from this region and whether the animal found there is *princeps* or not is quite uncertain.

Specimens examined.—Total number, 108, as follows:

Alberta: Grand Cache River (about 60 miles north of Jasper House), 1; Henry House (vicinity), 40; Jasper Park, 6;[29] Muskeg Creek (about 60 miles north of Jasper House), 6; Rocky Pass, 3;[30] Rocky River (near head), 1;[30] Smoky River (near head), 4; Smoky Valley (about 50 miles north of Jasper House), 1.

British Columbia: Mount Evans (near Cranbrook), 1;[31] Spillamacheen River, 2.[30]

Idaho: Bitterroot Mountains (west of Hamilton, Montana), 2; Mullan, 8; Thompson Pass, 12.

Montana: Bass Creek, Bitterroot Mountains (northwest of Stevensville), 7; Corvallis (mountains 15 miles east), 1; Lake Como, Bitterroot Mountains, 1; Mount Lo Lo, 1; Piegan Pass, Glacier National Park, 1; Silver [=Saltese], 4; St. Marys Lake [mountains near], 1; Sweeny Creek (7 miles west of Florence), 5.

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[25] Richardson, John, Fauna Boreali-Amer., vol. 1, p. 227, 1829.
[26] Preble, E. A., North Amer. Fauna No. 27, p. 198, 1908.
[27] Richardson, John, Loc. cit.
[28] Canad. Nat. and Geol., vol. 7, p. 141, 1862.
[29] Five in collection Victoria Mem. Mus.; one in collection Amer. Mus. Nat. Hist.
[30] Collection Amer. Mus. Nat. Hist.
[31] Collection Provincial Mus., Victoria, British Columbia.

OCHOTONA PRINCEPS LUTESCENS Howell.

Alberta Pika.

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

Ochotona princeps lutescens Howell, Proc. Biol. Soc. Washington, vol. 32, p. 105, May 20, 1919.

Type.—Collected on Mount Inglesmaldie, near Banff, Alberta, Canada (at about 8,000 feet altitude), July 26, 1899, by G. F. Dippie; ♂ adult, skin and skull; No. 108650, U. S. National Museum, Biological Survey collection; original number, 193 (2973, X Catalogue).

Geographic distribution.—Mount Inglesmaldie (near Banff) and other mountains in Canadian National Park, Alberta, south to Mount Forget-me-not (50 to 75 miles southwest of Calgary). (Fig. 2, p. 11.)

Characters.—Similar to *princeps*, but smaller; coloration decidedly paler, both above and below.

Color.—Summer pelage: Upperparts mixed pinkish buff and fuscous, darkest in the middle of the back, shading to clear pinkish buff along sides; ears hair-brown, broadly margined with light buff and clothed inside with buffy white hairs; feet creamy white, faintly washed with pinkish buff; soles drab; palms pale olive-buff; underparts creamy white, faintly washed with pale pinkish buff, chiefly along median line. *Worn winter pelage* (Mount Forget-me-not, Alberta, July 10): General tone of upperparts smoke-gray, faintly washed with fuscous; sides washed with pinkish buff; ears and feet as in summer pelage. *Fresh winter pelage:* Not represented.

Skull.—Similar to *princeps*, but smaller, with shorter nasals.

Measurements.—Average of 8 adults (4 males, 4 females) from Canmore, Alberta: Total length, 177 (170–188); hind foot, 29.4 (26–31). *Skull:* Average of 5 adult males from vicinity of type locality: Occipito-nasal length, 41.6 (39.3–43.4); zygomatic breadth, 20.9 (19.7–21.7); breadth of braincase, 17.3 (16.5–18); interorbital breadth, 5.4 (5.1–6); width of palatal bridge, 1.9 (1.7–2.2); length of nasals, 13.5 (12–14.1): Average of 3 females from same region: Occipito-nasal length, 41.9 (41.1–43.3); zygomatic breadth, 20.3 (20–20.5); breadth of braincase, 17.3 (16.3–18.8); interorbital breadth, 5.6 (5.5–5.8); width of palatal bridge, 1.8 (1.6–1.9); length of nasals, 12.9 (12.3–13.4).

Remarks.—The Alberta pika is a well-marked race, characterized by small size and pale coloration; it apparently has a rather restricted range on the easterly side of the main chain of the Rocky Mountains, but more extensive collections are needed to show its northern and southern limits. Three specimens in worn pelage from Ptarmigan Lake are apparently intermediate between *lutescens* and *princeps*. A series from Canmore, Alberta, is intermediate between *lutescens* and *levis*; in coloration above the specimens agree closely with *levis*, but the underparts are less buffy and the soles and palms paler, as in *lutescens*, to which form they are referred.

Specimens examined.—Total number, 50, as follows:

Alberta: Banff, 2;[32] Canmore, 17; Mount Forget-me-not [50 to 75 miles southwest of Calgary], 3;[32] Mount Inglesmaldie (near Banff), 25;[33] Ptarmigan Lake, 3.[34]

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[32] Collection Victoria Mem. Mus.

[33] Ten in collection Field Mus. Nat. Hist.; 6 in collection Mus. Comp. Zool.; 5 in collection Amer. Mus. Nat. Hist.

[34] Collection Amer. Mus. Nat. Hist.

OCHOTONA PRINCEPS LEVIS Hollister.

Hollister Pika.

Ochotona levis Hollister, Proc. Biol. Soc. Washington, vol. 25, p. 57, April 13, 1912.

Type.—Collected at Chief Mountain [Waterton] Lake, Alberta, August 24, 1874, by Dr. Elliott Coues; ♀ adult, skin and skull; No. $\frac{12000}{22241}$, U. S. National Museum; original number, 4593.

Geographic distribution.—Mountains of southern Alberta and Montana (east of the main divide) from Waterton Lake to the Belt Mountains. (Fig. 2, p. 11)

Characters.—Smaller and paler than *princeps*, similar to *lutescens*, but darker (more buffy) both above and below; soles and palms darker.

Color.—Summer pelage: Upperparts light pinkish cinnamon, mixed with fuscous, shading on lower sides to clear pinkish cinnamon or light pinkish cinnamon; ears dark hair-brown or chaetura drab, margined with light buff; feet pinkish buff or cinnamon-buff; soles hair-brown or chaetura drab; palms light drab; underparts whitish, partially or wholly suffused with pinkish buff, or light pinkish cinnamon. *Winter pelage:* Not represented.

Skull.—Closely similar to *lutescens;* smaller than *princeps.*

Measurements.—Average of 3 adult males from type locality: Total length, 183 (180–190); hind foot, 30.5. Adult ♀ (type), 168; 28. Average of 7 adult males from Belt Mountains, Montana: 173 (168–180), 30 (29–31). *Skull:* Adult male from Little Belt Mountains, Montana: Occipito-nasal length, 41.9; zygomatic breadth, 21.9; breadth of braincase, 17.4; interorbital breadth, 6.1; width of palatal bridge, 1.9; length of nasals, 14.2. Adult female (type): Occipito-nasal length, 41.8; zygomatic breadth, 20.5; breadth of braincase, 17.2; interorbital breadth, 5.2; width of palatal bridge, 1.5; length of nasals, 14.2.

Remarks.—Intermediate in color between *princeps* and *lutescens*, *levis* geographically occupies a region segregated from the range of *lutescens* but adjoining the range of *princeps.* The specimens from the type locality are mostly in worn summer pelage and the series is insufficient to show the characters clearly. A series from the Belt Mountains, Montana, in fresh summer pelage agrees closely with the type series and differs markedly from specimens of *princeps* from the main divide in Montana (Piegan Pass, Glacier National Park, and Bitterroot Mountains).

Specimens examined.—Total number, 15, as follows:

Alberta: Chief Mountain [Waterton] Lake, 5.
Montana: Belt Mountains, 1; Little Belt Mountains, 9.

OCHOTONA PRINCEPS LEMHI Howell.

Lemhi Pika.

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

Ochotona uinta lemhi Howell, Proc. Biol. Soc. Washington, vol. 32, p. 106, May 20, 1919.

Type.—Collected on the Lemhi Mountains (10 miles west of Junction), Idaho, August 19, 1890, by Clark P. Streator; ♀ adult, skin and skull; No. $\frac{23543}{30961}$, U. S. National Museum, Biological Survey collection; original number, 174.

Geographic distribution.—Mountains of south-central Idaho—the Lemhi, Lost River, Salmon River, and Sawtooth Ranges; eastward to the Beaverhead Mountains, east of Leadore; northern limits of range imperfectly known. (Fig. 2, p. 11.)

Characters.—Size small; colors very pale; similar in winter pelage to *princeps*, but upperparts paler and underparts more whitish; in summer decidedly paler (less blackish) above and less buffy beneath; similar in summer pelage to *levis* but general tone above more buffy and underparts more whitish or yellowish (less pinkish); skull small and relatively narrow, with narrow nasals.

Color.— *Winter pelage:* Upperparts mixed pinkish buff or cinnamon-buff and fuscous or fuscous-black, rather heavily washed in some specimens, chiefly on hinder back, with pale smoke-gray; sides pinkish buff or cinnamon-buff; ears dark mouse-gray, margined with buffy white; hairs on inside of ears buffy (or grayish white, tipped with fuscous); feet grayish white, washed with pinkish buff; soles hair-brown; palms grayish white, tinged with drab; underparts grayish white, washed with pinkish buff, or in some specimens nearly solid pinkish buff. *Summer pelage:* Upperparts cinnamon-buff or pinkish buff, moderately mixed with fuscous; hinder back and rump often washed with smoke-gray; sides cinnamon-buff or pinkish buff, ears dark mouse-gray or chaetura black; feet whitish, pinkish buff, or deep cream buff; soles and palms as in winter pelage; underparts whitish, faintly or sometimes heavily washed with pinkish buff or cream buff.

Molt.—The beginning of the midsummer molt is shown by a specimen from Elk Summit, Idaho, August 4, in which the new summer pelage is coming in on the head and in a small spot on the middle of the back. Specimens taken in the Lemhi Mountains in August are in full summer pelage, some of them showing considerable wear. One taken there on August 27 shows the fresh winter pelage coming in over the whole of the fore back; another from head of Wood River, Idaho, September 25, is in about the same condition of molt, while in two others from the same place, October 5, the entire dorsal surface is clothed with new winter pelage.

Skull.—Averaging smaller than in *princeps*, with narrower braincase and interorbital constriction; nasals narrowed posteriorly; interpterygoid fossa averaging broader, with a tendency to be more spatulate.

Measurements.—Average of 10 adults (8 males, 2 females) from type locality: Total length, 178.7; hind foot, 29.5. *Skull:* Average of 5 males and 5 females[35] from Lemhi Mountains and mountains near Birch Creek: Occipito-nasal length, 42.9; 41.4 (40.1–44.1); zygomatic breadth, 21.2; 20.5 (20–22); breadth of braincase, 17.9; 16.8 (16.1–18.5); interorbital breadth, 4.9 (4.6–5.3); width of palatal bridge, 2 (1.7–2.5); length of nasals, 14.2; 14.1 (13.2–14.9).

Remarks.—The Lemhi pika is a strongly marked form whose relationships are not as yet clearly understood. It undoubtedly intergrades with *princeps* somewhere in central Idaho and probably also with *ventorum* in southwestern Montana. Specimens of *princeps* from Mullan, Idaho, and Silver [Saltese], Montana, show a tendency to vary in skull characters in the direction of *lemhi*.[36] Two specimens from

[35] Averaged separately, the first measurement in each case being that of the males.
[36] As shown under *princeps*, p. 14.

Seven Devils Mountains, in western Idaho, are provisionally referred to *lemhi;* their skulls are typical of this form, but the hind feet are longer and the coloration of one of them is decidedly darker.

Specimens examined.—Total number, 40, as follows:

Idaho: Birch Creek [=mountains east], 4; Elk Summit (about 15 miles southeast of Warren), 2; Ketchum, 3;[37] Leadore [=mountains east], 3; Lemhi Mountains[38] (10 miles west of Junction), 18; Little Lost River mountains (near Birch Creek), 1; Seven Devils Mountains, 2; Stanley Lake, 3;[39] Wood River (near head), 4.

OCHOTONA PRINCEPS VENTORUM Howell.

Wyoming Pika.

Ochotona uinta ventorum Howell, Proc. Biol. Soc. Washington, vol. 32, p. 106, May 20, 1919.

Type.—Collected on Fremont Peak, Wind River Mountains, Wyoming, July 19, 1911, by H. E. Anthony; ♂ adult, skin and skull; No. 176778, U. S. National Museum, Biological Survey collection; original number, 395.

Geographic distribution.—Wind River, Gros Ventre, Absaroka, and Teton Ranges, Wyoming, north to the Beartooth and Absaroka Ranges in southern Montana. (Fig. 2, p. 11.)

Characters.—Similar to *princeps*, but coloration in summer pelage more buffy and less varied with blackish; skull averaging larger, with longer nasals and broader interpterygoid fossa. Compared with *levis*, the coloration is darker and more buffy and the skull much larger.

Color.—*Winter pelage* (Gros Ventre Range, near Jackson, Wyoming, September 19): General tone of upperparts between drab and wood-brown, shading on sides to light pinkish cinnamon; head and back washed with fuscous, front of face with clay color, and rump with blackish; ears deep mouse-gray, margined with buffy white; feet pinkish buff; soles hair-brown; palms buffy white, tinged with light drab; underparts soiled whitish, faintly washed with pinkish buff. *Summer pelage:* Upperparts mixed cinnamon-buff or pinkish cinnamon and fuscous-black, the general tone yellowish wood-brown; sides pinkish cinnamon or pinkish buff; ears chaetura drab, margined with buffy white; feet pinkish buff or pale pinkish buff; soles hair-brown; palms buffy white, tinged with light drab; underparts grayish white, moderately or sometimes heavily washed with pinkish buff or light pinkish cinnamon.

Skull.—Similar to *princeps*, but averaging larger; nasals longer and narrower posteriorly; interpterygoid fossa decidedly broader and usually more spatulate.

Measurements.—Average of 12 adults (7 males, 5 females) from Wind River Mountains, Wyoming: Total length, 197 (185–216); hind foot, 31.1 (29–33). *Skull*: Average of 6 adult males from Wind River Mountains: Occipito-nasal length, 45.2 (44–46.1); zygomatic breadth, 22 (21.5–22.6); breadth of braincase, 18 (17.3–18.5); interorbital breadth, 5 (4.6–5.6); width of palatal bridge, 2.2 (2–2.7); length of nasals, 15 (14.4–15.6). Average of 4 adult females from same

[37] Collection Mus. Comp. Zool.
[38] Recorded as "Salmon River Mts." in North Amer. Fauna No. 5, p. 74, 1891.
[39] Collection Amer. Mus. Nat. Hist.

localities: Occipito-nasal length, 44.5 (43.4–46.7); zygomatic breadth, 21.4 (21.2–21.6); breadth of braincase, 17.9 (17.3–18.5); interorbital breadth, 4.8 (4.6–5.2); width of palatal bridge, 1.8 (1.5–2); length of nasals, 14.5 (13.7–15.1).

Remarks.—This race resembles *princeps* rather closely in coloration, but is distinguished by pronounced skull characters. Intergradation between them is not definitely shown by the series in hand, but more material from extreme southwestern Montana doubtless will establish beyond question their subspecific relationship.

A small series from Emigrant Peak, Montana, agree in color and external measurements with *ventorum;* their skulls, however, are somewhat smaller and the nasals are shorter and broader—characters indicating an approach to *princeps* or possibly also to *lemhi.* Specimens from the Absaroka and Beartooth Mountains have somewhat smaller skulls than the typical series but agree with them in having long nasals. A considerable series from the Teton Range is referable to this race, though perhaps shading toward *uinta:* specimens in summer pelage agree well with the Wind River series of *ventorum* but have more buffy hind feet, a specimen from Teton Pass acquiring winter pelage (September 15) is light drab above, more grayish than specimens of *ventorum* from the Gros Ventre Range, near Jackson, and not at all like specimens of typical *uinta* in corresponding pelage.

The form occurring in the Big Horn Mountains is provisionally referred to this race, but material in fresh pelage may show it to be different. Specimens in worn winter pelage (June) agree closely with July specimens in corresponding pelage from the Wind River Mountains, but are slightly more buffy on the sides.

Specimens examined.—Total number, 77, as follows:

Montana: Beartooth Mountains, 8; Emigrant Peak, 7.[40]

Wyoming: Big Horn Mountains (head of Trappers Creek), 7; Fremont Peak (at 11,500 feet altitude), 9; Gros Ventre Mountains, near Jackson, 3; Lake Fork, Wind River Mountains, 13; Middle Piney Lake, near Stanley, 1; Needle Mountain, 4; Pahaska (Whirlwind Peak), 5; Teton Mountains (South Moose Creek, at 10,000 feet altitude), 12; Teton Pass, 2; Wind River Mountains (12 miles northeast of Kendall, at 11,000 feet altitude), 3; Yellowstone Park, 3 (Mammoth Hot Springs, 1; Upper Yellowstone, at Park boundary, 2).

OCHOTONA PRINCEPS UINTA Hollister.

Uinta Pika.

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

Ochotona uinta Hollister, Proc. Biol. Soc. Washington, vol. 25, p. 58, April 13, 1912.

Type.—Collected in the Uinta Mountains, near head of east fork of Bear River, Utah,[41] September 28, 1870, by the Hayden Expedition; adult, skin only; No. 9750, U. S. National Museum; original number, 567.

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[40] Two in collection Mus. Comp. Zool.

[41] The itinerary of the Hayden Expedition shows that the party was camped on the night of September 26–27 on the divide between the west fork of Blacks Fork and the east fork of Bear River at an altitude of 11,066 feet, and in all probability the type of *O. uinta* was taken near this camp. The original label on the type specimen records the date of capture as September 28, but a study of the records of the expedition (pp. 52, 495) shows that on that date they were at the Sulphur Creek camp, at 7,376 feet altitude, probably much below the range of the pikas. On the label of another specimen taken on the same trip the date has been altered from September 28 to 27, which strengthens the view that both specimens were taken at the higher camp near timber line and possibly not labeled till the next day (see Prelim. Rept. U. S. Geol. Surv., Wyoming [=4th Ann. Rept. U. S. Geol. Surv.], 1871, pp. 44–54, 495)

Geographic distribution.—The Uinta and Wasatch Ranges, in Utah, and the Salt River and Wyoming Ranges, in western Wyoming. (Fig. 2, p. 11.)

Characters.—Similar to *ventorum*, but coloration in winter pelage decidedly more buffy (less grayish); in summer pelage more intensely buffy, both dorsally and ventrally.

Color.—*Winter pelage:* General tone of upperparts buffy wood-brown, shading on sides to light vinaceous-cinnamon or light pinkish cinnamon; dorsal area moderately shaded with fuscous, darkest in the median line and on top of head; feet pinkish buff; soles drab or hair-brown; palms soiled whitish; ears fuscous or fuscous-black, margined with light buff; underparts soiled whitish, washed with pinkish buff or light pinkish cinnamon. *Summer pelage* (specimen from head of Smith Fork, Salt River Range, Wyoming): General tone of upperparts between cinnamon-buff and pinkish cinnamon, moderately shaded (chiefly on hinder back) with fuscous-black; sides pinkish cinnamon: ears deep mouse-gray or chaetura black edged with light buff; feet light ochraceous-buff; soles hair-brown; palms pinkish buff; underparts buffy white, washed with pinkish buff or light pinkish cinnamon, darkest along the median line.

Skull.—Closely similar to *ventorum;* possibly averaging slightly broader, with broader nasals.

Measurements.—Adult male and adult female from Uinta Mountains, Utah: Total length, 210; 205; hind foot, 29. Average of 3 adult males from Salt River Range, Wyoming; 192; 30.3. *Skull:* Average of 3 adult males from Uinta Mountains, Utah, and Salt River Mountains, Wyoming:[42] Occipito-nasal length, 45.3 (45.3); zygomatic breadth, 21.9 (22.1); breadth of braincase, 18.2 (17.5); interorbital breadth, 5.1 (5.1); width of palatal bridge, 2.2 (2.4); length of nasals, 15.5 (15.7). Average of 5 adult females from same localities:[42] Occipito-nasal length, 43.7 (44.2); zygomatic breadth, 21.3 (22); breadth of braincase, 18 (18.4); interorbital breadth, 5 (5.1); width of palatal bridge, 2 (2.8); length of nasals, 14.7 (15).

Remarks.—The distribution and relationships of this race, which is very poorly represented in the material at hand, are not accurately known. The only specimens available from the type region are 3 skins in fresh winter pelage, without skulls, taken by the Hayden Expedition, in 1870, and 2 skins in worn winter pelage, with skulls, taken by Vernon Bailey, in 1890. It is the most uniformly buffy-colored race of all the American forms. In the absence of any specimens in summer pelage from the type locality, specimens from the Salt River Range, Wyoming, are used for comparison in that pelage. These, however, may prove to be intermediate between *uinta* and *ventorum*, as specimens from farther north, in the Teton Range, certainly are.

Specimens examined.—Total number, 22, as follows:

Utah: Uinta Mountains, 5 (near head Bear River, 3; near head Black Fork, 2); Wasatch Mountains, 1.[43]

Wyoming: La Barge Creek, Salt River Mountains (9,000 feet), 6; Smith Fork (at head), Salt River Mountains, 3; Salt River Mountains, 7.

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[42] Measurements of one topotype in parentheses.

[43] No definite locality.

OCHOTONA PRINCEPS NEVADENSIS Howell.

Ruby Mountains Pika.

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

Ochotona uinta nevadensis Howell, Proc. Biol. Soc. Washington, vol. 32, p. 107, May 20, 1919.

Type.—Collected in the Ruby Mountains, southwest of Ruby Valley Post Office, Nevada (at 10,500 feet altitude), June 21, 1898, by Vernon Bailey; ♀ adult, skin and skull; No. 94213, U. S. National Museum, Biological Survey collection; original number, 6580.

Geographic distribution.—Known only from Ruby Mountains, Nevada. (Fig. 2, p. 11.)

Characters.—Similar (in worn winter pelage) to *uinta*, but distinctly paler; sides of nose and face more extensively grayish.

Color.—*Worn winter pelage:* Upperparts mixed pinkish buff and fuscous, darkest in the median line and on front of face; sides of nose and face smoke-gray; ears fuscous, margined with light buff; sides pinkish buff; feet pale pinkish buff; soles drab; palms soiled buffy white; underparts grayish white, moderately washed with pinkish buff.

Skull.—Closely similar to *uinta*.

Measurements.—One adult female (type) and one adult male (topotype): Total length, 200, 190; hind foot, 32, 30. *Skull* (same specimens): Occipito-nasal length, 44.1, 42; zygomatic breadth, 21.2, 21.1; breadth of braincase, 18, 17.9; interorbital breadth, 5.2, 5.4; width of palatal bridge, 2.8, 2.5; length of nasals, 14.5, 14.3.

Remarks.—The Ruby Mountains pika is closely related to *uinta* and is specifically distinct from *cinnamomea* of the Beaver Mountains, Utah, and the Toyabe Mountains, Nevada. In the absence of specimens in fresh pelage, its characters can not be fully described, and additional material may show greater differences than are indicated by the small series examined. The skull of the type (an adult female) resembles the skull of *uinta* very closely; a single adult male topotype, however, is considerably shorter and has the cranium noticeably elevated in the fronto-parietal region.

Specimens examined.—Total number, 3, from type locality.

OCHOTONA PRINCEPS FIGGINSI J. A. Allen.

Figgins Pika.

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

Ochotona figginsi J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 31, p. 103, May 28, 1912.

Ochotona saxatilis figginsi Henderson and Cockerell, Proc. Biol. Soc. Washington, vol. 26, p. 127, 1913.

Type.—Collected on Pagoda Peak, Rio Blanco County, Colorado, October 30, 1910, by J. D. Figgins; ♀ adult, skin and skull; No. 32721, American Museum of Natural History; original number, 6.

Geographic distribution.—Western Colorado, from Gunnison County north to eastern Routt County (Hahn Peak) and to Bridger Peak, Wyoming. (Fig. 2, p. 11.)

Characters.—Similar to *uinta*, but winter pelage more grayish (less buffy) and more varied with blackish; summer pelage darker (more blackish). Compared with *saxatilis*, the size is smaller and the coloration darker and more vinaceous.

Color.— *Winter pelage* (November): Upperparts mixed vinaceous-cinnamon or light vinaceous-cinnamon and fuscous, more or less shaded with grayish white, the general tone varying from drab to cinnamon-drab; sides vinaceous-cinnamon or light vinaceous-cinnamon; ears chaetura drab, margined with buffy white; feet light pinkish cinnamon; soles hair-brown; palms soiled whitish, washed with light drab; underparts grayish white, faintly or sometimes moderately washed with pinkish cinnamon. Specimens in fresh winter pelage (September 21) are much more blackish than November specimens, being mixed vinaceous-cinnamon and fuscous-black above. *Summer pelage* (September): Closely similar above to corresponding pelage of *saxatilis;* sides a deeper shade of vinaceous-cinnamon; underparts moderately, sometimes heavily, washed with light vinaceous-cinnamon or light pinkish cinnamon; feet light pinkish cinnamon or cinnamon-buff.

Skull.—Practically identical with *uinta:* similar to *saxatilis* but averaging smaller, with shorter nasals.

Measurements.—Average of 9 adults (6 males, 3 females) from type locality: Total length, 190.4 (184–197); hind foot, 30.1 (28.4–31.8). *Skull:* Average of 4 adult males from vicinity of type locality: Occipito-nasal length, 43.9 (42.8–44.7); zygomatic breadth, 21.6 (21–22.3); breadth of braincase, 18.3 (17.9–19.2); interorbital breadth, 5.1 (4.7–5.5); width of palatal bridge, 2.5 (2–2.8); length of nasals, 14.7 (14.2–15.3). Average of 4 adult females from same region: Occipito-nasal length, 42.9 (42.1–43.7); zygomatic breadth, 21.1 (20.7–21.4); breadth of braincase, 17.8 (17–19); interorbital breadth, 5.3 (5–5.7); width of palatal bridge, 1.9 (1.7–2); length of nasals, 14.8 (13.9–15.3).

Remarks.—Although separated from the range of *uinta* by an Upper Sonoran and Transition area of considerable width, the present form nevertheless is very closely related to that race, and the specific differences are overlapped by individual variation. In other words, while the two forms are readily distinguishable when a good series of specimens is available, individual specimens occur in both races which are difficult to tell apart. The skulls of the two forms, judging by a rather meager series, are practically identical. For these reasons it has seemed best to unite *saxatilis* and its races with *uinta* and its races as subspecies of *princeps*.

Specimens from Mount Zirkel are clearly intermediate between *figginsi* and *saxatilis;* those in fresh winter pelage are nearest to *figginsi* in coloration but the skulls agree closely with those of *saxatilis;* one skin in worn summer pelage is very similar to *saxatilis*. Specimens from Gunnison County (Irwin and Crested Butte) are likewise intermediate, some individuals agreeing with *figginsi*, others with *saxatilis;* the skulls being all smaller than those of *saxatilis*.

Specimens examined.—Total number, 41, as follows:

Colorado: Baldy Mountain (near Mount Zirkel), 3;[44] Crested Butte, 2;[44] Irwin, Gunnison County, 2;[45] Mount Zirkel, Larimer County, 6;[46] Pagoda Peak, 16;[47] Sand Mountain (9 miles southwest of Hahns Peak Post Office), 1; Trappers Lake, Garfield County, 7;[44] White House Mountain (near Marble), 2.[44]

Wyoming: Bridger Peak, Sierra Madre Mountains, 2.

[44] Collection of E. R. Warren.
[45] One in collection E. R. Warren; one in collection Mus. Comp. Zool.
[46] Collection Colorado Mus. Nat. Hist.
[47] Twelve in collection Colorado Mus. Nat. Hist.; 3 in collection Amer. Mus. Nat. Hist.

OCHOTONA PRINCEPS SAXATILIS Bangs.

COLORADO PIKA.

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

Ochotona saxatilis Bangs, Proc. New England Zool. Club, vol. 1, p. 41, June 5, 1899.

Type.—Collected at Montgomery, near Mount Lincoln, Park County, Colorado, July 27, 1871, by J. A. Allen;[48] ♂ adult (skin only); No. 2703, Museum of Comparative Zoology; original number, 945.

Geographic distribution.—Easterly mountain ranges of middle Colorado from the Medicine Bow Range south to the Sangre de Cristo Range; northward to Medicine Peak, Wyoming; westward in southern Colorado to the San Juan Range and to the La Sal Mountains in eastern Utah; altitudinal range approximately from 9,000 to 13,500 feet.[49] (Fig. 2, p. 11.)

Characters.—Size large; similar in coloration to *figginsi*, but coloration in winter pelage paler and more grayish (less vinaceous); in summer pelage slightly paler above and underparts less washed with vinaceous. Compared with *ventorum:* Coloration in winter pelage more grayish in general tone, the sides light ochraceous-buff instead of pinkish cinnamon, and the underparts more heavily washed with buff; in summer pelage the upperparts are usually a deeper shade of buff or cinnamon. Compared with *uinta*, the winter pelage is decidedly more grayish (less buffy).

Color.—Winter pelage: General tone of upperparts avellaneous, with a buffy ochraceous cast, moderately washed with fuscous-black; face, and head between eyes, dull cinnamon buff; sides light pinkish cinnamon, shading to pinkish buff; ears chaetura black, margined with light buff and clothed inside with buffy-white hairs; feet pinkish buff; soles hair-brown; palms soiled whitish, tinged with drab; underparts soiled whitish, moderately washed with pinkish buff. *Summer pelage:* Upperparts pinkish cinnamon or light pinkish cinnamon mixed with fuscous, the cinnamon shades usually prevailing; sides paler, shading along line of belly to light pinkish cinnamon or pinkish buff; ears chaetura drab, margined with light buff and clothed on inside with buffy-white hairs; front feet pinkish cinnamon or light pinkish cinnamon, the palms soiled whitish; hind feet light pinkish cinnamon varying to buffy white, the soles hair-brown; underparts whitish, washed with pinkish buff or pale cinnamon-buff.

Molt.—In a series of 24 adults from Mount Lincoln, Colorado, taken July 20, 1871, the midsummer molt is well advanced, and in about half the specimens it is nearly or quite complete; in several it is just beginning on the head, shoulders, and fore back; 2 adult females in the series show no signs of molting, apparently having carried the winter pelage to this date with relatively little wear; 2 young individuals about two-thirds grown, taken the same day, also show no sign of molting but have a moderately full, uniform pelage, similar to that of the adults, but duller in color.

In a specimen (♂ adult) from Geneva Park, Colorado, August 31, 1910, the midsummer molt has progressed on the back about three-fourths of the distance from nose to tail, but on the sides less than half that distance, the old, gray winter fur showing on rump in strong contrast to the fresh ochraceous summer coat.

[48] Cf. Allen, Bull. Amer. Mus. Nat. Hist., vol. 31, p. 103 (footnote), 1912.
[49] Cf. Cary, North Amer Fauna No. 33, p. 151, 1911.

A specimen from Colorado without date shows the midsummer molt beginning on the face and also in isolated patches on the nape, shoulders, and back.

The beginnings of the fall molt are not well shown by the material in hand; 3 specimens from Mount Lincoln, taken September 26 and 28, 1914, have practically completed the molt on the upperparts, though not on the belly; the molting line may be plainly seen on the lower sides.

Specimens from Geneva Park, taken in November, have a longer, fuller pelage than September specimens and the coloration is more grayish—the fuscous or blackish tints on the back and the ochraceous on the head and face decidedly less prominent.

Skull.—Similar to *figginsi*, *uinta*, and *ventorum*, but averaging larger; nasals long and rather narrow posteriorly.

Measurements.—Average of 10 adults (5 males, 5 females) from Mount Lincoln region and the Front Range (Corona and Mount Kelso): Total length, 195 (177–202); hind foot, 32.2 (32–33). *Skull:* Average of 6 adult males from the Front Range and Mount Lincoln: Occipito-nasal length, 45.5 (44.6–48.1); zygomatic breadth, 22 (21.3–23.2); breadth of braincase, 18.8 (17.9–19.6); interorbital breadth, 5.5 (5–5.9); width of palatal bridge, 2.4 (2.1–2.8); length of nasals, 15.3 (14.9–16.3). Average of 8 adult females from same localities: Occipito-nasal length, 45.3 (44.2–47.3); zygomatic breadth, 21.7 (21.1–22.4); breadth of braincase, 18.5 (17.8–19.3); interorbital breadth, 5.5 (5.2–5.9); width of palatal bridge, 2.2 (1.8–2.8); length of nasals, 15.7 (14.9–17).

Remarks.—The Colorado pika is the largest member of the genus, and is easily recognized either by the large skull with long nasals or by the general buffy-grayish coloration. It has an extensive range on the high mountains of Colorado, intergrading with *figginsi* on the westward and with *incana* and *nigrescens* on the southward.

A large series from Silverton, Colorado, in winter pelage, although practically typical in external characters, shows intergradation with *nigrescens* in cranial characters, some skulls being decidedly smaller than others. The average of the total length is about 5 per cent shorter, but the nasals are practically the same length as those of *saxatilis*.

Specimens examined.—Total number, 160, as follows:

Colorado: Alma, Park County, 13;[50] Bald Mountain [near Ward, Boulder County], 1; Berthoud Pass, 1;[51] Boreas Pass, Summit County, 5;[52] Boulder County, 11;[53] Corona [near Arrow, Grand County], 11;[54] Crystal Lake (5 miles west of Lake City), 2; Dixie Lake [near Arrow, Grand County], 4;[54] Estes Park, 5;[51] Geneva Park (about 70 miles west of Denver), 6;[51] Irwin Lakes, 1 (skull); Longs Peak, 5; Middle Brush Creek, Gunnison County, 2;[55] Montgomery (near Mount Lincoln), Park County, 29;[56] Mount Kelso, 1; Mount Lincoln, 8;[57] Mount Meeker, 4;[51] Mount Shavano, 3;[55] Pikes Peak, 5;[55] Silverton, 17; Ten Mile Creek, Summit County, 1;[55] Twin Lakes, 3; Ward, 3;[58] no specific locality, 16.

Utah: La Sal Mountains, 1.

Wyoming: Medicine Bow Mountains, 2.

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[50] Seven in collection of E. R. Warren, Colorado Springs, Colorado; 3 in collection Colorado Mus. Nat. Hist.

[51] Collection Amer. Mus. Nat. Hist.

[52] Three in collection of E. R. Warren; 1 in collection Amer. Mus. Nat. Hist.; 1 in collection Mus. Vert. Zool.

[53] Seven in collection Field Mus. Nat. Hist.

[54] Collection Colorado Mus. Nat. Hist.

[55] Collection of E. R. Warren.

[56] Collection Mus. Comp. Zool.

[57] Five in collection of E. R. Warren.

[58] Two in collection Amer. Mus. Nat. Hist.

OCHOTONA PRINCEPS INCANA Howell.

New Mexico Pika.

Ochotona saxatilis incana Howell, Proc. Biol. Soc. Washington, vol. 32, p. 107, May 20, 1919.

Type.—Collected on Pecos Baldy, New Mexico (at 12,000 feet altitude), August 10, 1903, by Vernon Bailey; ♀ adult, skin and skull; No. 128944, U. S. National Museum, Biological Survey collection; original number, 8079.

Geographic distribution.—High mountains of northern New Mexico, from Pecos Baldy north to the Culebra Range and probably to Sierra Blanca, Colorado (Fig. 2, p. 11.)

Characters.—Similar in size and coloration to *saxatilis*, but general tone of upperparts in summer pelage paler and less tawny; in winter pelage more grayish and less ochraceous. Compared with *nigrescens*, the upperparts are paler and more buffy.

Color.—Summer pelage: General tone of upperparts between cinnamon-buff and pinkish buff, moderately washed with fuscous or fuscous-black; sides cinnamon-buff, shading posteriorly to pinkish buff; ears chaetura black, margined with buffy white and blotched on inner surface with the same color; feet pinkish buff, washed with cinnamon-buff; soles chaetura drab; palms soiled whitish, tinged with drab; underparts soiled whitish, washed with pinkish buff. *Winter pelage* (specimen from near Twining, October 7): Upperparts nearly uniform pale smoke-gray, faintly tinged on fore back with buffy brown; sides of face and shoulders washed with pinkish buff and light pinkish cinnamon and faintly washed with fuscous; ears deep mouse-gray, margined with light buff; hind feet soiled whitish, tinged with pinkish buff, the soles hair-brown; front feet pinkish buff, the palms buffy white; underparts soiled whitish, very faintly tinged with light buff.

Skull.—Closely similar to *saxatilis;* nasals averaging slightly shorter.

Measurements.—Average of 7 adults (4 males, 3 females) from Pecos River Mountains and Taos Mountains, New Mex.: Total length, 190.5; hind foot, 30.5. *Skull:* Average of 4 adult males from Pecos Baldy and Truchas Peak: Occipito-nasal length, 45 (44.3–45.8); zygomatic breadth, 22 (21.8–22.3); breadth of braincase, 19 (18.8–19.5); interorbital breadth, 5.4 (5–5.8); width of palatal bridge, 2.5 (2.2–2.8); length of nasals, 15 (14.3–15.6). Average of 3 adult females from Pecos Baldy and Wheeler Peak, New Mex.: Occipito-nasal length, 44.6 (43-46.8); zygomatic breadth, 21.7 (21.3–22.5); breadth of braincase, 18.8 (18.3–19.1); interorbital breadth, 5.4 (5.2–5.6); width of palatal bridge, 2.5 (2.2–2.8); length of nasals, 14.5 (13.8–15.8).

Remarks.—Intergradation doubtless takes place in southern Colorado between this subspecies and its nearest relative, *saxatilis.* The characters on which the form is based are to some extent overlapping, but the differences are apparent when series in summer pelage are compared.

Specimens examined.—Total number, 13, as follows:

Colorado: Medano Creek (head), Saguache County, 1.[59]
New Mexico: Culebra Mountain, 1; Pecos Baldy, 5; Truchas Peak, 4; Twining [= Wheeler Peak], 2.

[59] Collection of E. R. Warren.

OCHOTONA PRINCEPS NIGRESCENS Bailey.

JEMEZ MOUNTAINS PIKA.

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

Ochotona nigrescens, Bailey, Proc. Biol. Soc. Washington, vol. 26, p. 133, 1913.

Type.—Collected in the Jemez Mountains, New Mexico (at 10,000 feet altitude), August 28, 1906, by Vernon Bailey; ♂ adult, skin and skull; No. 147976, U. S. National Museum (Biological Survey collection); original number, 8447.

Geographic distribution.—Jemez Mountains, New Mexico, north to the southern end of the San Juan Mountains, Colorado. (Fig. 2, p. 11.)

Characters.—Similar in summer pelage to *saxatilis*, but upperparts darker and more grayish (less buffy). Compared with *figginsi:* Color in summer pelage decidedly more grayish (less brownish); skull about the size of that of *figginsi*, smaller than in *saxatilis* or *incana*.

Color.—*Summer pelage* (August 28): Head, shoulders, and fore back mixed fuscous and pinkish cinnamon, shaded with light buff; hinder back smoke-gray, sparingly mixed with fuscous; sides of face and neck washed with pinkish cinnamon and sides of body with light pinkish cinnamon; ears blackish on both surfaces, narrowly margined with light buff and with a patch of grayish white on inner surface; feet light pinkish buff; soles fuscous; palms soiled whitish, washed with light drab; underparts grayish white, washed with light pinkish cinnamon (not cinnamon-brown, as in original description).

Skull.—Very similar to that of *figginsi*, but slightly smaller; decidedly smaller than that of *saxatilis* or of *incana*.

Measurements.—Three adults (2 males, 1 female) from type locality each measured: Total length, 200; hind foot, 30. *Skull.* Type: Occipito-nasal length, 43.3; zygomatic breadth, 20.9; breadth of braincase, 18; interorbital breadth, 5.3; width of palatal bridge, 2.1; length of nasals, 14.3.

Remarks.—In its typical form this race occupies the isolated mountain area of the Jemez Mountains in northern New Mexico. A series from Navajo Peaks—a spur of the San Juan Range in extreme southern Colorado—is provisionally referred to *nigrescens*, though apparently it is about as close in characters to *saxatilis*. In color these specimens average darker above than *saxatilis* but are not so gray as *nigrescens*; some of the skulls are nearly typical of *nigrescens*, while others agree well with *saxatilis*. The typical winter pelage is unrepresented; intermediate specimens from Osier, Colorado, taken late in July, still retain some of the worn winter pelage, which averages somewhat darker than that of typical *saxatilis*.

Specimens examined.—Total number, 20, as follows:

Colorado: Cumbres, 3; Navajo Peaks, Archuleta County, 4;[60] Osier, 4;[60] Upper Navajo River, 6.[60]
New Mexico: Jemez Mountains, 3.

[60] Collection Colorado Mus. Nat. Hist.

OCHOTONA PRINCEPS CUPPES Bangs.

Bangs Pika.

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

Ochotona cuppes Bangs, Proc. New England Zool. Club, vol. 1, p. 40, June 5, 1899.

Type.—Collected on the Monashee Divide, Gold Range, British Columbia (at 4,000 feet altitude), August 2, 1897, by Allan Brooks; ♂ subadult, skin and skull; No. 7389, Museum of Comparative Zoology; original number, 1030.

Geographic distribution.—Southeastern British Columbia, northeastern Washington, and northern Idaho, from Glacier south to Cabinet Mountains; west to the Gold Range, British Columbia; exact limits unknown. (Fig. 2, p. 11.)

Characters.—Similar to *princeps* but coloration darker, the upperparts and sides (in summer pelage) suffused with ochraceous-tawny instead of cinnamon-buff, the underparts pinkish cinnamon instead of pinkish buff.

Color.—*Type* (acquiring summer pelage): Head, shoulders, and fore back mixed ochraceous-tawny and fuscous; hinder back and sides (still retaining old worn pelage) mixed pinkish cinnamon and light buff, with scattering grayish hairs on dorsal surface; sides of neck ochraceous-tawny; ears chaetura drab, broadly edged with buffy white; hind feet pinkish buff, the soles chaetura drab; front feet cinnamon-buff, the palms buffy white, tinged with drab; underparts pinkish cinnamon, becoming ochraceous-tawny on throat.

Skull.—Not appreciably different from *princeps*.

Measurements.—(Subadult male, type): Total length, 190, hind foot, 30. *Skull*: (Type and an old male from Glacier, British Columbia): Occipito-nasal length, 43.4, 46; zygomatic breadth, 21.9, 22.5; breadth of braincase, 19, 18.3; interorbital breadth, 5; width of palatal bridge, 2.3, 3.5; length of nasals, 13.5, 15.4.

Remarks.—Bangs pika is a dark form of *princeps* occupying, probably, most of southeastern British Columbia. It is poorly represented in collections, and therefore its characters are imperfectly known. Five specimens from Glacier, British Columbia, agree in coloration with the type of *cuppes;* only one adult skull is available from that locality, however, and it is considerably larger than the type—about equaling the largest skulls of *princeps*. Three specimens from Rossland, British Columbia, have somewhat lighter underparts than typical *cuppes*.

A series of 5 adults in fresh winter pelage from Cabinet Mountains, Idaho, is provisionally referred to this race, but additional material in winter pelage from the type region of *cuppes* may show the Idaho specimens to be a recognizable race. In color these specimens are decidedly darker than specimens of *princeps* in the same pelage;[61] the skulls, compared with those of *cuppes*, are relatively shorter and broader.

[61] Upperparts mixed pinkish cinnamon and fuscous or fuscous-black, sometimes washed with smoke-gray; underparts pale pinkish buff; more or less washed with cinnamon-buff; soles dark hair-brown or fuscous; ears and feet as in *princeps*.

A series from Nelson, British Columbia, agrees well in cranial characters with typical *cuppes*, though one specimen in the series has a skull like the Cabinet Mountains series; the only one in summer pelage is somewhat paler than *cuppes* and not appreciably different from *princeps*, but others in winter pelage are darker than *princeps* in the same pelage and almost as dark as the Cabinet Mountains specimens.

Specimens examined.—Total number, 30, as follows:

British Columbia: Glacier, 6;[62] Monashee Divide, Gold Range, 4;[63] Nelson (Toad Mountain, 6 miles south), 10, Rossland, 3;[64].
Idaho: Cabinet Mountains, 5.
Washington: Sullivan Lake, Pend Oreille County, 2.

OCHOTONA PRINCEPS FENISEX Osgood.

Ashnola Pika.

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

Lagomys minimus Lord, Proc. Zool. Soc. London, 1863, p. 98 (not *Lagomys minimus* Schinz).
Ochotona minimus Elliot, Field Columbian Mus., Zool. Ser., vol. 2, p. 269, 1901 (not *Lagomys minimus* Schinz).
Ochotona fenisex Osgood, Proc. Biol. Soc. Washington, vol. 26, p. 80, March 22, 1913 (new name for *Lagomys minimus* Lord).

Type.—Collected on "Ptarmigan Hill," near head of Ashnola River, Cascade Range, British Columbia,[65] in early fall, 1860 (?), by J. K. Lord; sex unknown; skin No. 62.12.30.11; skull, No. 1443a (osteological collection), British Museum.[66]

Geographic distribution.—Interior mountain ranges of northern Washington and southern British Columbia from vicinity of Wenatchee, Washington, north to the upper end of Okanagan Lake. (Fig. 2, p. 11.)

Characters.—Similar to *cuppes*, but coloration in summer pelage paler and less ochraceous, especially on head, shoulders, and underparts; hind feet more whitish (less buffy); sides of nose washed with gray; very similar to *cuppes* in winter pelage, but hind feet and underparts paler (less buffy). Skull similar to that of *cuppes*, but averaging slightly smaller, with shorter nasals.

Color.—*Winter pelage* (Okanagan, British Columbia, November): Upperparts mixed fuscous and light pinkish cinnamon, the general tone varying between hair-brown and wood-brown; sides pinkish cinnamon or light pinkish cinnamon, more or less clouded with fuscous; sides of nose smoke-gray or pale smoke-gray; sides of face sometimes tinged with grayish; ears chaetura black, margined with buffy white; feet white, the fore feet washed with pinkish buff; soles hair-brown or chaetura drab; palms soiled whitish, washed with drab; underparts grayish white, washed with pinkish buff or light pinkish cinnamon. Specimens in fresh fall pelage (Okanagan, British Columbia, September 30) differ from November specimens in having the upperparts a paler shade of pinkish cinnamon or light buff, rather heavily washed on hinder back with blackish, and the underparts

[62] Three in collection Acad. Nat. Sci. Philadelphia.
[63] Collection Mus. Comp. Zool.
[64] Collection Victoria Mem. Mus.
[65] Cf. Lord, J. K., Naturalist in British Columbia, vol. 1, p. 321, 1866.
[66] Selected by Oldfield Thomas as lectotype from 3 specimens collected by Lord.

more heavily washed with light pinkish cinnamon, becoming almost pinkish cinnamon on chest. *Summer pelage* (Bald Mountain, Washington, September 7): Upperparts mixed pinkish cinnamon and fuscous, the general tone more tawny and less drabby than in winter pelage; sides pinkish cinnamon or light pinkish cinnamon.

Molt.—A specimen (♂ subadult) from Tulameen, British Columbia, June 11, shows the midsummer molt just beginning in a small patch of new hair on top of the head; another (♀ adult) from Okanagan, June 14, has a small patch of the new pelage in the middle of the nape. An adult male from Horseshoe Basin, Washington, July 22, shows the fresh summer pelage covering the head, shoulders, and fore back.

An adult male from Wenatchee, Washington, September 19, apparently is acquiring winter pelage, the new hair covering most of the dorsal area excepting the rump. In a specimen from Okanagan, British Columbia, September 30, new winter pelage covers the entire dorsal surface and the sides, but not the belly. Specimens from the same locality in May and June show the same pelage as fall specimens, with indications of moderate wear.

Skull.—Similar to *cuppes*, but averaging slightly smaller, with shorter nasals.

Measurements.—Average of 10 adults (5 males, 5 females) from Bald Mountain, Washington: Total length, 183 (165–190); hind foot, 31.5 (31–32). *Skull*: Type: Occipito-nasal length, 42; zygomatic breadth, 22; breadth of braincase, 18.7; interorbital breadth, 6; width of palatal bridge, 3; length of nasals, 13.4. Average of 6 adults (including the type) from type region (Bald Mountain and Horseshoe Basin, Washington): Occipito-nasal length, 42.9 (42–43.8); zygomatic breadth, 21.6 (21–22); breadth of braincase, 18.6 (18.2–19.2); interorbital breadth, 5.5 (5.1–6); width of palatal bridge, 2.6 (2.3–3); length of nasals, 13.8(13–14.6).

Remarks.—This species, the second American pika to be named, was originally described by J. K. Lord in 1863 under the name *Lagomys minimus*. The name was placed in synonymy, however, by Allen in his monograph of the group in 1877[67], and was not again recognized until revived by Bangs in 1899.[68] Some years later, Osgood pointed out that the name *Lagomys minimus* was preoccupied, and renamed the species *Ochotona fenisex*.[69]

Bangs applied the name *minimus* to the dark, brownish-colored form inhabiting the higher parts of the Cascade Range, of which form he had specimens from Hope, Sumas, and the Mount Baker Range, British Columbia. The original description, however, applies rather to the paler form ranging from the north end of Okanagan Lake southward along the interior ranges, east of the main Cascade Range, to Wenatchee, Washington. In order definitely to fix the name, specimens of both the Cascade form and the interior form were sent to Oldfield Thomas, who has compared them with the type of *minimus* in the British Museum. He states that the type agrees closely with a November specimen (No. 203214, U. S. Nat. Mus.) from Okanagan, British Columbia, and differs from specimens of the dark Cascade form. There need be no further doubt, therefore, as to the applicability of

[67] Allen, J. A., Monog. North Amer. Rodentia, Rept. U. S. Geol. Surv. Terr., vol. 11, p. 407, 1877.
[68] Bangs, O., Proc. New England Zool. Club, vol. 1, p. 39, 1899.
[69] Osgood, W. H., Proc. Biol. Soc. Washington, vol. 26, p. 88, 1913.

Lord's name to the pale interior form. This conclusion is furthermore confirmed by a series of specimens recently collected by Taylor and Cantwell on Bald Mountain, Washington—practically at the type locality of *fenisex*.

A large series in worn pelage (September), from Wenatchee, Washington, is apparently intermediate between *fenisex* and *brunnescens;* in coloration the specimens are nearest to *fenisex:* the skulls, however, average decidedly larger than those of *fenisex*, most of them, indeed, about equaling those of *brunnescens*.

Although no actual intergrades between this race and *cuppes* have been examined, the resemblance between the two forms is so close that it is considered desirable to unite them into one species.

Specimens examined.—Total number, 60, as follows:

British Columbia: Hope (Roab Ranch), 1;[70] Okanagan, 16;[71] Okanagan Lake (mountains west of Lake, 2,500 feet altitude), 5; Tulameen, 3.[72]

Washington: Bald Mountain, Okanogan County (head of Ashnola River), 12; Barron, 1; Hidden Lakes, 1; Horseshoe Basin (near Mount Chopaka), 1;[73] Pasayten River (west fork, at mouth of Holman Creek), 3; Stehekin, 2; Wenatchee (mountains near), 15.

OCHOTONA PRINCEPS BROOKSI, SUBSP. NOV.[74]

SHUSWAP PIKA.

Type.—Collected at Sicamous, British Columbia, September 24, 1894, by Clark P. Streator; ♂ adult, skin and skull; No. 69275, U. S. National Museum, Biological Survey collection; original number, 4319.

Geographic distribution.—Interior of southern British Columbia, from Shuswap Lake west to Mount McLean and McGillivary Creek, Lillooet District; limits of range unknown. (Fig. 2, p. 11.)

Characters.—Similar in winter pelage to *brunnescens*, but general tone more vinaceous and head more strongly cinnamon; in summer pelage very much paler. Compared with *fenisex*: Winter pelage distinctly more brownish or cinnamon (less grayish); summer pelage paler.

Color.—*Type* (acquiring winter pelage): Head cinnamon shaded with fuscous; rest of upperparts vinaceous-cinnamon mixed with fuscous-black, darkest in middle of back, where the blackish predominates; sides of nose faintly tinged with smoke-gray; ears chaetura drab, margined with buffy white; feet soiled whitish, washed with pinkish buff; soles hair-brown; palms soiled whitish, washed with drab; underparts soiled whitish, washed with pinkish cinnamon. *Summer pelage* (specimens from McGillivary Creek, Lillooet District, British Columbia, August 17): Head pinkish cinnamon, shaded with fuscous; rest of upperparts light pinkish cinnamon mixed with fuscous, palest on shoulders and fore back; ears, feet, and underparts as in winter pelage.

Molt.—A specimen from Sicamous, British Columbia, July 19, is acquiring summer pelage, the new hair covering the head, shoulders, fore back, and patches on the hinder back and sides; an adult female from Shuswap, British Columbia, September 5, is in complete summer pelage, moderately worn on the hinder back; an adult female from the

[70] Collection Mus. Comp. Zool.
[71] Nine in collection Provincial Mus., Victoria, British Columbia.
[72] Collection Provincial Mus.
[73] Collection of S. G. Jewett.
[74] Named for Maj. Allan Brooks, of Okanagan, British Columbia.

same locality, same date, is acquiring winter pelage, the new hair covering the head, shoulders, and more than half of the back; the hinder back and sides are in greatly worn summer pelage.

In a series of 8 adults from Sicamous, September 24–29, the new winter pelage covers the greater part of the dorsal surface excepting the rump; in one of this series, however (male, September 24), the molt is no further advanced than in the September 5 specimen referred to above.

Skull.—Closely similar to *fenisex* but nasals averaging slightly shorter; slightly smaller than in *cuppes*, with the interpterygoid fossa more spatulate (the sides less nearly parallel).

Measurements.—Type: Total length, 195; hind foot, 31. Average of 9 adults (8 males, 1 female) from type locality: Total length, 192.4 (180–206); hind foot, 31.3 (30–33). *Skull:* Average of 6 adult males from type locality: Occipito-nasal length, 43 (42.3–43.9); zygomatic breadth, 21.5 (21–22); breadth of braincase, 18.1 (17.7–18.6); interorbital breadth, 5.6 (5.4–6); width of palatal bridge, 2.2 (2–2.6); length of nasals, 13.6 (12.8–14.2). Average of 3 adult females from Sicamous and Shuswap, British Columbia: Occipito-nasal length, 42.4 (41.1–43.5); zygomatic breadth, 20.4 (19.9–20.8); breadth of braincase, 17.4 (17.2–17.6); interorbital breadth, 5.2 (5.1–5.3); width of palatal bridge, 2.2 (2–2.6); length of nasals, 13.3 (12.8–13.7).

Remarks.—Although occupying an area contiguous to that of *fenisex* and apparently quite similar in topographic conditions, this race is distinguished by pronounced color differences. In winter pelage it most nearly resembles *brunnescens* and doubtless intergrades with that race where their ranges meet. From *cuppes* it differs not only in the more spatulate interpterygoid fossa but also in being much paler in summer pelage.

Specimens examined.—Total number, 36, as follows:

British Columbia: Blackwater Lake, Lillooet District, 4;[75] Griffin Lake, 2 (skulls);[75] McGillivary Creek, Lillooet District, 6;[76] Mount McLean, Lillooet District, 1;[76] Shuswap, 9; Sicamous, 14.[77]

OCHOTONA PRINCEPS BRUNNESCENS Howell.

CASCADE PIKA.

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

Ochotona minimus Bangs, Proc. New England Zool. Club, vol. 1, p. 39, 1899 (not *Lagomys minimus* Lord).

Ochotona fenisex brunnescens Howell, Proc. Biol. Soc. Washington, vol. 32, p. 108, May 20, 1919.

Type.—Collected at Keechelus, Kittitas County, Washington, August 23, 1917, by George G. Cantwell; male subadult, skin and skull; No. 227259, U. S. National Museum, Biological Survey collection; original number, 38 (19568, X catalogue).

Geographic distribution.—Cascade Range, from southwestern British Columbia south to vicinity of Crater Lake, Oregon; interrupted apparently in central Oregon (vicinity of Mount Jefferson and Three Sisters) by the range of *fumosa*. (Fig. 2, p. 11.)

Characters.—Similar to *fenisex*, but upperparts decidedly more brownish (less grayish) and underparts more buffy.

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[75] Collection Provincial Mus., Victoria, British Columbia.
[76] Collection Victoria Mem. Mus.
[77] Four in collection Victoria Mem. Mus.

Color.— *Winter pelage* (November specimens from Hope, British Columbia): Upperparts mixed pinkish cinnamon and fuscous, the latter color predominating; sides pinkish cinnamon or light pinkish cinnamon; sides of nose smoke-gray, washed with pinkish cinnamon; ears fuscous-black, margined with light buff; feet light pinkish cinnamon; soles hair-brown; palms buffy white, tinged with light drab; underparts grayish white, moderately or sometimes heavily washed with pinkish cinnamon. *Summer pelage* (July and August): Very similar to the winter pelage (often identical) but general tone of upperparts averaging deeper cinnamon (less pinkish), the sides of the head and body frequently rich cinnamon, shaded with fuscous, and the underparts sometimes heavily washed with cinnamon; soles darker—fuscous or chaetura black.

Molt.—In an adult male from Easton, Washington, July 10, fresh summer pelage covers the greater part of the dorsal surface except the hinder back, the molting line being irregular and poorly defined; another from the same locality, July 19, is in practically complete summer pelage. An adult male from Stevens Pass, Washington, August 23, is still in badly worn winter pelage, the new summer coat having covered the head, shoulders, and fore back. An adult male from Mount Rainier, August 31, shows new summer pelage covering the head, shoulders, and middle of the back.

No specimens of this race are at hand showing the beginnings of winter pelage, but the fall molt probably occurs, as in the other races of the species, during September. Specimens taken in June resemble those in fresh winter pelage but show a moderate amount of wear.

Skull.—Similar to that of *fenisex*, but averaging larger, with relatively shorter nasals.

Measurements.—Average of 13 adults (8 males, 5 females): Total length, 203 (185–215); hind foot, 33.4 (31–35). *Skull:* Average of 11 adult males from Cascade Range, Washington: Occipito-nasal length, 44 (42.3–46.2); zygomatic breadth, 21.9 (21.5–22.3); breadth of braincase, 18.7 (18–19.2); interorbital breadth, 5.4 (4.9–5.7); width of palatal bridge, 2.4 (2.1–3.4); length of nasals, 14 (13.1–14.9). Average of 5 adult females from same region: Occipito-nasal length, 43.6 (41.8–44.6); zygomatic breadth, 21.8 (21.7–21.9); breadth of braincase, 18.4 (17.7–19); interorbital breadth, 5.4 (5–5.5); width of palatal bridge, 2.4 (2.2–2.7); length of nasals, 14.1 (13.2–14.9).

Remarks.—The Cascade pika is a wide ranging form which has been insufficiently characterized and erroneously identified with "*minimus*" of Lord [= *fenisex*]. The uncertainty concerning the correct name for this race is in large part due to the lack of material from the type locality of "*minimus*". Bangs assumed that his specimens from the Mount Baker Range represented "*minimus*," and no one since has questioned this decision. Material now in hand, however, from the immediate vicinity of the type locality indicates that the form described by Lord is not the same as the form occupying the higher parts of the Cascades. The latter, therefore, has recently been characterized by the writer under the name *brunnescens*.

This race is subject to relatively little variation in color over its entire range, and likewise is but little different in summer and winter pelage. A series from the vicinity of Crater Lake, at the southern end of the range, averages slightly paler and grayer than specimens from more northern localities, but the differences are too slight to

warrant recognition by name. This series shows no approach to *fumosa*, the range of which apparently cuts off the southern Cascade colonies of *brunnescens* from those of northern Oregon and Washington. Variation in size of the skull is considerable but apparently is individual and not regional.

Specimens examined.—Total number, 118, as follows:

British Columbia: Chilliwack, 6;[78] Chilliwack Lake, 1;[79] Hope (Lake House), 6;[80] Mount Baker Range, 9;[81] Sumas, 1;[80] Summit Lake, Cascade Mountains, 1;[80] Tami Hi Creek, 3;[79] Vancouver, 1.[79]

Oregon: Anna Creek, Mount Mazama, 2; Crater Lake, 13; Diamond Lake, 1; Mount Hood, 3.

Washington: Easton, 12; Hart Lake, 3; Keechelus, 3; Keechelus Lake, 1;[82] Lyman Lake, Chelan County, 2; Mount Adams, 3; Mount Aix, 2; Mount Index, 1; Mount Rainier, 24; Mount St. Helens, 8; Natches River (40 miles above North Yakima, at 2,800 feet altitude), 1; Snoqualmie Pass, 9;[83] Stevens Pass, King County, 1; Twin Sisters Lakes (near Cowlitz Pass), 1.

OCHOTONA PRINCEPS FUMOSA Howell.

Dusky Pika.

Ochotona fenisex fumosa Howell, Proc. Biol. Soc. Washington, vol. 32, p. 109, May 20, 1919.

Type.—Collected at Permilia Lake, west base of Mount Jefferson, Oregon, October 4, 1897, by J. Alden Loring; male adult, skin and skull; No. 91144, U. S. National Museum, Biological Survey collection; original number, 4799.

Geographic distribution.—Western slopes of the Cascade Mountains in Oregon, from the upper Clackamas River south at least to Three Sisters; also mountains near Paulina Lake, Crook County. (Fig. 2, p. 11.)

Characters.—About the size of *brunnescens* with slightly narrower skull; coloration above more blackish and less brownish.

Color.—*Winter pelage:* Upperparts a mixture of vinaceous-cinnamon and black, the median dorsal area nearly solid black, shading on sides to nearly clear vinaceous-cinnamon; sides of nose dark smoke-gray and top of head shaded with the same; sides of neck, beneath ears, washed with cinnamon-buff; ears chaetura black, edged with buffy white; feet cinnamon-buff; soles chaetura drab; palms hair-brown; underparts soiled whitish, strongly washed along middle of belly with vinaceous-cinnamon, shading on throat to pinkish cinnamon. *Summer pelage* (specimens from Three Sisters, Oregon, July 15): Similar to the winter pelage, but upperparts less blackish, less buffy, and more strongly shaded with grayish.

Skull.—Similar to *brunnescens* but averaging slightly narrower, with slightly longer nasals (at least in males); palate with a very small spine in center of interpterygoid fossa.

Measurements.—Average of 7 adults (5 males, 2 females) from type locality: Total length, 196 (184–202); hind foot, 32.3 (31–34); *Skull*: Average of 5 adult males from type locality: Occipito-nasal length, 44.3 (43–45.6); zygomatic breadth, 21.3 (20.9–22); breadth of brain-

[78] One in collection Field Mus. Nat. Hist.; one in collection Mus. Comp. Zool.
[79] Collection Victoria Mem. Mus.
[80] Collection Mus. Comp. Zool.
[81] Six in collection Mus. Comp. Zool.; 3 in collection Acad. Nat. Sci. Philadelphia.
[82] Collection S. G. Jewett.
[83] Collection Acad. Nat. Sci. Philadelphia.

case, 18.3 (18–18.7); interorbital breadth, 5.1 (4.7–5.3); width of palatal bridge, 2.8 (2.4–3.2); length of nasals, 14.8 (13.6–15.7). Average of 2 adult females from type locality: Occipito-nasal length, 43.6 (43.3–43.9); zygomatic breadth, 21.2 (21–21.4); breadth of braincase, 18.4 (17.8–18.9); interorbital breadth, 5.5 (5.5–5.6); width of palatal bridge, 3.4 (2.9–4); length of nasals, 13.5 (13.3–13.8).

Remarks.—Closely related to *brunnescens*, which occupies the summits of the Cascade Range in Oregon, this dark race apparently occupies the western slopes of the range, descending in some localities to as low as 900 feet altitude. Apparently it crosses the range to the eastward in the vicinity of Three Sisters and occupies also the mountains around Paulina Lake.

Specimens examined.—Total number, 16, as follows:

Oregon: Clackamas River, 15 miles above Estacada (at about 900 feet altitude), 1;[84] McKenzie Bridge (10 miles southeast, at Lost Creek Ranger Station), 1; Paulina Lake, 1; Permilia Lake (west base Mount Jefferson), 9; Three Sisters, 4.

OCHOTONA COLLARIS (Nelson).

Collared Pika.

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

Lagomys collaris Nelson, Proc. Biol. Soc. Washington, vol. 8, p. 117, December 21, 1893.

Type.—Collected near head of Tanana River, about 200 miles south of Fort Yukon, Alaska, by Indians, for E. W. Nelson in the summer of 1880; adult, skin and skull; No. $\frac{143844}{36297}$, U. S. National Museum; original number, 164.

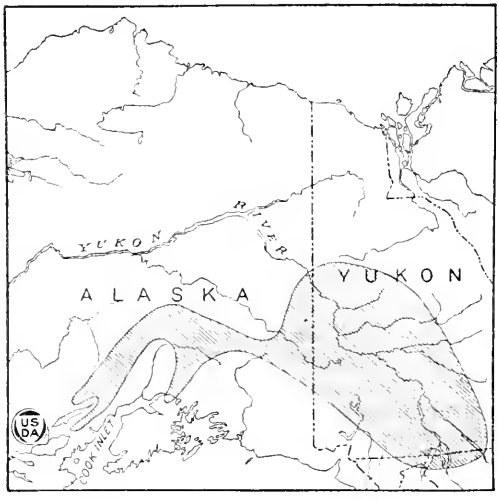

Fig. 3.—Distribution of *Ochotona collaris*.

Geographic distribution.—Central and southern Alaska and Yukon, from Mount McKinley and the Ogilvie Range south to Teslin Lake, British Columbia, and White Pass, Alaska. (Fig. 3.)

[84] Collection S. G. Jewett.

Characters.—Similar to *O. princeps princeps* in winter pelage but coloration decidedly more grayish and less buffy, both above and below; a more or less distinct grayish patch on nape and shoulders; skull relatively broad, with broad interpterygoid fossa and large audital bullae.

Color.—*Fresh winter pelage* (specimens from mountains near Eagle, July 31–September 2): Upperparts mixed pinkish buff and fuscous or fuscous-black, the general tone drab or light drab, shading to smoke-gray; lower sides (next to belly) rather faintly washed with pinkish buff or light pinkish buff; an irregular patch or collar (indistinct or nearly obsolete in some specimens) of pale smoke-gray on shoulders just behind ears; ears chaetura black, edged with light buff or buffy white, usually with a large blotch of buffy white or pinkish cinnamon on inner surface; feet whitish, washed with pale pinkish buff; soles hair-brown; palms buffy white or light drab; underparts whitish, faintly washed with pale pinkish buff. *Worn winter pelage* (specimens from head of Toklat River, May 3): Upperparts decidedly more grayish than in autumn, the general tone nearly smoke-gray, washed with buff, and the head and shoulders clear smoke-gray.

Molt.—The available material strongly indicates that this species has but a single annual molt, which extends from late July to early September.

Specimens from Mount McKinley, Alaska, July 28, show the molt in progress, the new pelage appearing in an irregular patch on the middle dorsal area and a small patch on the face between the eyes, the unrenewed portions of the pelage being greatly worn. The molt must in some cases begin earlier than this for in a specimen from near Eagle, Alaska, July 31, the pelage is almost entirely renewed, except for two small patches on each side of the rump; in other cases it does not begin until much later, as shown by an adult female from the same locality, taken September 1, in which the new pelage appears only in an irregular area on the middle of the back; another specimen taken August 30 has the entire back covered with the fresh pelage, but the top of the head and the nape are still in a much-worn, old pelage.

Specimens from the head of Toklat River in early May are moderately worn and are more uniform in coloration, the fuscous hairs of the fresh pelage having largely disappeared and the general tone become more grayish, often with a pronounced buffy tinge.

Skull.—Similar to *princeps* but broader, with shorter nasals and larger audital bullae; interpterygoid fossa broader and more spatulate, its sides not parallel, but expanding slightly near anterior end and contracting posteriorly.

Measurements.—Average of 15 adults (10 males, 5 females) from mountains near Eagle, Alaska: Total length, 189 (178–198); hind foot, 30 (29–31). *Skull*: Average of 10 adult males from same locality: Occipito-nasal length, 43.6 (42.7–44.2); zygomatic breadth, 21.8 (21.4–22.2); breadth of braincase, 18.6 (18–19.3); interorbital breadth. 5.6 (5.1–6.2); width of palatal bridge, 2.5 (2.3–2.7); length of nasals, 13.3 (13–13.6). Average of 5 adult females from same locality: Occipito-nasal length, 42.7 (42–44.1); zygomatic breadth, 21.4 (20.7–22); breadth of braincase, 18.4 (18.4–18.5); interorbital breadth, 5.6 (5.2–5.8); width of palatal bridge, 2.8 (2.5–3.2); length of nasals, 13.2 (12.6–13.8)

Remarks.—The collared pika is a well-marked species having an extensive range in Alaska and Yukon. Widely separated geographically from the other American species (see remarks on pp. 1–3) it is apparently more closely related to *O. princeps fenisex* of southern British Columbia than to typical *princeps* of the Rocky Mountain region. Both *O. collaris* and *O. p. fenisex* are characterized by a relatively broad skull, with short nasals and broad interpterygoid fossa. In external appearance, *collaris* is much more grayish and less buffy than either *princeps* or *fenisex*.

Specimens examined.—Total number, 118, as follows:

Alaska: Knik [=mountains near], 1; Mount McKinley, 5; Seward Creek (mountains at head), 89; Tanana River (near head), 3; Toklat River (head), 6; White Pass, 1.

British Columbia: Bennett, 5; Tagish Lake, 2.[85]

Yukon: Conrod, 1;[86] Ogilvie Mountains (head of Coal Creek), 4; Teslin Lake (vicinity), 1.[86]

OCHOTONA SCHISTICEPS (MERRIAM)

[Synonymy under subspecies.]

General characters.—Head and nape frequently grayish, in marked contrast to the rest of the upperparts; general tone of upperparts varying from cinnamon-buff or avellaneous to wood brown or sayal brown. Skull averaging somewhat smaller, but relatively broader than that of *O. princeps fenisex;* interpterygoid fossa about as in *fenisex*; palatal bridge averaging narrower than in any other American species.

Color.—Head and nape varying from pallid neutral gray or gull gray to smoke-gray, always more or less washed with chaetura drab, fuscous, or fuscous black; head sometimes pinkish cinnamon or pinkish buff, mixed with fuscous or blackish, the nape only being washed with grayish; rest of upperparts pinkish buff, light pinkish cinnamon, vinaceous-cinnamon, or cinnamon, more or less mixed with chaetura drab, fuscous, or fuscous-black; sides of nose washed with smoke-gray, pale smoke-gray, or light buff; sides pale pinkish buff, pinkish cinnamon, light pinkish cinnamon, vinaceous-cinnamon, or light ochraceous-salmon; ears chaetura drab, chaetura black, fuscous-black, or deep mouse-gray, margined with grayish white or light buff; feet grayish white, pinkish buff, light pinkish cinnamon, or cinnamon buff; soles chaetura drab, chaetura black, hair-brown, fuscous, or fuscous-black; palms grayish white, light drab, tilleul buff, or hair-brown; underparts pinkish buff, pinkish cinnamon, vinaceous-buff, light ochraceous-salmon, or soiled whitish with a faint wash of buff or cinnamon.

Geographic distribution.—The Sierra Nevada of California (chiefly above 7,000 feet altitude) from the headwaters of Tule River north to Mount Shasta and Goose Nest Mountain; the lava-bed region of northeastern California, southern Oregon, and southern Idaho, from Madeline Plains to the Snake River Desert, Idaho; the Blue Mountains of northeastern Oregon (except northern portion); the Toyabe Mountains of central Nevada, and the Beaver and Parowan Ranges of central Utah. (Fig. 4.)

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[85] Collection Provincial Mus., Victoria, British Columbia.
[86] Collection Victoria Mem. Mus.

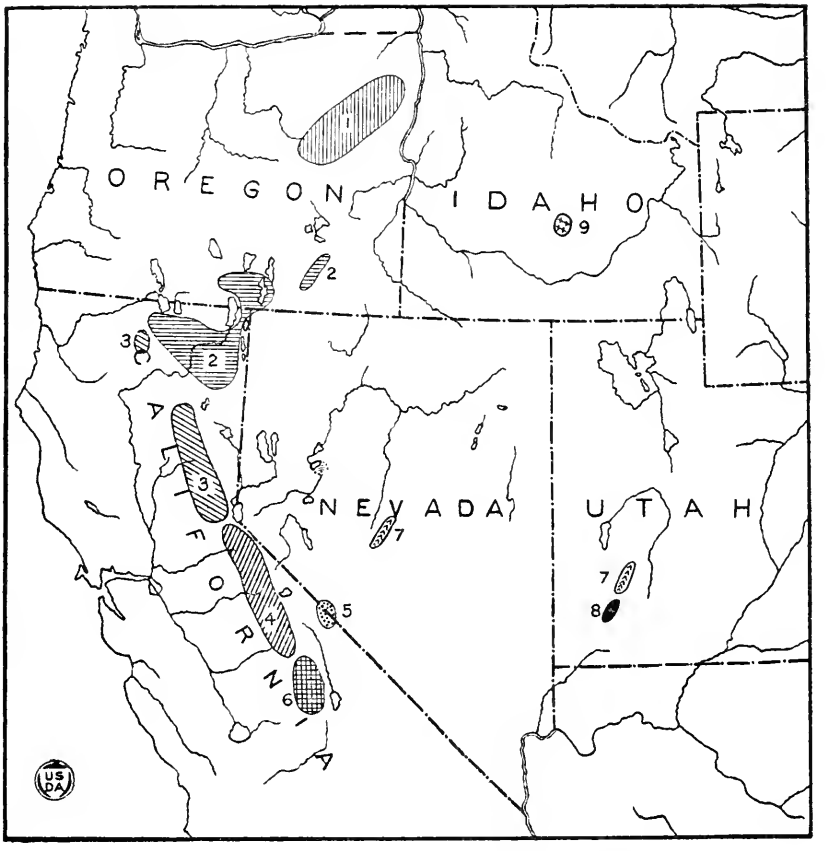

FIG. 4.—Distribution of the subspecies of *Ochotona schisticeps*.

1. *O. s. jewetti.* 3. *O. s. schisticeps.* 5. *O. s. sheltoni.* 7. *O. s. cinnamomea.*
2. *O. s. taylori.* 4. *O. s. muiri.* 6. *O. s. albata.* 8. *O. s. fuscipes.*
9. *O. s. goldmani.*

Remarks.—In the Sierra Nevada system and the mountains of the Great Basin the species *schisticeps* is widely distributed. It is separable into at least 9 races, many of which occupy isolated mountain areas or lava outcrops on the desert.

Living under such diverse conditions, the various forms have developed striking differences in coloration; the darkest forms (*goldmani* and *taylori*) are found in the lava-bed formations of northeastern California, eastern Oregon, and southern Idaho; passing southward in the Sierra Nevada the pikas gradually become paler, the palest form of all being found in the Mount Whitney region, at the extreme southern end of the range. The form (*cinnamomea*) found in the Toyabe Mountains (and probably other ranges) of central Nevada and in the Beaver Mountains, Utah, is not unlike *schisticeps* in coloration, though smaller, but strangely enough, the form occurring in the Parowan Range—practically adjacent to the Beaver Range—is larger and darker. The Blue Mountains form (*jewetti*) again is paler than typical *schisticeps* in summer, but darker in winter.

OCHOTONA SCHISTICEPS SCHISTICEPS (Merriam).

Gray-headed Pika.

(Pl. IV, fig. 2; Pl. VI, fig. 2.)

Lagomys schisticeps Merriam, North Amer. Fauna No. 2. p. 11, October 30, 1889.
Ochotona schisticeps Merriam, North Amer. Fauna No. 16, p. 99, 1899.

Type.—Collected at Donner, California, June 9, 1888, by Charles A. Allen; ♂ adult, skin and skull; No. 186518, U. S. National Museum (formerly No. $\frac{4725}{5376}$, Merriam collection).

Geographic distribution.—Boréal zones of the northern Sierra Nevada, from Mount Shasta south to Donner Pass; altitudinal range from about 5,000 feet (on Mill Creek, above Morgan, Tehama County) to at least 9,000 feet. (Fig. 4, p. 37.)

Characters.—Coloration paler than in *O. princeps brunnescens*, with head and nuchal region more or less strongly washed with grayish; skull smaller, with much narrower palatal bridge.

Color.—*Winter pelage:* Head and shoulders smoke-gray, mixed with fuscous; rest of upperparts vinaceous-cinnamon, mixed with fuscous, shading on sides to clear vinaceous-cinnamon; ears chaetura black, margined with light buff; feet soiled whitish, washed with pinkish buff; underparts soiled whitish, washed with pinkish buff or light pinkish cinnamon. *Summer pelage*: Very similar to the winter pelage, but upperparts less uniformly darkened with fuscous and general tone nearer cinnamon than vinaceous-cinnamon.

Molt.—An adult female from Donner, California, August 18, shows fresh summer pelage covering the head, shoulders, and middle of the back nearly to the rump, the sides and back of the shoulders retaining the old pelage; a male from Mount Shasta, September 25, is acquiring winter pelage, the new hair covering the dorsal area to within about an inch of the rump, the lower sides and underparts still retaining the worn summer pelage. An adult male from Donner, October 9, has completed the fall molt over the entire dorsal area, but the belly is still in old pelage; another from the same locality, October 8, is in complete winter pelage.

Skull.—Similar to that of *O. princeps brunnescens* but averaging slightly smaller; palatal bridge averaging decidedly narrower.

Measurements.—Average of 15 adults (10 males, 5 females) from type locality; Total length, 186 (178–200); hind foot, 29.5 (27–31). *Skull:* Average of 8 adult males from type locality:[92] occipito-nasal length, 42.5 (41.5–45); zygomatic breadth, 21.1 (20.4–21.7); breadth of braincase, 18.8 (18.1–19.4); interorbital breadth, 5.1 (4.8–5.3); width of palatal bridge, 1.6 (1.2–2.6); length of nasals, 13.7 (13.2–14.5). Average of 2 adult females from type locality: Occipito-nasal length, 41.8 (41.4–42.2); zygomatic breadth, 21 (20.8–21.1); breadth of braincase, 18.5 (18.1–19); interorbital breadth, 5.5 (5.3–5.7); width of palatal bridge, 1.35 (1.3–1.4); length of nasals, 13.55 (13.5–13.6).

Remarks.—The gray-headed pika—the first of the California forms to be characterized—is the darkest of the Sierra races, though not quite so blackish as *taylori* from the lava-bed region of Oregon and northern California. It intergrades with *taylori* in the Mount Shasta region, as shown by specimens from Mount Shasta in fresh fall pel-

[92] It seems remarkable that in this series of topotype skulls all are considerably smaller than the type and in all the palatal bridge is much narrower; the measurements of the type are the maxima given above.

age which are slightly darker than typical *schisticeps*. Southward, *schisticeps* passes into *muiri* in the region between Donner Pass and Mount Tallac.

Specimens examined.—Total number, 54, as follows:

California: Donner, 25;[93] Donner Pass, 2;[94] Lassen County, 2; Lassen Peak, 4; Mount Shasta, 15;[95] Prattville (12 miles northeast), 1; Summit [=Donner], 4; Tahoe, Placer County, 1.

OCHOTONA SCHISTICEPS TAYLORI Grinnell.

Taylor Pika.

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

Ochotona taylori Grinnell, Proc. Biol. Soc. Washington, vol. 25, p. 129, July 31, 1912.

Type.—Collected on Warren Peak (at 9,000 feet altitude), Warner Mountains, Modoc County, California, July 18, 1910, by W. P. Taylor and H. C. Bryant; ♂ adult, skin and skull; No. 11292, Museum of Vertebrate Zoology, University of California; original number, 3885.

Geographic distribution.—Northeastern California and southern Oregon, from Madeline Plains north to Steens Mountains, Oregon, and west to Goose Nest Mountain, Siskiyou County, California; altitudinal range from about 5,000 to 8,000 feet. (Fig. 4, p. 37.)

Characters.—Similar to *schisticeps* but smaller; coloration in summer pelage slightly more blackish, especially on head; in winter pelage, decidedly darker above, the fuscous shades of *schisticeps* largely replaced by black in *taylori* and the gray on head also darker.

Color.—*Summer pelage* (July): Upperparts light pinkish cinnamon, strongly shaded with fuscous-black; head usually (?) like back without trace of gray (all of the small series from the type locality are practically without gray on head) but in some specimens extensively sprinkled with whitish hairs, producing a general tone near neutral gray; ears chaetura black, margined with buffy white; soles fuscous-black; palms tilleul buff, washed with drab; lower sides and underparts light ochraceous-salmon, becoming more cinnamon on the throat. *Winter pelage* (October): Face and head pale gull gray, mixed with blackish, producing an "iron-gray" tone; nose sometimes washed with smoke-gray and fuscous; dorsal area pale pinkish cinnamon, heavily washed with dark fuscous-black; sides between light vinaceous-cinnamon and light pinkish cinnamon, with only a slight mixture of fuscous; ears blackish, margined with buffy white; feet soiled whitish, faintly washed with pinkish buff; soles fuscous-black; palms light drab; underparts soiled whitish, moderately washed with vinaceous-buff.

Molt.—The date of the midsummer molt in this race is not shown by the series at hand; specimens from Goose Nest Mountain, California, July 15 and 16, are apparently in worn winter pelage, while one from Steens Mountains, Oregon, July 26, is in full summer pelage. The fall molt apparently begins early, as shown by a series from Steens Mountains, August 26–30, in which the fresh winter pelage covers nearly all the dorsal surface of more than half the specimens, the rest being in worn summer coat.

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[93] Two in collection Amer. Mus. Nat. Hist.
[94] Collection Mus. Vert. Zool.
[95] One in collection Mus. Vert. Zool.

Skull.—Similar to *schisticeps* but averaging smaller.

Measurements.—Average of 9 adults (6 males, 3 females) from vicinity of type locality and southern Oregon (Adel and Mount Warner): Total length, 175 (162–190); hind foot, 26.7 (25–28). *Skull*: Two adult males (type and one from Madeline Plains, California): Occipitonasal length, 41.7, 41.8; zygomatic breadth, 20.8, 20.5; breadth of braincase, 18.7, 18.1; interorbital breadth, 5.8, 4.7; width of palatal bridge, 1.2, 1.4; length of nasals, 13.6. Average of 5 adult females (2 from type region and 3 from Steens Mountains, Oregon.): Occipitonasal length, 41.5 (39.7–42.7); zygomatic breadth, 20.3 (19.6–20.8); breadth of braincase, 17.9 (17.4–18.6); interorbital breadth, 4.6 (4.4–4.7); width of palatal bridge, 1.4 (1.2–1.6); length of nasals, 13.5 (12.5–14.4).

Remarks.—This race is closely related to *schisticeps*, with which it intergrades in northeastern California. Its range is chiefly in the lava-bed region of southern Oregon and northeastern California, where it descends to quite low altitudes. In summer pelage it differs but little from *schisticeps* but in winter pelage it is noticeably darker. Specimens available from the type locality are all in summer pelage, and judging from these alone, one would hardly be justified in separating the form from *schisticeps;* apparently, however, the series from southern Oregon shows more distinctive characters, especially in winter pelage.

Specimens examined.—Total number, 35, as follows:

California: Goose Nest Mountain, 3; Little Shasta River (near head), Siskiyou County, 1;[96] Madeline Plains (near Termo, 5,400 feet altitude), 1; Sugar Hill, Modoc County, 2;[96] Sugarloaf Mountain, Modoc County, 2; Warren Peak, Warner Mountains, 7.[96]

Oregon: Adel, 1; Jack Lake (20 miles northeast of Adel), 2;[97] Mount Warner, 2; Steens Mountains, 14.

OCHOTONA SCHISTICEPS GOLDMANI, SUBSP. NOV. [98]

LAVA-BED PIKA.

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

Type.—Collected at Echo Crater, Snake River Desert, Idaho (20 miles southwest of Arco), June 18, 1921, by Luther J. Goldman; ♂ adult, skin and skull; No. 236408, U. S. National Museum (Biological Survey collection); original number, 2754.

Geographic distribution.—Known only from Echo Crater and Fissure Crater, Snake River Desert, Idaho. (Fig. 4, p. 37.)

Characters.—Similar to *taylori*, but upperparts much darker (more blackish); sides and underparts paler and more pinkish (less cinnamon); sides of nose with patches of gray; skull broader interorbitally with shorter nasals.

Color.—*Type* (fresh summer pelage): Upperparts (including head) mixed blackish and light ochraceous-buff, the black prevailing; nape with a rather indistinct patch of pale smoke-gray (apparently a remnant of winter pelage); sides of nose with large patches of neutral

[96] Collection Mus. Vert. Zool.
[97] Collection S. G. Jewett.
[98] Named for Luther Jacob Goldman, who collected all the specimens at present known.

gray; ears chaetura black, margined with creamy white; lower sides pinkish buff, becoming light pinkish cinnamon on sides of neck; feet and underparts whitish, moderately washed with pinkish buff; soles deep mouse-gray; palms soiled whitish, washed with mouse-gray. *Worn winter pelage* (June 13): Upperparts much less blackish and sides paler than in summer pelage; general tone of upperparts near hair-brown (produced by a mixture of light ochraceous-buff and pale smoke-gray, moderately shaded with fuscous); sides pale pinkish buff, shading to light pinkish cinnamon on sides of neck.

Molt.—The midsummer molt begins in June; one specimen (♀), taken June 13, is still in winter pelage; the other 5 are acquiring summer pelage, which first covers the head and progresses backward over the body; in one specimen, taken June 13, the molt is practically complete; in others, taken June 13 and June 18, the old pelage still shows on the rump and in an irregular patch of smoke-gray on the nape.

Skull.—Similar to *taylori* but averaging longer, and broader interorbitally; palatal bridge slightly wider; nasals shorter and broader, expanding anteriorly.

Measurements.—*Type:* Total length, 188; hind foot, 31. Average of 6 adults from type locality: 183; 30.2. *Skull*: Average of 4 adults: Occipito-nasal length, 42.6 (41.5–43.9); zygomatic breadth, 20.6 (20.1–21.6); breadth of braincase 18.5(17.5–19); interorbital breadth, 5.8 (5.7–6.1); width of palatal bridge, 1.6 (1.3–1.9); length of nasals, 13.1 (12.8–13.4).

Remarks.—The lava-bed pika is the darkest-known form in the genus. In general coloration it most resembles *O. princeps princeps*, but it is darker and has prominent gray patches on the sides of the nose, and differs widely from that form in cranial characters.

It is strikingly different from its nearest geographical neighbor—*O. princeps lemhi*—which lives in the Lemhi Mountains, about 60 miles northeast of the type locality of the present form. Compared with *lemhi, goldmani* is very much darker in coloration and has a broader skull with shorter, broader nasals, larger audital bullae, and narrower palatal bridge.

Its close relationship to the *schisticeps* group makes advisable its designation as a race of that species; although possessing the diagnostic skull characters of the group this race apparently never has a gray head (at least in summer pelage).

The occurrence of a species of *Ochotona* in the Snake River Desert of Idaho was unsuspected; its discovery by Luther Goldman extends the range of the *schisticeps* group eastward from the Steens Mountains, Oregon, into central Idaho. This race doubtless is completely isolated from its relatives, occurring only in scattered lava piles on the desert. Mr. Goldman states that at Echo Crater the animals were found in small numbers, and that at Fissure Crater, about 15 miles south in the interior of the desert, abundant old sign was found but at the time of his visit the pikas had mostly disappeared, and he secured only one specimen as a result of considerable effort.

Specimens examined.—Total number, 6, as follows:

Idaho: Echo Crater (20 miles southwest of Arco), 5; Fissure Crater (26 miles southwest of Arco), 1.

OCHOTONA SCHISTICEPS JEWETTI Howell.

Blue Mountains Pika.

Ochotona schisticeps jewetti Howell, Proc. Biol. Soc. Washington, vol. 32, p. 109, May 20, 1919.

Type.—Collected at head of Pine Creek, near Cornucopia, south slope Wallowa Mountains, Baker County, Oregon, September 3, 1915, by Stanley G. Jewett; ♂ adult, skin and skull; No. 208352, U. S. National Museum, Biological Survey collection; original number, 2362.

Geographic distribution.—Wallowa Mountains, Strawberry Mountains, and southern portion of Blue Mountains, northeastern Oregon; altitudinal range approximately from 5,000 to 10,000 feet. (Fig. 4, p. 37.)

Characters.—Similar to *schisticeps* but paler in summer pelage slightly darker in winter pelage. Compared with *taylori*: Size larger; coloration in winter pelage deeper cinnamon but less blackish; in summer pelage decidedly paler both above and below.

Color.—Summer pelage: Upperparts light pinkish cinnamon, mixed with fuscous; sides of nose pale smoke-gray; sides of face, occiput, and nape washed with the same; ears chaetura drab, margined with grayish white and faintly washed inside with the same; sides light pinkish cinnamon; feet grayish white, washed with light pinkish cinnamon; soles chaetura drab; palms grayish white, washed with drab; underparts grayish white, washed with light pinkish cinnamon. *Winter pelage:* Closely similar to *schisticeps* in the corresponding pelage, but slightly darker.

Molt.—The midsummer molt apparently occurs during July; in a specimen from Bourne, Oregon, August 4, the summer pelage is practically complete, except for a patch on the rump. A specimen from Anthony, Oregon, September 2, shows the beginnings of the fall molt, the new winter pelage covering the head, shoulders, and fore back, the rest of the upperparts being in badly worn summer pelage.

Skull.—Closely similar to *schisticeps;* larger than that of *taylori.*

Measurements.—Average of 12 adults (6 males, 6 females) from Cornucopia, Bourne, and Anthony, Oregon: Total length, 182 (165–195); hind foot, 31 (30–32). *Skull*: Average of 16 adults (7 males, 9 females) from the type region and Strawberry Mountains: Occipitonasal length, 43.3 (41.8–44.8); zygomatic breadth, 21.2 (20.6–22.1); breadth of braincase, 18.1 (16.9–19); interorbital breadth, 5.3 (4.9–5.8); width of palatal bridge, 1.8 (1.3–2.4); length of nasals, 14.1 (13.1–15.3).

Remarks.—This race most nearly resembles *schisticeps* of the high Sierra; the ranges of the two are separated, however, by that of *taylori*, which occupies the intervening lava-bed region.

The Wallowa Mountains mark the eastern limit of *O. schisticeps* in this region; in the Seven Devils Mountains—directly across the canyon of Snake River in Idaho—occurs a race of *O. princeps*, a quite distinct species.

Specimens examined.—Total number, 49, as follows:

Oregon: Anthony, Baker County, 15;[99] Austin, 1; Bourne, 9; Cornucopia (near head East Pine Creek), 6; Strawberry Butte, 2; Strawberry Mountains, 8; Wallowa Lake, 2; Wallowa Mountains, 6.

[99] Twelve in collection Amer. Mus. Nat. Hist.; 2 in collection Mus. Vert. Zool.; 1 in collection E. R. Warren.

OCHOTONA SCHISTICEPS MUIRI Grinnell and Storer.

Yosemite Pika.

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

Ochotona schisticeps muiri Grinnell and Storer, Univ. California Publ. Zool., vol. 17, p. 6, August 23, 1916.

Type.—Collected at Ten Lakes, Yosemite National Park, Tuolumne County, California (at 9,300 feet altitude), October 11, 1915, by W. P. Taylor; ♂ adult, skin and skull; No. 23480, Museum of Vertebrate Zoology, University of California; original number, 7720.

Geographic distribution.—Central portion of Sierra Nevada, from Mount Tallac south to Mammoth Pass; altitudinal range, 7,800 to 12,800 feet. (Fig. 4, p. 37.)

Characters.—Similar to *schisticeps* but paler, with smaller admixture of fuscous on upperparts and sides; gray of head and nape paler; decidedly paler than *jewetti* both in winter and summer.

Color.—*Winter pelage: Vinaceous phase:* Upperparts vinaceous-cinnamon, moderately mixed on dorsal area with fuscous; sides of nose washed with pale smoke-gray and light buff; occiput and nape with a rather indistinct and irregular (often nearly obsolete) wash of pale smoke-gray; ears chaetura black, margined with buffy white; feet soiled whitish, washed with pinkish buff; soles hair-brown; palms grayish white, washed with mouse-gray; underparts heavily washed with pinkish cinnamon. *Drab phase* (type): Upperparts mixed light pinkish cinnamon and fuscous, producing a yellowish drab tone; head, face, and nape mixed pale smoke-gray and fuscous, washed with pinkish buff; sides light pinkish cinnamon; underparts grayish white, moderately washed with pale pinkish buff; ears and feet as in vinaceous phase. *Summer pelage:* Upperparts cinnamon-buff or light pinkish cinnamon, moderately mixed with fuscous; sides and underparts between pinkish buff and cinnamon-buff, or sometimes pinkish cinnamon; head, ears, and feet as in winter pelage.

Molt.—An adult female from Mount Dana, California, August 20, is in badly worn winter pelage, the fresh midsummer pelage showing on the nose and face and in small patches on the middle of the back; in an adult male from Mount Lyell, August 30, the new pelage covers the head, shoulders, and most of the back to the rump excepting a small area on the hinder back and the greater part of the sides; the underparts apparently are in fresh pelage; an adult male from Mammoth Pass, July 25, is in nearly complete summer pelage except on the rump and buttocks.

This pelage must be retained but a short time, for specimens taken at Ten Lakes, Yosemite Park, October 10 and 11, have acquired a fresh winter pelage (differing in color from the summer pelage) over the entire dorsal area, the molting line showing clearly on the lower sides.

Skull.—Similar to *schisticeps*, but averaging slightly smaller and relatively narrower.

Measurements.—Average of 22 adults (11 males, 11 females) from Yosemite National Park: Total length, 188 (180–205); hind foot, 29.7 (27–32). *Skull.* Average of 20 adults (10 males, 10 females) from Yosemite National Park: Occipito-nasal length, 42 (40.2–42.7);

zygomatic breadth, 20.7 (20.1–22.1); breadth of braincase, 17.9 (17.2–19.1); interorbital breadth, 4.9 (4.4–5.7); width of palatal bridge, 1.6 (1.2–2); length of nasals, 13.9 (13.1–14.6).

Remark.—The Yosemite pika is a well-marked form, distinctly paler than *schisticeps*, but not nearly so pale as *albata* of the Mount Whitney region. It has a more extensive range than any of the other Sierra forms and is apparently abundant throughout its range.

Specimens examined.—Total number, 100, as follows:

California: Bishop Creek [= mountains west], 3; Bloody Canyon, Mono Lake, 1;[1] Donohoe Pass, Mono County, 1;[1] Echo, El Dorado County, 4;[2] Ellery Lake, Mono County, 1;[1] Heather Lake, 10;[1, 2] Lake Tenaya, 6;[3] Lucile Lake, El Dorado County, 1;[1] Lyell Canyon, Yosemite National Park, 13;[1] Markleeville, 3; Mono Pass, 1; Mount Dana, 3;[4] Mount Gibbs, 1; Mount Hoffman, 2;[1] Mount Lyell, 10; Mount Parsons, 1;[1] Mount Tallac, 9;[5] Mount Unicorn, 2; Owens River (head), 1; Pine City, Mono County [near Mammoth Pass], 2; Soda Springs, Yosemite National Park, 3;[1] Summit of Sierra (Latitude 39°), 2;[1] Ten Lakes, Yosemite National Park, 6;[1] Tioga Lake, Mono County, 1;[1] Vogelsang Lake, Yosemite National Park, 12;[1] Washburn Lake, Yosemite National Park, 1.[1]

OCHOTONA SCHISTICEPS ALBATA Grinnell.

Mount Whitney Pika.

Ochotona albatus Grinnell, Univ. California Publ. Zool., vol. 10, p. 125, January 31, 1912.

Ochotona schisticeps albatus, Grinnell, op. cit., vol. 17, p. 6, 1916.

Type.—Collected at Cottonwood Lakes, near Mount Whitney (at 11,000 feet altitude), Inyo County, California, September 3, 1911, by Joseph Grinnell; ♀ adult, skin and skull; No. 16223, Museum of Vertebrate Zoology, University of California; original number, 1741.

Geographic distribution.—Southern part of the high Sierra Nevada, from Kearsarge Pass south to the headwaters of the Tule and Kern Rivers: altitudinal range from about 8,500 feet to 13,000 feet. (Fig. 4, p. 37.)

Characters.—Similar to *O. schisticeps muiri*, but coloration decidedly paler.

Color.—Summer pelage: Head and face pale smoke-gray, moderately washed with chaetura drab; dorsal area pinkish buff, sparingly darkened with chaetura drab, shading to pale pinkish buff on lower sides; ears between chaetura drab and deep mouse-gray; feet grayish white, faintly washed with pinkish buff; soles fuscous or dark hair-brown; palms soiled whitish, washed with light drab; underparts grayish white, faintly, or sometimes strongly washed with pinkish buff. *Worn winter pelage* (June): Very similar to the summer pelage but upperparts, especially the head, more grayish (less buffy). *Fresh winter pelage:* Not represented.

Molt.—Two adult males from Mount Whitney, California, August 9, are apparently acquiring summer pelage, the new hairs coming in irregularly over the greater part of the dorsal area; three adult females from Mineral King, California, September 9, likewise show a new pelage (presumably the summer pelage) investing the head, shoulders, and middle of the back. The beginnings of winter pelage are not shown by the specimens at hand.

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[1] Collection Mus. Vert. Zool.
[2] Collection Mus. Comp. Zool.
[3] Five in collection Mus. Vert. Zool.
[4] Two in collection Mus. Vert. Zool.
[5] Five in collection Mus. Comp. Zool.; 3 in collection Acad. Nat. Sci. Philadelphia.

Skull.—Practically identical with that of *muiri*.

Measurements.—Average of 18 adults (10 males, 8 females) from type region (Mount Whitney and Kearsarge Pass): Total length, 182 (176–190); hind foot, 29.6 (28–31). *Skull:* Average of 17 adults (9 males, 8 females) from type region (Kearsarge Pass to Mineral King): Occipito-nasal length, 42.4 (40.8–43.4); zygomatic breadth, 20.7 (20–21.2); breadth of braincase, 17.9 (17–18.9); interorbital breadth, 4.8 (4.2–5.5); width of palatal bridge, 1.6 (1.3–2.4); length of nasals, 13. 9 (13.3–14.4).

Remarks.—Palest of the American pikas, the nearest relative of this race is *muiri*, of the Yosemite region, intergradation with which is apparently shown by a series from Mineral King, some of which are typical of *albata*, while several are scarcely distinguishable from *muiri*. Its range is not extensive, being restricted to the region around Mount Whitney, northward to Kearsarge Pass, between altitudes of about 8,500 feet (Onion Valley) to 13,000 feet (on west slopes of Mount Whitney). Grinnell refers to the aridity of the climate of this region, as compared with that of the northern Sierra Nevada, and to its long existence as a land mass of high elevation as possible explanations of its faunal distinctness.[6]

Specimens examined.—Total number, 68, as follows:

California: Bullfrog Lake, Fresno County, 8;[7] Cottonwood Lakes, 4;[7] Cottonwood Meadows, 2; Independence Creek (10,000 feet altitude), 1; Kaweah River (East Fork, near Mineral King), 2; Kearsarge Pass, 17;[7] Kern River (near head of North Fork), 2; Mineral King [East Fork Kaweah River], 20; Mount Whitney, 10;[8] Whitney Creek, Tulare County (altitude 10,850 feet), 2.[7]

OCHOTONA SCHISTICEPS SHELTONI Grinnell.

White Mountains Pika.

Ochotona schisticeps sheltoni Grinnell, Univ. California Publ. Zool., vol. 17, no. 14, p. 429, April 25, 1918.

Type.—Collected in the White Mountains (at 11,000 feet altitude), near Big Prospector Meadow, Mono County, California, July 29, 1917, by A. C. Shelton; ♂ adult, skin and skull; No. 27560, Museum of Vertebrate Zoology, University of California; original number, 3414.

Geographic distribution.—The White Mountains of California and Nevada (8,000 to 13,000 feet altitude). (Fig. 4, p. 37.)

Characters.—Size of *taylori:* somewhat intermediate in coloration between *schisticeps* and *muiri*. Compared with *schisticeps:* Dorsal area averaging slightly less cinnamon in general tone and in some specimens more heavily washed with blackish; nape a slightly paler shade of gray. Compared with *muiri*: Dorsal area averaging slightly darker, some specimens decidedly more blackish; sides deeper cinnamon. Compared with *taylori:* Coloration in summer pelage similar, but averaging decidedly paler, especially on the head.

Color.—Summer pelage: Upperparts (including head) light pinkish cinnamon, more or less washed with fuscous-black, the general tone varying from avellaneous to wood brown; occiput and nape washed to a varying extent by grayish white (in some specimens scarcely evident); ears dark fuscous-black (almost black), margined with grayish white: sides pinkish cinnamon or light pinkish cinnamon; feet

[6] Grinnell, Joseph, Univ. California. Publ. Zool., vol. 10, p. 127, 1912.
[7] Collection Mus. Vert. Zool.
[8] Seven in collection Field Mus. Nat. Hist.; 2 in collection Mus. Comp. Zool.

whitish, more or less washed with light pinkish cinnamon; soles chaetura black; palms soiled whitish, shaded with hair-brown; underparts whitish, moderately washed with pinkish cinnamon or light pinkish cinnamon. *Winter pelage:* Not represented.

Skull.—Closely similar to *taylori* but palatal bridge broader; similar to *schisticeps* but averaging slightly smaller; nasals narrower posteriorly; closely similar to *muiri* but averaging slightly shorter and relatively broader.

Measurements.—Average of 11 adults (7 males, 4 females) from White Mountains, California: Total length, 175 (167–188); hind foot, 27.6 (26–30). *Skull:* Average of 11 adult males from type region: Occipito-nasal length, 41.8 (40.9–42.8); zygomatic breadth, 21 (20.3–21.8); breadth of braincase, 18.3 (17.3–18.7); interorbital breadth, 4.8 (4.5–5.2); width of palatal bridge, 1.7 (1.4–2.2); length of nasals, 13.9 (13.2–14.4); average of 10 adult females from type region: Occipito-nasal length, 40.9 (39.5–42.5); zygomatic breadth, 20.5 (20.2–21.2); breadth of braincase, 17.9 (17.3–18.4); interorbital breadth, 4.7 (4.4–5.2); width of palatal bridge, 1.8 (1.4–2.2); length of nasals, 13.5 (13–14.6.)

Remarks.—The pika of the White Mountains is somewhat intermediate in color between *schisticeps* and *muiri*, to both of which it is very closely related; on geographic grounds it might be expected to be nearer *albata* of the Mount Whitney region.

Specimens examined.—Total number, 45, from the type region.[9]

OCHOTONA SCHISTICEPS CINNAMOMEA J. A. Allen.

Beaver Mountains Pika.

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

Ochotona cinnamomea J. A. Allen, Mus. Brooklyn Inst. Arts and Sci., Science Bull. vol. 1, no. 5, p. 121, March 31, 1905.

Type.—Collected at "Briggs" [=Britts] Meadows, Beaver Mountains, Utah (at 11,000 feet altitude), August 20, 1904, by George P. Engelhardt; adult (unsexed), skin and skull; No. 28733, American Museum of Natural History (formerly No. 434, Museum of the Brooklyn Institute of Arts and Sciences).

Geographic distribution.—Beaver Range, Utah, and Toyabe Mountains, Nevada; altitudinal range from 8,000 to 11,000 feet. (Fig. 4, p. 37.)

Characters.—Very similar to *schisticeps* but smaller; face, head, and nape (in summer pelage) averaging paler; sides slightly richer cinnamon.

Color.—*Summer pelage:* Upperparts cinnamon or vinaceous-cinnamon, mixed with fuscous-black, shading on sides to deep vinaceous-cinnamon; nose and face washed with smoke-gray, pale smoke-gray, or light buff; top of head fuscous or fuscous-black, washed with light buff; nape with an irregular and often indistinct patch of pallid neutral gray; ears chaetura black or chaetura drab, margined with buffy white, the long hairs at anterior base grayish white; feet grayish, washed with pinkish buff or cinnamon-buff; soles hair-brown or fuscous; palms buffy white, washed with drab; underparts light pinkish cinnamon, the bases of the hairs deep neutral gray. *Winter pelage:* Not represented.

[9] Thirty-eight in collection Mus. Vert. Zool.

Molt.—The date of the midsummer molt in this race is not indicated by the material at hand; the series from the type locality, taken between August 14 and 21, are all in complete summer pelage, more or less worn. The fall molt begins early in September, as shown by a specimen from Toyabe Mountains, Nevada, September 5, in which the fresh winter pelage covers the fore back and part of the head, the occiput and nape being in old worn pelage. Another specimen from the same locality, September 15, has practically the whole dorsal area renewed, but likewise shows a worn area on the occiput.

Skull.—Similar to that of *taylori* but braincase averaging narrower; smaller than that of *schisticeps*.

Measurements.—Average of 11 adults (5 males, 6 females) from type locality: Total length, 188 (180–200); hind foot, 28.4 (27–29). *Skull*: Average of 5 adult males from type locality: Occipito-nasal length, 41.6 (40.7–42.2): zygomatic breadth, 20.7 (20.3–21); breadth of braincase, 17.8 (17.4–18.5); interorbital breadth, 5.2 (4.8–5.9); width of palatal bridge, 1.6 (1.4–1.7); length of nasals, 13.5 (13–14.1). Average of two adult females from type locality: Occipito-nasal length, 39.9 (39.5–40.3); zygomatic breadth, 20.1; breadth of braincase, 17 (16.5–17.5); interorbital breadth, 5; width of palatal bridge, 1.5 (1.4–1.7); length of nasals, 12.6 (12.2–13).

Remarks.—Considering the wide area of desert separating the range of *cinnamomea* from that of *schisticeps* the differences between the two forms are remarkably slight. A series from the Toyabe Mountains, central Nevada, agrees closely with typical *cinnamomea*. In this series are two specimens acquiring winter pelage (September 5 and 15); this pelage differs from the summer pelage of typical specimens in being nearer vinaceous-cinnamon above; others in the series taken in May are decidedly paler than August specimens from the Beaver Mountains, the sides and upperparts being light pinkish cinnamon in general tone, moderately washed on the dorsal area with fuscous.

Specimens examined.—Total number, 25, as follows:

Nevada: Arc Dome [Toyabe Mountains] 5; Toyabe Mountains (South Twin River), 4. **Utah**: Beaver Mountains (Britt's Meadows, 15; Puffer Lake, 1), 16.[10]

OCHOTONA SCHISTICEPS FUSCIPES Howell.

Parowan Mountains Pika.

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

Ochotona schisticeps fuscipes Howell, Proc. Biol. Soc. Washington, vol. 32, p. 110, May 20, 1919.

Type.—Collected at Brian Head, Parowan Mountains, Iron County, Utah, September 7, 1908, by W. H. Osgood: ♂ adult, skin and skull; No. 158094, U. S. National Museum, Biological Survey collection; original number, 3475.

Geographic distribution.—Known only from type locality. (Fig. 4, p. 37.)

Characters.—Closely similar (in summer pelage) to *schisticeps*, but soles and palms darker; similar to *taylori*, but head paler and more grayish, general tone of upperparts less vinaceous (more pinkish) and

[10] One in collection Amer. Mus. Nat. Hist.

underparts paler; similar to *cinnamomea* but larger, and coloration above more blackish and less intensely cinnamon.

Color.—Summer pelage: Upperparts mixed light pinkish cinnamon and fuscous-black (the blackish prevailing); tip of nose fuscous-black; sides of nose and face smoke-gray, tinged with buff and washed with fuscous; back of head and nape washed with pale neutral gray; ears fuscous-black, margined with buffy white; sides pinkish cinnamon mixed with fuscous, becoming clear pinkish cinnamon along line of belly; hind feet soiled whitish, washed with pale cinnamon-buff, the soles fuscous; front feet cinnamon-buff, the palms hair-brown; underparts grayish white, heavily washed with pinkish cinnamon. *Winter pelage:* Not represented.

Skull.—Similar to that of *cinnamomea*, but larger and relatively broader, with larger audital bullae; very similar to that of *schisticeps*, but braincase averaging slightly narrower.

Measurements.—Average of 5 adults (1 male, 4 females) from type locality: Total length, 200 (195–207); hind foot, 30.3 (29–32). *Skull:* Average of 5 adults (1 male, 4 females): Occipito-nasal length, 42.4 (41.7–43.4); zygomatic breadth, 21.3 (20.4–22.2); breadth of braincase, 17.8 (17.2–18.5); interorbital breadth, 5.1 (4.9–5.3); width of palatal bridge, 1.4 (1.2–1.5); length of nasals, 13.1 (12.3–13.9).

Remarks.—On account of the close physical connection existing between the Parowan Range and the Beaver Range, the pikas on the two ranges would reasonably be expected to be the same. The Parowan Mountain form, however, is apparently more closely related to *schisticeps* of the Sierra Nevada and to *taylori* of the lava-bed region of southern Oregon than to its near neighbor, *cinnamomea*, of the Beaver Mountains. Its range is separated, however, from the ranges of the California and Oregon races by a broad expanse of desert; furthermore, the Toyabe Mountains in central Nevada are occupied by *cinnamomea*.

Specimens examined.—Total number, 6, from type locality.

Cranial measurements of Ochotona.

No.	Species and locality.	Sex.	Occipito-nasal length.	Zygomatic breadth.	Breadth of braincase.	Interorbital breadth	Width of palatal bridge.	Length of nasals.	Remarks.
	Ochotona princeps princeps:								
81541	Henry House, Alberta	♂	45.2	21.1	18.3	4.5	2.3	14.5	Old adult.
81528	Do	♂	43.2	21	17.6	5.6	2	13.9	Adult.
81533	Do	♀	45	21.9	18.6	5.6	2.1	14.7	Old adult.
81550	Do	♀	42	21	17.4	5.8	1.8	14.2	Do.
	Ochotona princeps lutescens:								
108650	Mount Inglesmaldie, Alberta	♂	43.3	21.6	18	5.3	2	13.9	Old adult; type.
108652	Do	♂	41.9	21	17.3	6	1.8	14.1	Old adult.
108653	Do	♀	43.3	.....	18.8	5.8	.....	12.9	Adult.
[1]15517	Do	♀	41.1	20.5	16.9	5.5	1.6	12.3	Do.
	Ochotona princeps levis:								
232759	Little Belt Mountains, Montana	♂	41.9	21.9	17.4	6.1	1.9	14.2	Do.
22241	Chief Mountain Lake, Montana	♀	41.8	20.5	17.2	5.2	1.5	14.2	Adult; type.
	Ochotona princeps lemhi:								
31209	Lemhi Mountains, Idaho	♂	41.6	21	17.6	4.7	1.7	13.8	Adult.
31205	Do	♂	44.1	21.3	18.5	4.9	2.1	14.9	Do.
30961	Do	♀	41.3	20.4	17	4.8	2.1	14.3	Adult; type.
31058	Do	♀	42	20.5	16.7	4.7	1.8	14	Adult.
	Ochotona princeps ventorum:								
176778	Wind River Mountains, Wyoming.	♂	44	21.5	17.8	4.6	2	15	Do.
176839	Do	♂	46.1	22.6	18.5	5.1	2.1	14.4	Do.
55663	Do	♀	43.8	21.4	17.3	4.6	1.9	13.7	Do.
55665	Do	♀	46.7	.....	18.5	5	1.9	14.9	Do.
	Ochotona princeps uinta:								
25608	Uinta Mountains, Utah	♂	45.3	22.1	17.5	5.1	2.4	15.7	Do.
55175	Salt River Mountains, Wyoming.	♂	44	.....	18.2	5.6	2.3	15	Do.
25609	Uinta Mountains, Utah	♀	44.2	22	18.4	5.1	2.8	15	Do.
55174	Salt River Mountains, Wyoming.	♀	43.4	21.7	18.2	5.6	1.8	14.7	Do.
	Ochotona princeps nevadensis:								
94212	Ruby Mountains, Nevada	♂	42	21.1	17.9	5.4	2.5	14.3	Do.
94213	Do	♀	44.1	21.2	18	5.2	2.8	14.5	Adult; type.
	Ochotona princeps figginsi:								
[1]32719	Pagoda Peak, Colorado	♂	42.8	21.4	18	5.2	1.8	14.5	Adult.
[2]4031	Trapper's Lake, Colorado	♂	44.7	22.3	19.2	5.5	2.7	15	Do.
[1]32721	Pagoda Peak, Colorado	♀	.....	20.7	17	5.1	2	14.8	Subadult; type.
[3]333	Do	♀	43.7	21.4	19	5	1.7	15	Adult.
	Ochotona princeps saxatilis:								
205789	Alma, Colorado	♂	46	21.8	18.9	5.6	2.4	15.1	Subadult.
[3]1381	Corona, Colorado	♂	48.1	23.2	19.6	5.9	2.8	16.3	Old adult.
74056	Long's Peak, Colorado	♀	44.5	21.3	17.9	5.3	1.8	15.3	Adult.
205792	Mount Lincoln, Colorado	♀	47.2	22.1	18.5	5.7	2	16.8	Do.
	Ochotona princeps incana:								
128913	Pecos Baldy, New Mexico	♂	44.4	21.8	19.5	5	2.8	15	Do.
128740	Do	♂	45.8	22.3	19	5.8	2.2	15	Do.
130970	Wheeler Peak, New Mexico	♀	44.1	21.3	18.3	5.2	2.2	14	Do.
128914	Pecos Baldy, New Mexico	♀	46.8	22.5	19	5.3	2.5	15.8	Adult; type.
	Ochotona princeps nigrescens:								
147976	Jemez Mountains, New Mexico	♂	43.3	20.9	18	5.3	2.1	14.3	Do.
	Ochotona princeps cuppes:								
[4]7389	Gold Range, British Columbia	♂	43.4	21.9	19	5	2.3	13.5	Subadult; type.
69234	Glacier, British Columbia	♂	46	22.5	18.3	5	3.5	15.4	Old adult.

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection E. R. Warren, Colorado Springs, Colorado.
[3] Collection Colorado Mus. Nat. Hist.
[4] Collection Mus. Comp. Zool.

Cranial measurements of Ochotona—Continued.

No.	Species and locality.	Sex.	Occipito-nasal length.	Zygomatic breadth.	Breadth of braincase.	Interorbital breadth.	Width of palatal bridge.	Length of nasals.	Remarks.
	Ochotona princeps fenisex:								
[5]1443a	Head of Asimola River, British Columbia.	.....	42	22	18.7	6	3	13.4	Type.
[6]848	Horseshoe Basin, Washington....	♂	43.1	22	19	5.1	2.8	14	Adult.
	Ochotona princeps brooksi:								
69274	Sicamous, British Columbia.....	♂	42.3	21.5	17.9	5.6	2	12.8	Do.
69275	Do	♂	43.9	22	18.4	.....	2	14.2	Adult; type.
67130	Do	♀	43.5	20.6	17.5	5.1	2.6	13.7	Adult.
	Ochotona princeps brunnescens:								
227258	Keechelus, Washington.....	♂	45.9	22.3	19.2	5.9	2.6	14.4	Old adult.
89840	Mount Rainier, Washington.....	♂	42.3	21.5	18.7	5.2	2	13.1	Adult.
41538	Easton, Washington.....	♀	44.6	21.8	18.3	5	2.4	14.2	Do.
	Ochotona princeps fumosa:								
91144	Mount Jefferson, Oregon.....	♂	44.5	21.3	18.2	5.3	2.4	15.4	Adult; type.
91140	Do	♂	45.6	22	18.1	5.3	2.8	15.7	Adult.
91143	Do	♀	43.9	21.4	18.9	5.6	2.9	13.8	Do.
	Ochotona collaris:								
131266	Seward Creek, near Eagle, Alaska	♂	43.1	21.9	19.1	5.1	2.5	13	Do.
131329	Do	♂	44.2	22	18.6	6.2	2.5	13.4	Do.
131298	Do	♀	44.1	22	18.4	5.6	3.2	12.6	Do.
	Ochotona schisticeps schisticeps:								
186517	Donner, California.....	♂	45	21.7	19.4	5.3	[7]2.6	14.5	Old adult; type.
100466	Do	♂	41.5	20.9	18.2	4.8	1.8	13.7	Adult.
100250	Do	♀	42.2	20.8	18.1	5.3	1.3	13.5	Do.
	Ochotona schisticeps taylori:								
[8]11292	Warner Mountains, California....	♂	41.7	20.8	18.7	5.8	1.2	.....	Adult; type.
89120	Madeline Plains, California.....	♂	41.8	20.5	18.1	4.7	1.4	13.6	Adult.
[8]11294	Warner Mountains, California....	♀	42.7	.....	17.6	4.6	1.2	14.4	Do.
	Ochotona schisticeps goldmani:								
236408	Snake River Desert, Idaho.....	♂	43.5	20.4	18.8	5.8	1.3	13.4	Adult; type.
236406	Do	♀	43.9	21.6	18.7	6.1	1.8	13	Adult.
	Ochotona schisticeps jewetti:								
208352	Cornucopia, Oregon.....	♂	42.6	21.6	19	5.2	1.5	13.7	Adult; type.
207676	Bourne, Oregon.....	♂	44	21.3	18.5	5	1.4	13.8	Adult.
[10]40548	Anthony, Oregon	♀	43.8	21.8	18.2	5.8	1.6	15.3	Do.
	Ochotona schisticeps muiri:								
[8]23480	Ten Lakes, California.....	♂	41.6	20.4	17.3	4.8	1.9	14.1	Adult; type.
109407	Mount Lyell, California.....	♂	42.4	21	17.8	5.2	1.2	13.6	Adult.
109408	Do	♀	42.5	20.5	18	4.6	1.6	14.1	Do.
	Ochotona schisticeps alpata:								
[9]12584	Mount Whitney, California.....	♂	43.3	20	18.2	5	1.5	13.7	Do.
42689	Mineral King, California.....	♂	41.7	20.8	17	4.9	1.6	14.1	Do.
[9]12590	Mount Whitney, California.....	♀	42.6	21.2	18.2	5.2	2	13.6	Do.
	Ochotona schisticeps shelloni:								
[8]27560	White Mountains, California.....	♂	42.8	21.5	18.7	5	1.7	14	Adult; type.
41420	Do.....	♀	40.8	20.3	18	4.7	1.7	13.2	Adult.
	Ochotona schisticeps cinnamomea:								
158089	Beaver Mountains, Utah.....	♂	41.7	20.9	17.8	5.3	1.6	13	Do.
158093	Do.....	♀	40.3	20.1	17.5	5	1.4	12.2	Do.
	Ochotona schisticeps fuscipes:								
158094	Parowan Mountains, Utah.....	♂	41.7	21.4	17.9	5	1.4	12.3	Adult; type.
158096	Do.....	♀	43.4	21.4	18.3	5.1	1.2	13.3	Adult.
158095	Do.....	♀	41.7	20.4	17.3	4.9	1.5	13	Do.

[5] Collection British Mus.; measured by Oldfield Thomas.
[6] Collection of S. G. Jewett.
[7] Abnormally broad for the species.
[8] Collection Mus. Vert. Zool., Univ. California.
[9] Collection Field Mus. Nat. Hist.
[10] Collection Amer. Mus. Nat. Hist.

PLATE III.

[All natural size.]

FIG. 1.—*Ochotona princeps princeps*, ♂ adult, Henry House, Alberta (No. 81537, U. S. Nat. Mus., Biological Survey collection).

FIG. 2.—*Ochotona collaris*, ♂ adult, Seward Creek, near Eagle, Alaska (No. 131266, U. S. Nat. Mus., Biological Survey collection).

FIG. 3.—*Ochotona princeps uinta*, ♂ adult, Uinta Mountains, Utah (No. 25608, U. S. Nat. Mus., Biological Survey collection).

FIG. 4—*Ochotona princeps cuppes*, ♂ subadult (type), Monashee Divide, Gold Range, British Columbia (No. 7389, Mus. Comp. Zool.).

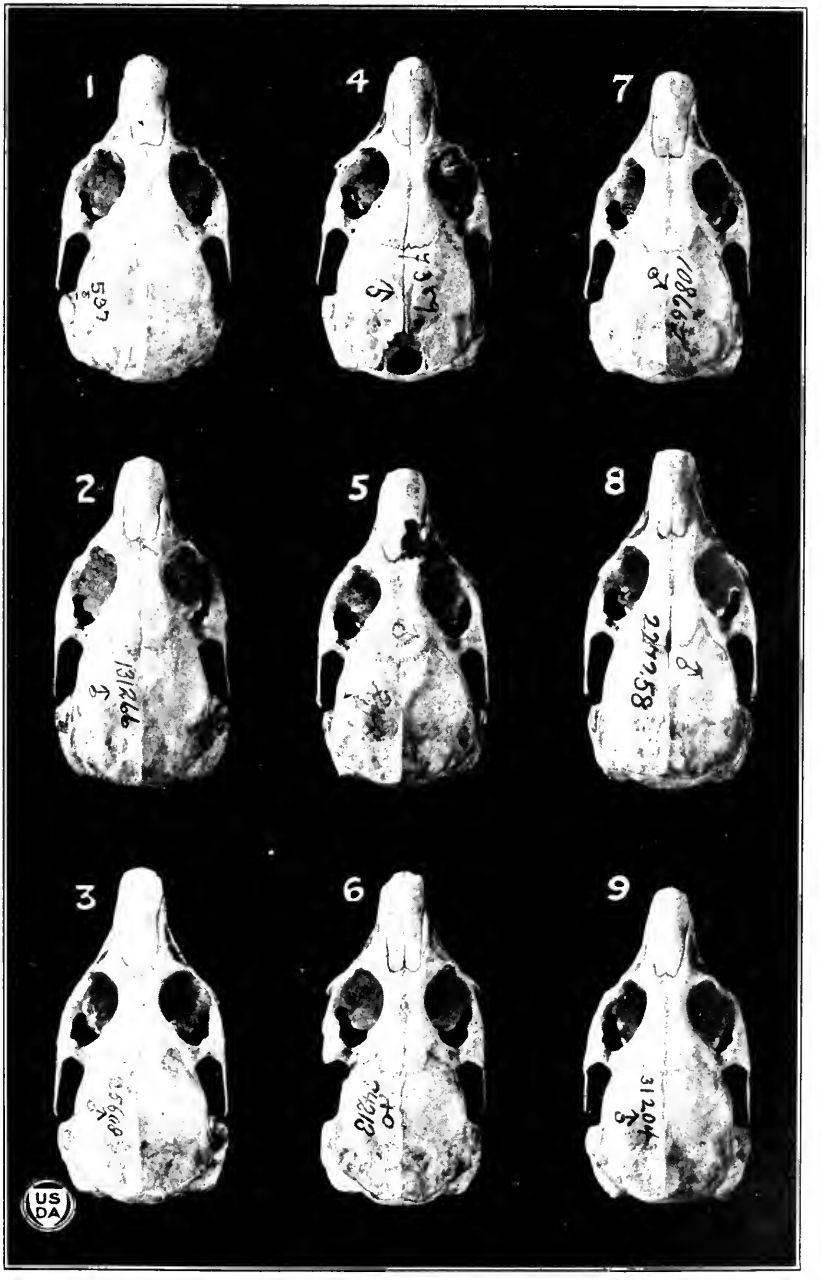
FIG. 5.—*Ochotona princeps fenisex*, ♂ adult, Horseshoe Basin [near Mount Chopaka], Washington (No. 848, collection S. G. Jewett).

FIG. 6.—*Ochotona princeps nevadensis*, ♀ adult (type), Ruby Mountains, Nevada (No. 94213, U. S. Nat. Mus., Biological Survey collection).

FIG. 7.—*Ochotona princeps lutescens*, ♂ adult, Mount Inglesmaldie, near Banff, Alberta (No. 108652, U. S. Nat. Mus., Biological Survey collection).

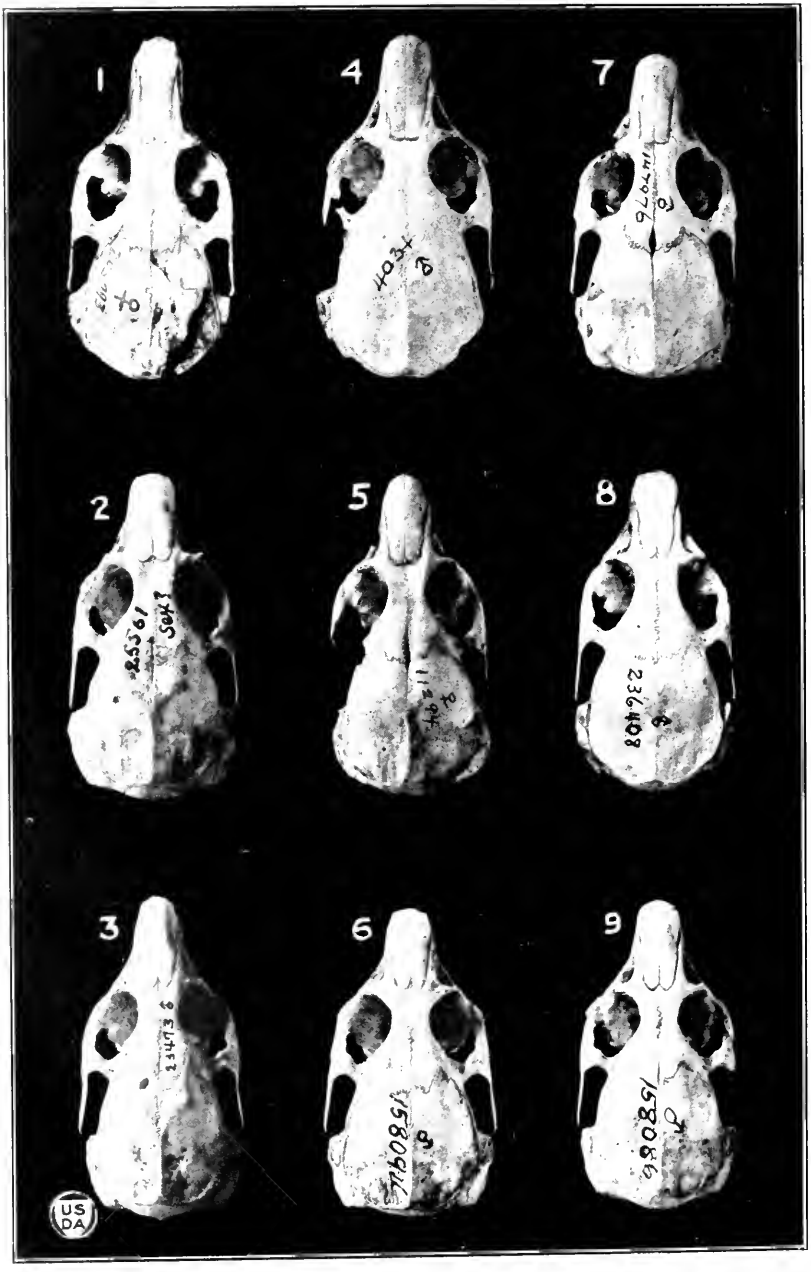
FIG. 8.—*Ochotona princeps brunnescens*, ♂ adult, Keechelus, Washington (No. 227258, U. S. Nat. Mus., Biological Survey collection).

FIG. 9.—*Ochotona princeps lemhi*, ♂ adult, Lemhi Mountains, Idaho (No. 31204, U. S. Nat. Mus., Biological Survey collection).



SKULLS OF OCHOTONA PRINCEPS AND O. COLLARIS, DORSAL VIEWS.

1. O. p. princeps.
2. O. collaris.
3. O. p. uinta.
4. O. p. cuppes.
5. O. p. fenisex.
6. O. p. nevadensis.
7. O. p. lutescens.
8. O. p. brunnescens.
9. O. p. lemhi.



SKULLS OF OCHOTONA PRINCEPS AND O. SCHISTICEPS, DORSAL VIEWS.

1. O. p. saxatilis.
2. O. s. schisticeps.
3. O. s. muiri.
4. O. p. figginsi.
5. O. s. taylori.
6. O. s. fuscipes.
7. O. p. nigrescens.
8. O. s. goldmani.
9. O. s. cinnamomea

PLATE IV.

[All natural size.]

FIG. 1.—*Ochotona princeps saxatilis*, ♀ adult, Mount Lincoln, Colorado (No. 205793 U. S. Nat. Mus., Biological Survey collection).

FIG. 2.—*Ochotona schisticeps schisticeps*, adult, Donner Pass, California (No. 25561, Mus. Vert. Zool., Univ. of California).

FIG. 3.—*Ochotona schisticeps muiri*, ♂ adult, Vogelsang Lake, Yosemite National Park, California (No. 23473, Mus. Vert. Zool.).

FIG. 4.—*Ochotona princeps figginsi*, ♂ adult, Trappers Lake, Garfield County, Colorado (No. 4031, collection of E. R. Warren).

FIG. 5.—*Ochotona schisticeps taylori*, ♀ adult, Warner Mountains, California (No. 11294, Mus. Vert. Zool.).

FIG. 6.—*Ochotona schisticeps fuscipes*, ♂ adult (type), Parowan Mountains, Utah (No. 158094, U. S. Nat. Mus., Biological Survey collection).

FIG. 7.—*Ochotona princeps nigrescens*, ♂ adult (type), Jemez Mountains, New Mexico (No. 147976, U. S. Nat. Mus., Biological Survey collection).

FIG. 8.—*Ochotona schisticeps goldmani*, ♂ adult (type), Snake River Desert, Idaho (No. 236408, U. S. Nat. Mus., Biological Survey collection).

FIG. 9.—*Ochotona schisticeps cinnamomea*, ♂ adult, Beaver Mountains, Utah (No. 158086, U. S. Nat. Mus., Biological Survey collection).

PLATE V.

[All natural size.]

FIG. 1.—*Ochotona princeps princeps*, ♂ adult, Henry House, Alberta (No. 81537, U. S. Nat. Mus., Biological Survey collection).

FIG. 2.—*Ochotona collaris*, ♂ adult, Seward Creek, near Eagle, Alaska (No. 131266, U. S. Nat. Mus., Biological Survey collection).

FIG. 3.—*Ochotona princeps uinta*, ♂ adult, Uinta Mountains, Utah (No. 25608, U. S. Nat. Mus., Biological Survey collection).

FIG. 4.—*Ochotona princeps cuppes*, ♂ subadult (type), Monashee Divide, Gold Range, British Columbia (No. 7389, Mus. Comp. Zool.).

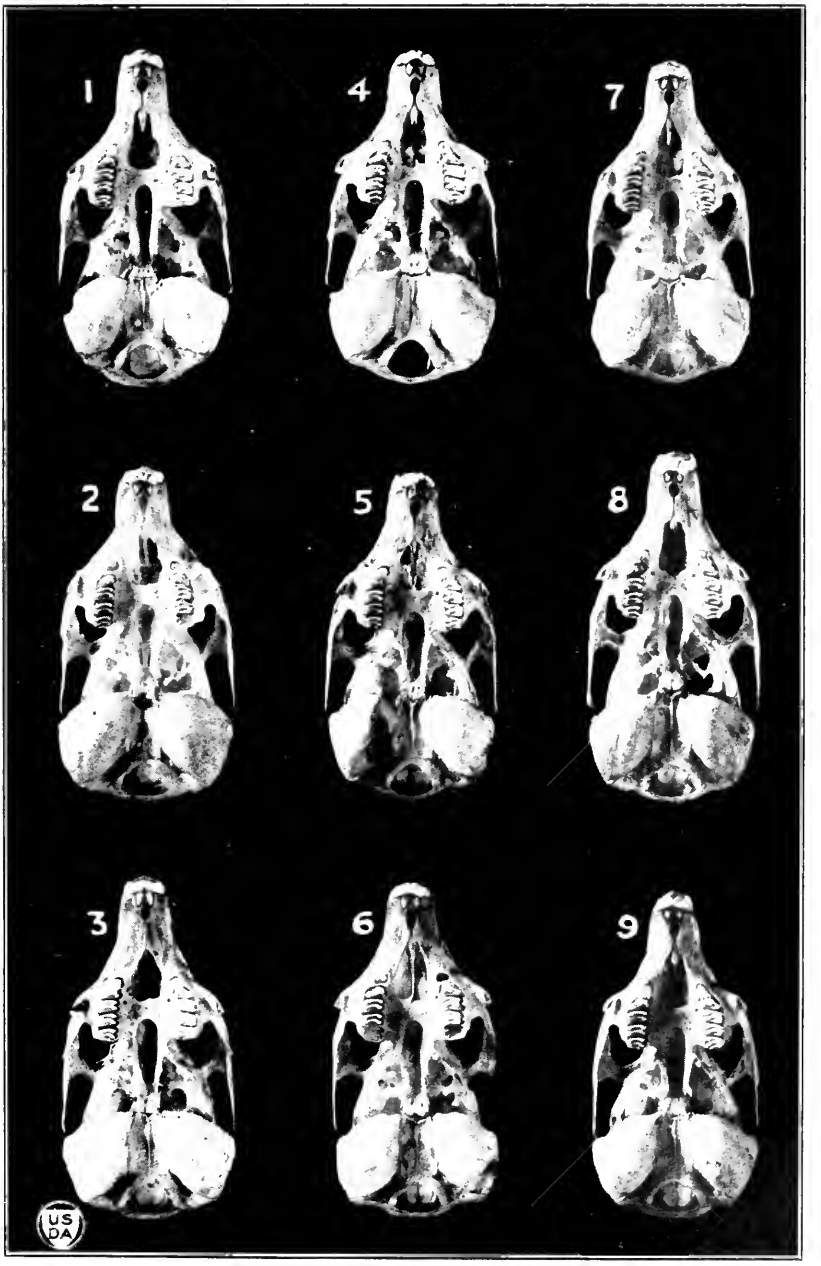
FIG. 5.—*Ochotona princeps fenisex*, ♂ adult, Horseshoe Basin [near Mount Chopaka], Washington (No. 848, collection S. G. Jewett).

FIG. 6.—*Ochotona princeps nevadensis*, ♀ adult (type), Ruby Mountains, Nevada (No. 94213, U. S. Nat. Mus., Biological Survey collection).

FIG. 7.—*Ochotona princeps lutescens*, ♂ adult, Mount Inglesmaldie, near Banff, Alberta (No. 108652, U. S. Nat. Mus., Biological Survey collection).

FIG. 8.—*Ochotona princeps brunnescens*, ♂ adult, Keechelus, Washington (No. 227258, U. S. Nat. Mus., Biological Survey collection).

FIG. 9—*Ochotona princeps lemhi*, ♂ adult, Lemhi Mountains, Idaho (No. 31204, U. S. Nat. Mus., Biological Survey collection).



SKULLS OF OCHOTONA PRINCEPS AND O. COLLARIS, VENTRAL VIEWS.

1. O. p. princeps.
2. O. collaris.
3. O. p. uinta.
4. O. p. cuppes.
5. O. p. fenisex.
6. O. p. nevadensis
7. O. p. luteseens.
8. O. p. brunnescens.
9. O. p. lemhi.

SKULLS OF OCHOTONA PRINCEPS AND O. SCHISTICEPS. VENTRAL VIEWS.

1. O. p. saxatilis.
2. O. s. schisticeps.
3. O. s. muiri.
4. O. p. figginsi.
5. O. s. taylori.
6. O. s. fuscipes.
7. O. p. nigrescens.
8. O. s. goldmani.
9. O. s. cinnamomea.

PLATE VI.

[All natural size.]

FIG. 1.—*Ochotona princeps saxatilis*, ♀ adult, Mount Lincoln, Colorado (No. 205793, U. S. Nat. Mus., Biological Survey collection).

FIG. 2.—*Ochotona schisticeps schisticeps*, adult, Donner Pass, California (No. 25561, Mus. Vert. Zool., Univ. of California).

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FIG. 8.—*Ochotona schisticeps goldmani*, ♂ adult (type), Snake River Desert, Idaho (No. 236408, U. S. Nat. Mus., Biological Survey collection).

FIG. 9.—*Ochotona schisticeps cinnamomea*, ♂ adult, Beaver Mountains, Utah (No. 158086, U. S. Nat. Mus., Biological Survey collection).

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[New species in **bold-face** type.]

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RED TREE MOUSE (PHENACOMYS LONGICAUDUS)

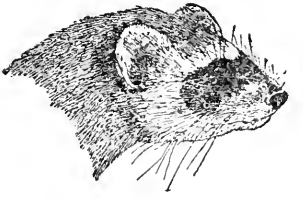
Photographed near Carlotta, Calif.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 48

[Actual date of publication, October 12, 1926]



VOLES OF THE GENUS PHENACOMYS

I. REVISION OF THE GENUS PHENACOMYS
II. LIFE HISTORY OF THE RED TREE MOUSE (PHENACOMYS LONGICAUDUS)

BY

A. BRAZIER HOWELL
SCIENTIFIC ASSISTANT, DIVISION OF BIOLOGICAL INVESTIGATIONS
BUREAU OF BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1926

LETTER OF TRANSMITTAL

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., February 10, 1926.

SIR: I have the honor to transmit herewith, with the recommendation that it be published as No. 48 in the series of the North American Fauna, a report on the voles of the American genus *Phenacomys*, by Alfred Brazier Howell, an assistant of this bureau. The report consists of two parts, (1) a technical revision of the genus, and (2) the results of a study of one of the more interesting and scientifically important species, concerning which the author has had exceptional opportunities for observation.

These investigations constitute an intensive study of the subject and are based on an examination of practically all the specimens extant in public and private collections in this country and Canada.

Respectfully,

E. W. NELSON, *Chief of Bureau.*

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

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VOLES OF THE GENUS PHENACOMYS

I. REVISION OF THE GENUS PHENACOMYS

By A. Brazier Howell

INTRODUCTION

The rodent genus *Phenacomys* belongs to the section Microti, subfamily Microtinae, family Cricetidae, and so far as known it is confined to the New World. As its main range lies in regions comparatively unfrequented by man, and as the animals are usually decidedly rare, study material has been slow to accumulate.

There has been little need of a colloquial name for this genus, but when one has been desired, the animals have usually been called "lemming mice." They are not lemmings, however, nor more closely related to the latter than are many other genera of voles, and the name is misleading. Because of a diversity of habits and habitat, no one name, strictly English, can well be applied, except to two arboreal long-tailed species, which are termed "tree mice," and it is thought better for the short-tailed terrestrial species to retain the Latin generic name for its colloquial equivalent.

Although it is hoped that everything possible that might prove of real value to the investigator has been included in the following revision, an effort has been made to exclude all minute descriptions of an attempted exactitude impossible of attainment and often highly confusing to the student.

GEOGRAPHIC DISTRIBUTION

In general, *Phenacomys* is found in scattered localities throughout practically the whole of the upper Canadian and the Hudsonian Zones of Canada; apparently it is absent from Alaska; and in the United States it is found in the Rocky Mountain system as far south as northern New Mexico, on the boreal summits of isolated mountain ranges of the Great Basin, and south in the Sierra Nevada at least to the Yosemite Park, Calif.; and also in the coastal belt of Oregon and northern California. (See map, fig. 1.)

HABITS

The habitats of members of the genus are extremely diverse in character and vary from sandy blueberry barrens, boreal heather meadows, dry woods of the far north, and sphagnum bogs, to a riparian association on the Pacific coast and an arboreal habitat among evergreen forests. Habits are equally diverse, but very little is known of them. Well-defined runways seldom occur but are occasionally made when the animals are living among beds of heather or other very dense growth.

The short-tailed species, usually living in dry situations where cover is ample, probably feed on a variety of seeds, tender growth, and other relatively soft or brittle foods for which their teeth are best suited. The majority of existing specimens of *Phenacomys albipes* were obtained on the immediate banks of little streams in the forest, so that its habitat seems to be chiefly riparian in character, but its food is unknown. Two long-tailed species, *P. longicaudus* and *P. silvicola*, are definitely, although not exclusively, arboreal. Their food, so far as known, consists chiefly of the fleshy parts of the needles of the conifers in which they live, and the medullary portions constitute the chief material from which their nests are constructed. Some tender bark also is consumed.

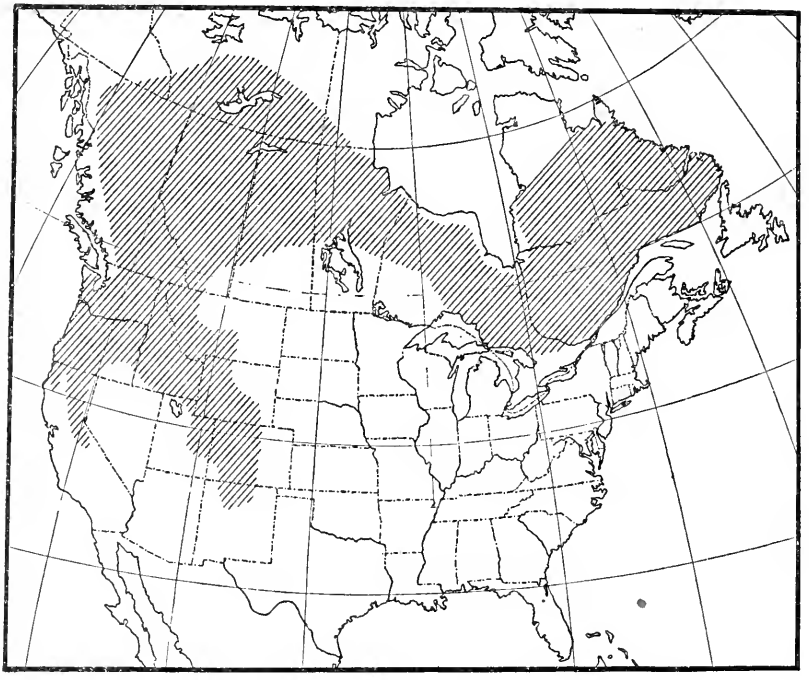

FIG. 1.—Approximate distribution of the genus *Phenacomys*

In all probability, more than one litter of young is raised during the warmer months each year, but exact data upon the subject are lacking. There are records among Biological Survey field notes of females containing from 4 to 9 embryos; the usual number seems to be 5 or 6, but is fewer in the case of *P. longicaudus*, which the writer has found to have 1 to 3 young, and which must also have fewer predatory enemies to contend with.

It is believed that no member of the genus hibernates, and that there is no diminution of activity because of cold weather. With rare exceptions the ranges of the short-tailed species are situated in regions unsuited to agriculture, and they could be of little or no economic importance even were they far more abundant than is now the case. One long-tailed species, *P. longicaudus*, is said by

Taylor (1915b, p. 142) [1] occasionally to girdle and kill the top of its nest tree, but it is not certain that the mice are directly responsible for this damage.

MATERIAL EXAMINED AND DESIRED

This revision is based upon the study of 317 specimens of the genus *Phenacomys*, practically all now available, except some juvenile material of the better-known forms, which it was thought unnecessary to examine.[2]

For the generic revision made by G. S. Miller, jr., in 1897 (1897b, pp. 77–87) the material available was so very scanty that a proper understanding of relationships and the degree of individual variation was at that time hardly possible, and in consequence, further revision has been needed for some years. Although material is now more abundant, it is far from all that could be desired in this regard and will probably remain so for many years. Upon the study of hundreds of additional specimens, still another revision will undoubtedly prove desirable.

Examples of the genus *Phenacomys* will always be eagerly sought by collectors because of their rarity. Specimens are especially needed from a number of critical localities, for it is folly to claim that a perfect understanding of a species or subspecies can be gained from one or two specimens. More material is urgently needed from the whole of the eastern half of Canada, especially Ungava, Quebec, and the area to the south of Hudson Bay, from the Hudsonian Zone of New Brunswick, and from the New England States.

In the western portion of North America a special effort should be made to obtain a small series of adults from the basaltic plateau to the northward of Kamloops, British Columbia—the type locality of *intermedius*. Material from several places in the Bitterroot Mountains between Montana and Idaho, as well as series from the Lemhi Mountains (the type locality of "*orophilus*") of the latter State, and from some one spot in Colorado, are also greatly to be desired. A small series from the Blue Mountains of Oregon would be worth an effort, as well as from various localities in the Cascade Mountains of that State.

Additional skins of *albipes*, although desirable because of their rarity, would not add materially to our systematic knowledge of the species, but specimens of *silvicola* would be of the greatest importance. The recent discovery of that species is an indication of the possibilities of the region, and all collectors in the forests of the humid Northwest should investigate everything encountered that might prove to be the nest of an arboreal phenacomys.

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[1] Literature citations in parentheses refer to the bibliography beginning on page 58.

[2] The writer's thanks are hereby tendered G. S. Miller, jr., curator of mammals, of the United States National Museum, for the unrestricted use of the material in his care. For the loan of pertinent material, he is also greatly indebted to the Museum of Comparative Zoology (29 specimens), through G. M. Allen; the Academy of Natural Sciences of Philadelphia (5 specimens), through Witmer Stone; the Field Museum of Natural History (10 specimens), through W. H. Osgood; the Museum of Vertebrate Zoology (9 specimens), through Joseph Grinnell; the Victoria Memorial Museum (11 specimens), through R. M. Anderson; the Provincial Museum (8 specimens), through Francis Kermode; the American Museum of Natural History (4 specimens), through H. E. Anthony; the Oregon Agricultural College (1 specimen), through H. M. Wight; Washington State College (10 specimens), through W. T. Shaw; and to D. R. Dickey (9 specimens), S. G. Jewett (10 specimens), E. R. Warren (2 specimens), W. S. Saunders (1 specimen), and A. Walker (3 specimens). Grateful acknowledgment is made also to various members of the staff of the Biological Survey and to G. S. Miller, jr., for advice.

EXPLANATIONS OF MEASUREMENTS AND COLOR TERMS

All measurements given are in millimeters. With the exception of a few alcoholics as noted, the external measurements were taken by the collector in the field from the specimen in the flesh. Since collectors frequently measure the same specimen differently, too much reliance should not be placed on such figures, nor on differences indicated in the size of the sexes when very few individuals are concerned. For this reason slight differences in body size between closely related forms are not emphasized unless supported by ample evidence.

Only those skulls (except types) were measured which were sufficiently adult to show an indication beyond the mandibular alveoli of the rooted nature of the molars, the measurements being taken by the writer with dial calipers on which divisions were in tenths of a millimeter.

Condylobasilar length.—Distance from the posterior border of the condyle to the posterior edge of the alveolus of the incisor on the corresponding side of the skull.

Nasals.—Greatest length of nasals.

Interorbital breadth.—Shortest distance between the orbits.

Zygomatic breadth.—Distance between the zygomatic arches at their widest point.

Lambdoidal width.—Greatest width of posterior portion of brain case measured across the lambdoidal ridges.

Incisive foramina.—Greatest length of incisive foramina.

Maxillary tooth row.—Aggregate length of right-hand upper molar series.

Height.—Height of skull, measured from a plane passing from the inferior surface of the bullae to the inferiormost molar projection.

Listed specimens are in the United States National Museum unless otherwise stated.

For the reason that it is often impossible to apply a single precise color term to an animal of the agouti pattern, the color names given herein, including those of Ridgway,[3] are meant to be only approximate. Although such terms as "warm brown" and "grayish brown" are admittedly unsatisfactory, it is at least felt that they do not indicate a misleading exactness impossible of attainment in the case of most small mammals.

Genus PHENACOMYS Merriam

Phenacomys Merriam, North Amer. Fauna No. 2, p. 28, 1889.

HISTORY

The characters whereby the present genus is distinguished from other microtines were first appreciated by C. Hart Merriam, who named *Phenacomys* as a new genus in 1889, designating *intermedius* as the type species, and at the same time describing as additional new species *ungava*, "*celatus*," and "*latimanus*," each from a single spirit-specimen of poor quality. In the following year F. W. True described *longicaudus* from an Oregon example with badly damaged

[3] Ridgway, Robert. Color standards and color nomenclature. 43 pp., illus. 1912.

skull; and in 1891 Merriam described "*orophilus*" from Idaho, based on an immature individual of which no adult topotypes have as yet been collected. In 1894 J. A. Allen named "*truei*" from a skin with fragmentary skull then supposed to have come from the Black Hills of South Dakota, but since ascertained to have been taken in Wyoming. In 1895, S. N. Rhoads described still another species, from southern British Columbia, under the name "*oramontis*"; and in 1897 Merriam (1897b) characterized "*preblei*" from Colorado. In 1899 J. A. Allen named "*constablei*" from British Columbia, and D. G. Elliott (1899b), *olympicus*, from Washington, as well as "*Microtus* (*Lagurus*) *pumilus*," which proved to be a juvenile *Phenacomys*. The following year Outram Bangs named *crassus* as a subspecies of "*celatus*," from Labrador. Then, in 1901, came *albipes* by Merriam, and a year later, *mackenzii* by E. A. Preble (1902a). In 1921 *silvicola* was described, and in 1923, *levis* and *celsus*, these three by the writer.

Thus, 18 forms of *Phenacomys* have been described as new, all but 3 of them as full species. Of these, 10 are herein recognized, the remainder being placed in synonymy.

In 1894, Nehring (1894, p. 346) referred to the genus *Phenacomys* some fossil material from the late Pliocene forest beds of England, previously described by Newton as *Arvicola intermedius*. This is of interest in the present connection, because the teeth of this animal have roots and because it is the only case in which Old World material has been ascribed to this genus. The type of enamel pattern, however, definitely precludes the possibility of this material being referable to *Phenacomys* as at present defined, and it has since been included with several other Pliocene species from various parts of Europe in the extinct genus *Mimomys* Major (1902, p. 102). None of these animals, however, is believed to be directly ancestral to either *Microtus* or *Phenacomys*. (See Hinton, in Barrett-Hamilton, 1913, p. 385.)

In Miller's revision of the genus *Phenacomys* (1897b, p. 77), six of the forms that had then been described were recognized. The author of this revision was seriously handicapped in having so few specimens available (64 in all), especially from any single locality, and a proper understanding of variations and relationships could not be obtained.

In 1915, W. P. Taylor (1915b, p. 111) described a subgenus *Arborimus* to include *longicaudus* (the type species) and *albipes*. In addition, several other races were discussed and an effort made to define their relationships. Unquestionably, *longicaudus* and *silvicola*, which latter was unknown in 1915, constitute a readily recognizable group, but the characters on which the subgenus were based are all weak, ill-defined, and not, in the opinion of the writer, of sufficient importance to merit subgeneric position, especially when one considers what a compact unit-division is included within the genus as it now stands. Furthermore, *albipes* is intermediate in many respects between the short-tailed members of the genus and the arboreal species, and this fact would still further complicate the establishment of a subgenus. In short, it is considered that the recognition of a subgeneric division within the genus could be based only upon weakly defined characters, and that such a step would complicate, rather than clarify, our understanding of the subject.

KEY TO THE GENUS

Molars of adults rooted---------- Genera *Ondatra, Evotomys, Phenacomys.*
Skull in adults less than 40 mm. long---------- *Evotomys, Phenacomys.*
Posterior border of palate not shelf-like: inner reentrant angles of lower molars much deeper than outer---------- *Phenacomys.*

CHARACTERS

Generic diagnosis.—The most important characters by which the genus may be distinguished are the presence of rooted molars when adult (versus all other recent genera but *Evotomys* and *Ondatra*—or *Fiber* of authors) and by not having a palate that is transversely continuous and shelf-like (versus *Evotomys*). The enamel pattern of the molars is unique, chiefly in the great depth of the reentrant angles, as compared with the external, of the mandibular teeth, a character readily distinguishing animals of this genus at any age from all other Microti. The upper incisors are without grooves, and the proximal terminations of the roots of the lower ones are situated on the buccal side of the molars and terminate posterior to the last one. The tail is longer than the hind foot, and in the short-tailed groups does not taper to an appreciable extent. The palate is normal, with or without a median projection.

External characters.—Externally there is little to distinguish *Phenacomys* from many other microtines. There is variation in the length of the tail, from short to long, and also in the degree of hairiness of this member. The ears are rather small in most cases and hidden to a large extent by the body hairs. The coloration varies through a number of shades of agouti gray and brown, and in one case it is strongly reddish. In some of the races there is a tendency toward increased grayness about the head; one group has the face yellow, and two species, dusky. The feet of the terrestrial species are whiter than is usually the case with *Microtus*, and the tail more sharply bicolor in the shorter-tailed ones. Juveniles are usually considerably darker and more plumbeous than adults, as is normally the case in this subfamily. In *longicaudus* the coat is inclined to be short and coarse, but all other known species of the genus are covered with hair that is longer and more silky than in the majority of meadow mice.

On account of the dearth of winter and early-spring material, it is impossible to be sure whether there are one or two annual molts, but as the winter pelage is not only longer but slightly paler than that of early summer, it may be assumed that there are two. At any rate, the autumnal molt takes place at almost any period late in summer or early in fall, the exact time probably depending upon the age of the animal and local conditions of temperature. Usually the old pelage becomes somewhat worn and ragged and is gradually replaced by the new coat, but variations are noted in two instances. In the case of an old male from the Bitterroot Mountains near Mullan, Idaho, July 3, 1920, most of the pelage is decidedly worn and dull, but the new coat has been assumed upon the underparts and has begun to appear in a clearly defined area upon the top of the head and the nape. In an immature male taken at Sawtooth City, Idaho, October 4, 1895, this change is reversed, for the top of the head, from the

nose to the nape, is covered with short hairs of the immature, summer coat, while the remainder of the body has assumed the full, grayer, and paler winter pelage of the adult. Winter pelage is naturally more luxuriant than summer, and it seems to be paler as well, but there is so little late-fall material available that any such statement must be offered with hesitation.

Where collectors' measurements indicate any difference at all in size between the sexes, it is invariably in favor of the female. This difference is considerable in some cases, but varies, and the figures here are usually offered without comment, so that the reader may form his own conclusions. Such difference seldom extends to the crania.

It is sometimes difficult to distinguish hip glands in the case of dried specimens, or even alcoholics, and as no observations in this regard seem to have been made in the field upon fresh material, there is little on the subject that can be stated with certainty. *Phenacomys longicaudus* apparently does not have well-developed hip glands at any age, but the males of most, if not all, of the short-tailed species develop large glands when fully adult.

The full number of mammae, as determined by various members of field parties of the Biological Survey, is evidently 8, distributed 2:2 inguinal and 2:2 pectoral in the case of the short-tailed species; but this formula is often found to vary, because of the fact that the full complement of mammae does not always develop in young females with small litters. In all specimens of *P. longicaudus* examined there are but 2:2 inguinal mammae functional. The only female of *albipes* that has so far been taken has 2:2 inguinal and 1:1 pectoral mammae, but the front legs are dried in such position that these may possibly hide an additional pectoral pair.

There are six well-developed tubercles on the soles of the hind feet of five spirit specimens of *longicaudus*, three of *ungava*, and two of *olympicus*, but there may be some variation in this respect, as in many other microtines.

Skull.—The skull of *Phenacomys* is very typically *Microtus*-like in general form, and some species of *Microtus* can be found to match almost every one of the characters of outline. On the whole, however, the postorbital processes of the squamosals are more prominent than in all but a few species of *Microtus*. The palate is essentially *Microtus*-like, and in some forms (as *celsus*) it is very simple and without detail; in others (as the *ungava* group) it is more complex, with a median process or spine projecting posteriorly.

Teeth.—It has been asserted a number of times (Major, Hinton, Winge, et al.) that the cheek teeth of the Microtinae consist of the fourth premolar and the first and second molars. Although not yet prepared to discuss this matter in full, the writer is not at all antagonistic to this interpretation of the facts, but preliminary investigation has caused him to doubt the conclusiveness of the evidence on which this assertion has been based. Therefore, the more conservative terminology (first, second, and third molars) will be retained for the present (fig. 2).

In young individuals of *Phenacomys* the molars are rootless, as in *Microtus*, and at first seem to grow from their matrices at a rate slightly more rapid than that at which they are worn away. Shortly

before full size has been attained, however, it will be found that the dental pulp has begun to fail, and a basal zone, devoid of crenulations, is then formed on each molar. As this progresses, the proximal opening becomes slightly constricted, especially at a point near the middle, at which spot a bridge of dentine is speedily formed. The edges of the two resulting openings then become elongated until two fangs result, the basal openings of which, with increasing age, become entirely closed. Adults in their early prime often have an internal, longitudinal thickening upon the edge of the anterior root of the larger molars, most pronounced in the first upper one. This condition—not confined to the genus, or even the order Rodentia—is of great interest as probably either indicating a tendency toward the formation of a third root by a process of division, or, what is more probable, illustrating the manner in which the third root so often found in other families and subfamilies may have been lost through mergence with a neighbor. An examination of considerable material does not indicate that this thickening of the root increases with advancing senescence of the individual; on the contrary, the roots of very old animals are more attenuate, and it is believed that this may be caused by a process of absorption of the thickened root, thus, perhaps, favoring the theory that this thickening is a relic of a primitive character.

Fig. 2.—Left upper and right lower molar series of *Phenacomys intermedius intermedius* (No. 67325), from Beartooth Mountains, Mont. Enlarged

Fig. 3.—Extreme change in enamel pattern due to age and wear. Second upper molar, right-hand series, of *Phenacomys mackenzii* (No. 110435). Enlarged

The point where the longitudinal striations or foldings of the enamel upon the sides of the teeth cease does not appear beyond the alveoli until the animal is fully adult, and this point can usually be seen first in the case of the mandibular teeth. The pattern of enamel folding is constant and highly characteristic in a generic sense and little or no variation that can be correlated with specific differences occurs; but there is usually much individual variation within certain limits, some of which is due to advancing age, causing a decrease in the acuteness of the angles. Finally the teeth may become so worn that the divisions of the roots are pushed well beyond the alveoli, the lateral grooving practically disappears and the basal ring or zone, being partly exposed on the grinding surface, causes the formation of small vacuities or pits completely surrounded by enamel (fig. 3). These pits first appear upon the lingual side of the mandibular molars and the buccal side of the maxillary ones, but their origin is mechanical and they are not of fundamental importance.

There is no appreciable deposit of cementum within the apices of the reentrant angles, but the significance of this fact is not apparent.

In the case of the maxillary teeth, the first molar has an anterior crescent and two closed triangles on each side. The second has an anterior crescentic triangle, and an interior and two exterior triangles, both normally closed. The third has an anterior crescentic division, an internal triangle, and, normally, two much smaller external ones, the posterior of which varies considerably in form and position.

At times this really constitutes a part of the posterior loop, and this whole is less constant than any part of the maxillary series.

In the mandibular teeth, the first molar consists of an anterior trefoil of a pattern too variable to be of practical value in diagnosis, but part of this variability is often due to wear. There are also three internal and two external triangles and a posterior crescent. All these are normally closed, but there is a decided tendency for them to remain open, and the postero-external one or two is sometimes practically lacking; or to be more exact, these may be integral with the corresponding internal triangles. The second has three internal and two external triangles. The third usually consists of three simple internal loops, highly characteristic of the genus; but there is sometimes a very small external, open triangle formed medially.

In the maxillary series, the internal reentrant angles are only slightly deeper than are the external; but in the mandibular series the difference is much more pronounced, to such an extent that this point constitutes one of the most important generic characters.

The roots of the mandibular incisors of *Phenacomys* extend posteriorly between the roots of the second and third molars, terminating upon the buccal side of the rami, but at a level below the alveolar borders. This condition is also present in *Evotomys* and, to a lesser extent, in *Ondatra*.

VARIATION

Mice of the *ungava* group are probably rather uniform over wide areas, with changes of character gradually accomplished. In the case of the short-tailed mountain forms, however, the colonies for the most part are well segregated upon detached mountain ranges or parts of such ranges, separated by strips of low-zone country; and variation, especially in coloration, is comparatively large and abrupt. In fact, it must be emphasized that variation of color is so extreme in some cases, even among animals taken in the same locality, that this character is almost useless for differentiation between some subspecies. The skulls of animals from segregated colonies also vary considerably, even though the areas may be closely contiguous, and extreme caution must be used in their assignation, especially when material is scanty.

Broadly speaking, the molar pattern within the genus is uniform, but although the width and proportions of the molars are subspecifically dependable, the details of their patterns can not be considered reliable. Variation is excessive in certain particulars, and no solid basis of relationship could be established upon this character. It is considered wiser, therefore, not to accentuate the importance of minute *average* differences in the molar patterns over what is felt to be their real relational worth.

The difference observable in the extent of wear of the molar crowns does not seem to be invariably due to age, but undoubtedly depends also upon the nature of the food to which the animal has been accustomed. A relatively tough or gritty food would cause more than ordinary wear, and hence it is sometimes difficult to distinguish by this character a comparatively young adult from one that might be very much older.

Immaturity is indicated by the rounded and weak appearance of the skull, by the failure of the portion of the molars beyond the alveolar border to show indications of roots, and by the fact that usually, but not always, the pelage of the partly grown animal is darker and more slaty-colored than in the adult. These, except for the tooth characters, are the same indications of immaturity as are usually found in the genus *Microtus*. As compared with adults, juvenile crania are weak, rounded, and unridged, and they appear to have relatively small bullae, short incisive foramina, a wide interorbital region, compressed zygomata, and short rostra. Racial differences are rather late developing in the skulls of forms that are at all closely related, and for this reason immature crania are of little value in diagnoses.

Much attention has been given to obtaining a correct understanding of the extent of individual variation occurring among the *Phenacomys* from a single locality, and of the characters most constant in the various races. The former has been obtained by studying the topotype series of *mackenzii*. These consist of 14 specimens that are fully adult, and with the exception of a single individual in ragged pelage, exhibit great uniformity in coloration, but there is some variation in size, as is the case with all microtines. It has been found that size and shape of the nasals and the adjoining ascending branches of the premaxillae, the interparietals, and the palatal and pterygoid regions are untrustworthy characters on which to place dependence. The interorbital width is usually constant in the case of animals of comparable ages, as is the degree of interorbital ridging, but there are occasional exceptions. The most uniform and reliable characters are size of skull, size and shape of brain case, supraorbital development, interorbital characters, rostrum (taken as a whole), incisive foramina, bullae, and size of the cheek teeth. In addition, the occasionally exceptional development of some other character, as curvature of the upper incisors or the infero-superior depth of the jugals, proves of value in specific or group discrimination. The degree of development of the median process of the palate is not at all constant, but its average is sometimes significant. (See fig. 4.)

FIG. 4.—Palates of *Phenacomys*, selected to show extremes of variation within the genus. *P. i. olympicus* (No. 90376), *P. longicaudus* (No. 206384), and *P. mackenzii* (No. 110624). Enlarged

PROBABLE AFFINITIES

The molar teeth of the genus *Phenacomys* are more completely rooted than are those of any other recent microtine, for although this character is shared by the genera *Evotomys* and *Ondatra*, the teeth of these last do not become rooted until a more advanced age is attained, and the fangs never become completely closed. This is considered to be a primitive character, and taking the teeth as a criterion of the greatest importance in judging the systematic position of the genus, as is usually done, *Phenacomys* is indicated as being the most primitive of recent Microtinae.

Such argument can be accepted only tentatively, however, for there are other factors to be considered in determining the evolutional age of the genus. There is strong, if not conclusive evidence, though, that the ancestors of the microtines had rooted teeth. In considering the existing state of affairs, the possibility must be entertained of an animal, directly ancestral to *Phenacomys*, having developed rootless teeth from an original stock with rooted molars, and the present genus developed from that. This rooted-rootless-rooted theory, being a case of the modification of a part, not the loss of one, is a possibility, but the evidence so far available does not encourage its acceptance.

Most of the genera of the Microtinae now have molars growing from a persistent pulp (hypsodont), and this is believed (Hinton in Barrett-Hamilton, 1913) to be a development brought about by the gradual adoption of tougher and more fibrous foods, which would increase the wear of the crowns and stimulate the teeth to a longer period of growth. An investigation of the teeth of animals of various ages, including embryos, of a number of genera of the Cricetidae (to be discussed at greater length in a future paper) indicates that there is no radical difference in the development of these two types of molars, for whatever the cause, it seems to be due merely to a stimulation of growth of the teeth, greatly prolonged in the case of the microtines, beyond the usual period. The same stages of tooth growth, generally speaking, that occur in *Phenacomys* may be observed in *Neotoma*, but at a very much earlier state of development in the latter, and the growth of fangs seems to be the natural sequence to the atrophy of the dental pulp.

Rooted (brachyodont) molars are more suitable for crushing soft and brittle foods, as seeds. It thus seems probable, but is as yet unproved, that the food of *Phenacomys* on the whole is of a character more nearly comparable with that of the majority of the Cricetinae than it is with that of *Microtus*.

No fossil remains of *Phenacomys* have been discovered, nor anything that may be considered as having been truly ancestral to the genus; but knowledge of the subfamily indicates the likelihood that *Phenacomys* is descended from a pretype in which the outer and inner reentrant angles of the lower teeth were of practically equal depth, the angles less sharp, the triangles more open, and the enamel of the concave and convex sides of the prisms of equal thickness. Furthermore, it is very possible, and even probable, that the genus originated in North America. The fact that it now occupies a boreal habitat, however, is no reason for assuming that it has always been confined to such surroundings. The present facts of its distribution point to the probability that it, like the lemmings, is usually unable to withstand much competition, and that it has had to give way from time to time before the advance of more adaptable species of meadow mice. This probably accounts for its presence in, or restriction to, such situations as the heather beds of the high mountains, or the dense forests of the Pacific coast—localities where it should encounter little competition ecologically. Occasionally, where conditions are especially favorable, and there seems to be "room for all," this genus may be found closely associated, and apparently on favorable terms, with both *Microtus* and *Evotomys*.

Summarizing the characters by which the systematic position of the genus may best be judged, it is considered that although the rooted nature of the molars is a character that is often considered primitive, it does not necessarily indicate more in this case than that the genus has never experienced the necessity for faster-growing teeth. The great depth of the inner reentrant angles of the lower teeth and the difference between the thickness of the enamel on the anterior and posterior faces of the prisms is considered to indicate a high degree of specialization for a certain food or manner of feeding. These details, coupled with distributional facts, indicate that the *Phenacomys* type of microtine is of decided antiquity, and in some ways the genus *Phenacomys* may be considered primitive, but the enamel pattern is highly specialized.

The majority of species of *Phenacomys* are terrestrial, but two of them are arboreal. The most apparent and probably the most important difference between these two groups is in the length and degree of hairiness of the tail. From this it is impossible to draw profitable conclusions as regards ancestry. Although there are many exceptions, nonsaltatorial, terrestrial rodents living in a nonmountainous habitat in which there is only low cover, usually have tails that are rather short for their respective families or groups, while those living in forests, or where the brush is very heavy, have longer tails. It is judged that this modification follows the choice of habitat. The terrestrial *Phenacomys albipes*, living in a densely forested region, is in a number of characters intermediate between the shorter-tailed forms and the two arboreal species, and the fact that these two are arboreal is probably correlated with the hairiness of their tails. It is impossible now, however, to be sure whether *albipes* is derived from a hairy-tailed, arboreal ancestor, or from a short-tailed, terrestrial one that originally inhabited low cover. It is probable, though by no means certain, that all of the species were derived from a homogeneous ancestral stock, but it now seems impossible to speculate with any degree of profit on whether this ancestor was arboreal or terrestrial.

GROUPS

The genus *Phenacomys* as at present known is naturally divisible into four groups, as follows:

(1) The *intermedius* group, comprising the short-tailed races without distinctly yellowish faces: to be found in the mountainous sections of the West.

(2) The *ungava* group, containing all forms characterized chiefly by the distinctly yellowish color of the face: occurring in Canada east of the Rocky Mountain region.

(3) The *albipes* group, containing a single species, evidently terrestrial, but characterized by a long tail, which is only slightly hairy; with a sooty nose, and long, weak skull: occurring along the Pacific coast of northern California and Oregon.

(4) The *longicaudus* group, holding two arboreal species that may be known by long, rather heavy tails, more hairy than those of other species: and cranially, by sharply decurved incisors: found in forests of the humid coast-district of northern California and Oregon.

List of Species and Subspecies, with Their Type Localities

Phenacomys intermedius group:	
Phenacomys intermedius intermedius Merriam	Twenty miles north-northwest of Kamloops, British Columbia, Canada.
intermedius levis A. B. Howell	Saint Marys Lake, Teton County, Mont.
intermedius olympicus Elliot	Happy Lake, Olympic Mountains, Wash.
intermedius celsus A. B. Howell	Muir Meadow, Tuolumne Meadows, Yosemite Park, Calif.
Phenacomys ungava group:	
Phenacomys ungava ungava Merriam	Fort Chimo, Ungava, Canada.
ungava crassus Bangs	Rigolet, Hamilton Inlet, Labrador.
mackenzii Preble	Fort Smith, Mackenzie, Canada.
Phenacomys albipes group:	
Phenacomys albipes Merriam	Arcata, Humboldt County, Calif.
Phenacomys longicaudus group:	
Phenacomys longicaudus True	Marshfield, Coos County, Oreg.
silvicola A. B. Howell	Five miles southeast of Tillamook, Oreg.

Key to Species and Subspecies

a^1 Tail much less than 50 mm.
- b^1 Face not pronouncedly yellow; rostrum but slightly depressed.
  - c^1 Skull large; condylobasilar length averaging more than 24 mm.; rostrum robust.
    - d^1 Coloration light, incisive foramina small; molars very wide — *P. i. celsus* (p. 23).
    - d^2 Coloration dark; incisive foramina larger; molars very narrow — *P. i. olympicus* (p. 21).
  - c^2 Skull smaller; condylobasilar length averaging less than 24 mm.; rostrum light.
    - d^1 Skull moderate; condylobasilar length averaging more than 23 mm.; zygomatic breadth averaging more than 15 mm — *P. i. intermedius* (p. 15).
    - d^2 Skull small and light; condylobasilar length averaging less than 23 mm.; zygomatic breadth averaging less than 15 mm — *P. i. levis* (p. 20).
- b^2 Face pronouncedly yellow; rostrum noticeably depressed.
  - c^1 Coloration bright; size medium; incisive formina small — *P. u. ungava* (p. 25).
  - c^2 Coloration duller.
    - d^1 Size large; condylobasilar length averaging more than 24 mm.; coloration darker. (Labrador) — *P. u. crassus* (p. 27).
    - d^2 Size small; condylobasilar length averaging less than 23 mm.; coloration lighter, grayer (central Canada) — *P. mackenzii* (p. 28).

a^2 Tail much more than 50 mm.
- b^1 Incisors strongly decurved; tail thick, quite hairy; arboreal.
  - c^1 Coloration reddish; brain case relatively unridged; nose not sooty — *P. longicaudus* (p. 32).
  - c^2 Coloration brownish; brain case strongly ridged; nose sooty — *P. silvicola* (p. 34).
- b^2 Incisors not strongly decurved; tail slender, scantily haired; terrestrial — *P. albipes* (p. 30).

DESCRIPTIONS OF SPECIES AND SUBSPECIES

Phenacomys intermedius Group

(Characters under the species)

Remarks.—The *P. intermedius* group, including all of the short-tailed forms from mountainous areas of the West, may at once be dis-

tinguished from the *P. ungava* group by the lack in the former of a pronouncedly yellowish nose. The skulls of *P. mackenzii* have a narrower interorbital measurement than have any of the forms of *P. intermedius*, and this region is more heavily ridged.

PHENACOMYS INTERMEDIUS MERRIAM

Geographic distribution.—Mountainous country of western North America, from northern British Columbia to the southern Sierra

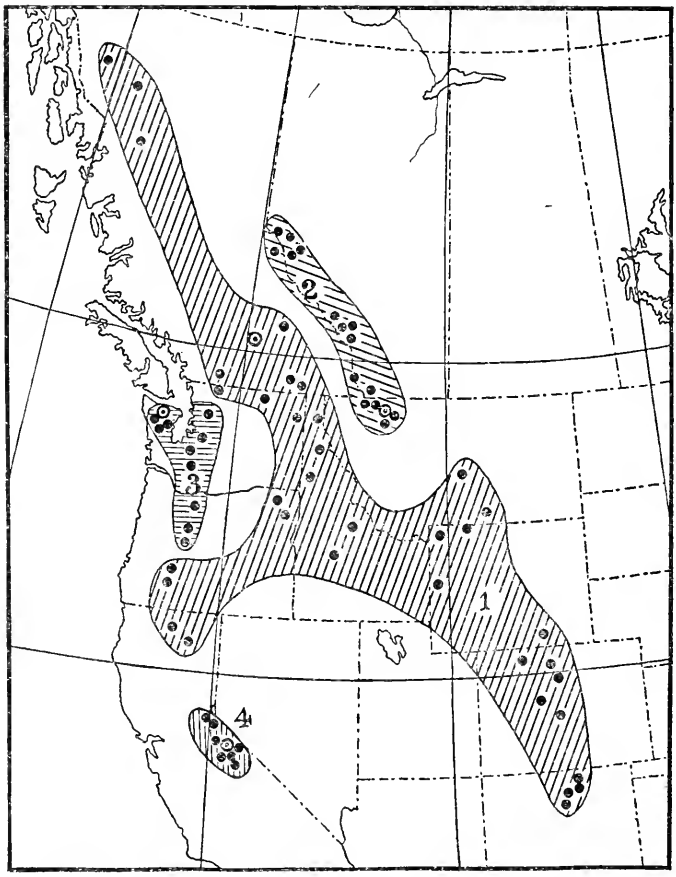

FIG. 5.—Distribution of the *Phenacomys intermedius* group:
1. *P. i. intermedius.* 3. *P. i. olympicus.*
2. *P. i. levis.* 4. *P. i. celsus.*
Circle shows type locality of subspecies

Nevada in California, and the southern Rocky Mountains in northern New Mexico (fig. 5).

General characters.—This species is distinguished from other short-tailed *Phenacomys* by the lack of a decidedly yellowish nose. The coloration varies from palest to darkest of the genus, and in size, from smallest to large. The skull varies accordingly, but it is rather lightly ridged interorbitally.

On the whole, the palates of mice of this group average simpler, with less well-defined median processes than have the yellow-nosed phenacomys, but there is much subspecific and individual variation in this regard. Mammae: Inguinal, 2:2; pectoral, 2:2.

Size least and skull lightest in the northeastern portion of its range (*P. i. levis*), increasing in size towards the west and south, and culminating in the large, dark, heavy-skulled Washington race (*P. i. olympicus*). As a rule, the animals living in regions of slight precipitation are pale. There is a marked increase in the size of the rostrum in the case of the two westernmost races.

PHENACOMYS INTERMEDIUS INTERMEDIUS Merriam

Rocky Mountain Phenacomys

(Pl. 2, figs. 1, 2, and 6)

Phenacomys intermedius Merriam, North Amer. Fauna No. 2, p. 32, October 30, 1889.

Phenacomys orophilus Merriam, North Amer. Fauna No. 5, p. 65, July 30, 1891. Type collected at 10,500 feet altitude, east slope of Lemhi Mountains, Idaho, August 28, 1890, by Merriam and Bailey; female immature; No. $\frac{2}{3}\frac{3}{1}\frac{8}{2}\frac{5}{5}\frac{6}{8}$ U. S. Nat. Mus. (Biol. Surv. coll.); original number, 1710.

Phenacomys truei Allen, Bul. Amer. Mus. Nat. Hist., 6: 331, November 7, 1894. Type collected in Black Hills (=Laramie Mountains), Wyo., August 10, 1857, by W. A. Hammond; immature; No. $\frac{3}{3}\frac{0}{6}\frac{5}{8}\frac{6}{4}$; U. S. Nat. Mus.; original number, 109.

Phenacomys oramontis Rhoads, Amer. Nat., 29: 941, October, 1895. Type collected on Mount Baker Range, British Columbia, at 6,000 feet altitude (=Lumsden (sometimes spelled Lihumitson) Mountain, now called Church Mountain, just north of the International Boundary near longitude 121° 50′ west), August 6, 1895, by A. C. Brooks; male adult; No. 9354, Acad. Nat. Sci. Philadelphia (formerly No. 2354, S. N. Rhoads coll.); original number, 428.

Phenacomys preblei Merriam, Proc. Biol. Soc. Washington, 11: 45, March 16, 1897. Type collected at about 9,000 feet altitude, Longs Peak, Colo., August 12, 1895, by E. A. Preble; male immature; No. 74513, U. S. Nat. Mus. (Biol. Surv. coll.); original number, 647.

Phenacomys constablei Allen, Bul. Amer. Mus. Nat. Hist., 12: 4, March 4, 1899. Type collected at Telegraph Creek, British Columbia, August 25, 1898 [=1897], by A. J. Stone; female adult; No. 14406, Amer. Mus. Nat. Hist.

Type.—Collected on basaltic plateau about 20 miles north-northwest of Kamloops, British Columbia, altitude 5,500 feet, October 2, 1888, by George M. Dawson; immature; No. 780, Museum of the Geological and Natural History Survey of Canada.

Geographic distribution.—British Columbia west of the eastern divide of the Rocky Mountains, northeastern Washington, Idaho, eastern and southern Oregon, and northern California; thence in the mountains through southern Montana, Wyoming, Colorado, and into northern New Mexico (fig. 5, *1*).

Habitat.—Canadian and Hudsonian Zones, mostly in open, grassy parks.

General characters.—A phenacomys normally of a rather pale coloration and the most "medium" form of this group, with no characters, either external or internal, accentuated.

Color.—The range of coloration, even in the same locality, is often great, and varies from tawny olive to the Saccardo umber of Ridgway, with various blendings of the two. The plumbeous bases

of the hairs show through to a greater extent in the case of the darker individuals. The underparts are whitish, occasionally with a tinge of buffy. Nose not pronouncedly tinged with yellow. This is the only species of the genus of which thoroughly satisfactory specimens in undoubted winter pelage are available. This, in a December specimen from Colorado and two October skins from Idaho, is much grayer (between drab and hair brown of Ridgway) and with little of the brownish cast to be found in summer skins. During cold weather the feet are whiter, because of the longer hairs, and the tail is then uniformly whitish, instead of bicolor. Young animals are usually darker than adults from the same place, and are more plumbeous, both above and below.

Skull.—The superior aspect of the skull is essentially medium in the development of all characters—rostrum, interorbital, and brain case. Inferiorly, the incisive foramina and bullae are proportionately rather small, and the palatal projection or spine is sometimes present, but as often practically absent. There is variation in skull characters, even in the case of animals from the same locality, but not to such an extent in animals considered to be typical of the race as to cause overlapping with surrounding forms herein recognized.

Teeth.—Maxillary teeth of a pattern normal to the genus, with posterior loop of third molar tending to vary in antero-posterior length. The anterior trefoil of the first lower molar varies from an excessive development of the reentrant angles, causing an almost complete tripartite division, to a condition in which the trefoil has no anterior loop whatever, and the exterior one is but slightly indicated. The third lower molar usually has a complete external triangle. Occasionally there is a tendency for the triangles, especially the external ones of the first lower molar, to remain open.

Measurments.—Collectors' measurements of adults: Male from Hazelton, British Columbia: Total length, 141; tail, 27; hind foot, 18.5. Female from Nelson, British Columbia: 142; 37; 18. Skin from Okanagan, British Columbia: 142; 37; 17. Five males, Beartooth Mountains, Mont.: 145 (142–147); 30 (26–34); 17 (17–18). Two females, Beartooth Mountains, Mont.: 152; 34; 18. *Skull*: Average of six adults from Beartooth Mountains, Mont.: Condylobasilar length, 23.8 (23.5–24.1); nasals, 8 (7.6–8.4); interorbital breadth, 3.6 (3.5–3.7); zygomatic breadth, 15.2 (14.9–15.7); lambdoidal width, 11.4 (11.2–11.5); incisive foramina, 4.7 (4.6–4.9); maxillary tooth row, 6 (5.7–6.2); height, 9.3 (8.9–9.7).

Remarks.—The typical subspecies *intermedius* can best be described by the word composite, for the animals comprising it are, in large part, from isolated mountain colonies, most of which vary in some slight particular from what is considered to be typical. To one not familiar with the material, it will doubtless seem remarkable that the range of this form is so extended. It can not be denied that when far more specimens are available than are now at hand it may possibly prove practicable to recognize one or more additional forms within this area. At present, however, this can not be done without naming a number of new and very poorly defined races.

It is desired to emphasize strongly the belief that with the present material these slight variations can not be assigned a geographical foundation, and animals from the same spot often vary to a greater extent from one another than from still others taken hundreds of miles away. Coloration, except within rather wide limits, is unreliable, and there seems often to be a sort of dichromatism. Unfortunately, there are no perfect adult skulls from southern British Columbia, the majority of specimens having the occipital region broken. Measurements of a series of skulls from southern Montana are given, however, so as to demonstrate the great extent of variation occurring at one locality. For the most part, the material is from scattered areas, and although some of the variations may later prove to be constant, the specimens at hand indicate that they are not. There seems to be no other solution but to recognize *intermedius* as a composite race, with many local variations too slight and inconstant to be worthy of names, but yet a form sufficiently homologous to be readily distinguishable from other contiguous races now recognized. For the foregoing reasons, it may be desirable to discuss these variations at some length.

The type of this form and of the genus is an immature individual of which the unstuffed (but not "flat") skin is pressed between two pieces of glass, and the skull is badly smashed, with only the anterior portion remaining. The characters assigned to the species when it was described consisted of the considerable breadth of the interorbital (3.8 mm.), the expanded terminations of the ascending branches of the premaxillae, and the pattern of the anterior lower molar. None of these points are distinctive, for there are other crania from widely separated localities, both adult and immature, with interorbital measurement greater than this. There is slight chance that the width of the premaxillary branches is significant in this case, for broader ones are found in topotypes of *mackenzii* and others, and there is great variation in this respect within almost every series of phenacomys. Maximum width of these branches usually occurs in immature skulls, but sometimes in adults also, their breadth being in inverse ratio to the width of the posterior portion of the nasals, and this last is often variable. The molar pattern of the type of *intermedius* was supposed to be distinctive because the anterior trefoil of the first lower molar is so deeply cut by reentrant angles that an outer triangle is wholly isolated and an inner one nearly cut off. It can not be denied that in the type this is carried to a degree slightly more pronounced than is to be found in any other specimen at hand from British Columbia but this character has been found to be so extremely variable that it is worthless for diagnosis in other cases; so it is inferred that it should be considered the same in this. Finally, the skin, as well as can be told through the glass, appears indistinguishable from a number of other skins taken both to the north and to the south of it, even though the pelage may well be a trifle less dense than is usually the case.

Although there are no topotypes of *intermedius*, there is every reason for assuming that these would not prove different from individuals from surrounding areas, and it is felt that a fairly good understanding of the characters of the form has been obtained

from a study of the material available from contiguous localities, even though few of the skulls are undamaged.

It is unfortunate that neither the type nor topotypes (except two fragmentary skulls of juveniles) of "*constablei*" are available at this time. Edward A. Preble[4] examined this material several years ago and came to the conclusion that not only are the specimens clearly referable to the *intermedius* rather than to the *ungava* group, as stated by the describer, but that there are no skull characters distinguishing this so-called species from *intermedius* or "*orophilus*," and the only difference existing is its slightly darker color in comparison with "*orophilus*." As the type of the latter is lighter than most specimens of *intermedius*, no reliance is placed on this dissimilarity, and it is deemed better to place the name in synonymy for the present. Incidentally Preble advises the writer that the date of collection should have been stated as 1897 instead of 1898.

Specimens from the Mount Baker Range of British Columbia, described by Rhoads under the name "*oramontis*," are indistinguishable in color from animals of the Cascade Mountains of Washington, but the short skulls with weak rostra certainly more nearly approach *intermedius*. After these comparisons were made, a single specimen from the Washington portion of the Mount Baker Range was identified as *olympicus*. Subsequent material from the same region showing variable characters, however, indicates that although selected specimens are fairly intermediate in character between *olympicus* and *intermedius*, the wiser course is to allocate them all to the latter race. It should be mentioned that the type of "*oramontis*" has a tail generously tipped with white, but so have several Washington individuals.

There is a small series of skins available from southern British Columbia, but unfortunately the skulls are damaged, though not to an extent to make them useless for study; and most of them are without measurements. Two of these skins are a shade darker than any of this race from the United States, but four other specimens from the same locality are almost at the opposite limit of brightness.

An old male from near Mullan, Idaho, has an unusually narrow, weak skull with constricted brain case, which may be interpreted as showing a tendency toward *levis*. The skin is notable because of the excessively worn condition of the pelage and, therefore, its superficial darkening.

Merriam described "*orophilus*" from the Salmon River Mountains of Idaho, but on current maps this name is restricted to the western part of the range, the portion from which the type came now being known as the Lemhi Mountains. As far as can be told from the subadult type, the skull has no peculiar characters whatever. The skin is rather light in color, but can be matched by animals from several other distant localities. In comparing specimens with the type of "*orophilus*," there have often been used two immatures from Sawtooth City, which is virtually in a part of the Salmon River Mountains. These are paler than the type, but are

[4] Preble, Edward Alexander. Discussion of species of *Phenacomys* occurring in British Columbia. [Unpublished manuscript.]

hardly comparable, as they are in winter pelage. After a careful consideration of the question involved, it is felt that this name must be placed in synonymy.

As one becomes more familiar with the fauna of the Crater Lake region of southern Oregon, he is increasingly impressed with the fact that it has a well-marked relationship with that of the Great Basin area; but, nevertheless, it was somewhat surprising to find that the *Phenacomys* not only of this locality but also of northern California must be called *intermedius*. It is certain that specimens can be placed neither with the form directly to the northward, nor the one to the south. In coloration they are entirely similar to *intermedius*, and in cranial characters as well, except for a very slight increase in the size of the bullae.

The skull of the only adult (barely so) from the Wallowa–Blue Mountain country shows a greater departure from what is considered typical *intermedius* than does any other individual of this race examined. This is shown by the rather broad and stubby rostrum, and by the peculiar, though not greatly developed, ridging of the broad interorbital and the very wide sulcus between. With but the single specimen it is impossible to judge whether this is a character constant throughout the region or merely fortuitous. It is certainly closer to *intermedius* than to anything else now recognized, and is so placed.

Specimens from southern Montana have a slight accentuation of the interorbital ridging, and some of the skulls have rostra that are a little more robust, and bullae a shade larger than usual, but there is so much variation in this character, even at the same locality, that it is impossible to give it much significance.

Allen described "*truei*" (1894) from a damaged immature supposed to have come from the Black Hills of South Dakota, in which case the specimen might have been expected to belong to a new race. It was later ascertained that the true locality was the Black Hills, now known as Laramie Mountains, Wyo.

The type of "*preblei*" Merriam is a very buffy example, immature, with the ascending branches of the maxillae very wide. The latter character is found to be without significance, as mentioned elsewhere, and the skin can be practically matched by another from Okanagan, British Columbia. It is very closely approached, also, by two others from the same locality and by New Mexico individuals as well; hence, it can hardly be considered a valid race.

Specimens examined.—Total number, 85, as follows:

British Columbia: Chapa-atan River, mountains near the head of, 1; Glacier, 1[5]; Hazelton, 3[6]; Kamloops, 20 miles north northwest of, 1[7] (type); Mount Baker Range, 3[8] (including type of "*oramontis*"); Nelson, 1; Okanagan, 6[9]; Rossland, 1[9]; Telegraph Creek, 2[8] (broken skulls only).

California: Fort Crook, 1; Mount Shasta, 3.

Colorado: Buffalo Pass, Jackson County, 1[10]; Fairplay (skull only), 1; Lake Moraine, El Paso County, 1[10]; Longs Peak, 1 (type of "*preblei*"); Nederland, 1[11].

[5] Amer. Mus. Nat. Hist.
[6] Mus. Vert. Zoöt.
[7] Victoria Mem. Mus.
[8] Mus. Comp. Zool., 2; Acad. Nat. Sci. Philadelphia, 1.
[9] Provincial Mus.
[10] E. R. Warren coll.
[11] Acad. Nat. Sci. Philadelphia.

Idaho: Cabinet Mountains, 3; Moscow, 8 miles northeast of, 1; Mullan, east of, 1 [12]; Salmon River Mountains (=Lemhi Mountains), 4 (including type of "*orophilus*"); Sawtooth City, 2.
Montana: Beartooth Mountains, 14; Big Snowy Mountains, 1.
New Mexico: Pecos Baldy, 1; Santa Fe, 1; Taos Mountains, 1; Twining, 1.
Oregon: Blue Mountains, 1; Crater Lake, 2; Diamond Lake, 1; Wallowa Lake, 4.
Washington: Loomis, 1 [12]; Round Top Mountain, Pend Oreille County, 1 [13]; Mount Baker, 3 [13].
Wyoming: Beartooth Lake, 9; Laramie Mountains (=Black Hills), 3 (including type of "*truei*"); Merna, 1; Yellowstone Park, 1.

PHENACOMYS INTERMEDIUS LEVIS A. B. HOWELL

ALBERTA PHENACOMYS

(Pl. 2, fig. 3)

Phenacomys intermedius levis A. B. Howell, Proc. Biol. Soc. Washington, 36: 157, 1923.

Type.—Collected at Saint Marys Lake, Teton County, Mont., May 23, 1895, by Arthur H. Howell; male adult; No. 72405, U. S. Nat. Mus. (Biol. Surv. coll.); original number, 13.

Geographic distribution.—Upon the eastern slope of the Rocky Mountains at least from central Alberta south to Teton County, Mont. (fig. 5, 2).

Habitat.—Canadian and Hudsonian Zones in rather open grassy or mossy situations.

General characters.—A subspecies differing but slightly in color from many specimens of *intermedius*, but skull weak and smaller than any other form. Bullae and rostrum relatively large.

Color.—Topotypes of this form have the basal tone close to the drab of Ridgway, with the tips of the dorsal hairs brown, the exact shade differing apparently with age—duller and darker in the case of old animals, and brighter and lighter in the younger ones (large immatures). The underparts are grayish, occasionally with a faint tinge of buffy. The feet are pure white, except when darkened by grease, and the tail is indistinctly bicolor. Young animals are darker and more plumbeous.

Skull.—Weak and smallest of the genus, with little ridging and variable interorbital width; but this last is sometimes considerable. Rostrum and bullae relatively large, and incisive foramina usually short. Palatal spine slightly developed.

Dentition.—Normal for the genus, but in the maxillary teeth the second external triangle of the third molar, although variable, tends to disappear to a greater extent than usual. Of the mandibular teeth, the trefoil of the first molar is variable and there is always an external triangle to the third molar, although this is not invariably closed. With this exception, there seems to be no tendency for the triangles of the teeth to remain open.

Measurements.—Collectors' measurements of adult specimens from the type locality are as follows: Of two males: Total length, 135; tail, 34; hind foot, 17. Of 6 females: 139 (132–146); 33 (30–36); 18 (17–18). *Skulls* of two adult male topotypes average as follows: Condylobasilar length, 22.3; nasals, 7.1; interorbital breadth, 3.6; zygomatic breadth, 14.1; lambdoidal width, 11.3; incisive foramina,

[12] D. R. Dickey coll. [13] Wash. State College.

4.3; maxillary tooth row, 5.8; height, 8.7. Of five adult females: Condylobasilar length, 22.6; nasals, 7.3; interorbital breadth, 3.6; zygomatic breadth. 13.9; lambdoidal width, 10.9; incisive foramina, 4.5; maxillary tooth row, 5.8; height, 8.3.

Remarks.—One of the unexpected results of the present study was the discovery of this new race apparently confined to the vicinity of the eastern slope of the easternmost range of the Rocky Mountains in Alberta and northern Montana. Although it differs in some respects from most skins of *intermedius*, the coloration of the latter is subject to such a range of variation that slight reliance can be placed thereon. On the whole, topotypes of *levis* are almost indistinguishable in coloration from the type of "*orophilus*" and the series of skins from the Beartooth Mountains of Montana, except that the present form has less overwash of dark-tipped hairs. The skull, however, presents differences that necessitate the separation of these animals from any race heretofore known. Compared with *intermedius* it has a skull much smaller, with a rostrum that, although relatively slightly shorter, seems to be a trifle more robust. The bullae are also relatively larger than those of the southern neighbor. In most but not all cases the incisive foramina are smaller.

The difference in the coloration of the nose is sufficient to distinguish *levis* from *mackenzii* at a glance; the latter has a larger skull with proportionately narrower interorbital, heavily ridged.

The animals from central Alberta, included here, are undeniably somewhat darker than typical, approaching in this respect the darkest *intermedius*, but their skulls can not be so assigned. Although some of them exhibit slight variation, as in the shape of the rostrum. this is not directly towards *intermedius*, and they clearly belong with *levis*. With one exception the skulls of the southwestern Alberta specimens are either missing or badly damaged; hence identification is made largely on geographical grounds.

Specimens examined.—Total number, 43 as follows:

Alberta: Banff, 2 [14]; Braggs Creek, 1 [15]; Crows Nest Pass, 1 [16]; Fiddle Creek, 1 [15]; Fishing Lake, 1; Head of Smoky River, 8 [17]; Jasper House, 1 [15]; Moose Mountain (=Indian Head), 2 [15]; Mount Forgetmenot, 1 [16] (?, no skull); Waterton Lakes Park, 5 [15].

British Columbia: Moose River, 3.

Montana: Kintla Lake, 1; Many Glaciers, 1; Midvale, 1; Saint Marys Lake, 13 [18] (including type); Summit, 1.

PHENACOMYS INTERMEDIUS OLYMPICUS Elliot

Olympic Phenacomys

(Pl. 2, fig. 4)

Phenacomys olympicus Elliott, Field Columb. Mus., Pub. 30, Zool. Ser., 1: 225, February, 1899.

Microtus (*Lagurus*) *pumilus* Elliot, Field Columb. Mus., Pub. 30. Zool. Ser., 1: 226, February, 1899. Type from Happy Lake, Clallam County, Wash. Male juvenile; No. 6269, Field Columb. Mus.; collected by D. G. Elliot, September 2, 1898.

Type.—Collected at Happy Lake at 5,000 feet altitude, Olympic Mountains, Wash., August 14, 1898, by D. G. Elliot; male adult; No. $\frac{6187}{239}$, Field Columbian Museum.

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[14] Mus. Comp. Zool.
[15] Victoria Mem. Mus.
[16] Acad. Nat. Sci. Philadelphia.
[17] U. S. Nat. Mus., 7; Provincial Mus., 1.
[18] U. S. Nat. Mus., 12; Amer. Mus. Nat. Hist., 1.

Geographic distribution.—In the Hudsonian Zone of the Olympic and Cascade Mountains of Washington, and as far south as central Oregon (fig. 5, 3).

Habitat.—Upper Canadian and Hudsonian Zones about logs and brush at the edge of timber and among the grass and heather of the higher parks.

General characters.—The darkest species of short-tailed phenacomys, with skull large, heavy and well angled, and rostrum heavy. No difference in size between the sexes is indicated.

Color.—It is odd that of nine topotypes taken subsequent to 1920, only one individual is as light in color as all of those, numbering eight, taken prior to 1900. Part of this, but not all, may be due to age, the majority of the paler ones being subadult, whereas the others, slightly darker than the drab of Ridgway, are mostly old adults with short pelage. These latter, which are assumed to be most typical of the race, have very little brown in the pelage, while the lighter animals have much brown and are slightly paler than the darkest *intermedius*. All are clear gray below—rather dark—with white feet, and tails bicolored in varying degree.

Skull.—Large and heavy, with robust rostrum and quite prominent ridging, but brain case not large. Supraorbital processes prominent; incisive foramina broad but short, and bullae moderately large. The supraoccipital is more nearly at right angles to the axis of the skull (less sloping) than is usual in the genus. Palatal spine present or absent.

Dentition.—The molars of this race are very small and narrow. The only character of the enamel pattern worthy of note is the trefoil of the anterior lower molar, which is proportionately larger, and usually more fully expanded, than in any other race.

Measurements.—Collectors' measurements of six adult topotypes are: Total length, 154; tail, 43; hind foot, 20. *Skull* measurements of five adult males from the Olympic Mountains are: Condylobasilar length, 24.5; nasals, 7.6; interorbital breadth, 3.8; zygomatic breadth, 15.4; lambdoidal width, 11.7; incisive foramina, 4.7; maxillary tooth row, 6.3; height, 9.6.

Remarks.—On the whole *olympicus* is the darkest and dullest form of the genus, but there is considerable variation in this regard, as previously mentioned, and it may be well nigh impossible to identify the lighter individuals by color alone. Skulls of this race may be told almost at a glance from those of *intermedius* by the large size and robust rostrum, broad interorbital usually well ridged in adults, and less sloping supraoccipital. Inferiorly the incisive foramina are broader but not longer; the bullae are larger and the molars narrower.

Skins and skulls from Mount Rainier are practically indistinguishable from topotypes except for narrower incisive foramina and molars a shade wider.

Of two skins from Mount Adams, one is exceedingly rusty, and differs from the other by very much the same degree that the type of "*preblei*" does from darker examples of *intermedius*.

Grayest and darkest of all the specimens is a female from Three Sisters, Oreg., and its skull is also much closer to *olympicus* than to any other. Another adult female from the same locality, how-

ever, is not only closer in color to *intermedius*, but its skull is considerably weaker and smaller than any specimen of that form, and hence not at all like *olympicus*. As there are no other adults from the Cascades of Oregon north of the Crater Lake region, and as the writer dislikes exceedingly to assign two specimens from the same locality to different subspecies, it is considered better to class both of these individuals as *olympicus* for the present, although it is freely admitted that other disposition could be made of at least one of them with equal propriety.

"*Microtus* (*Lagurus*) *pumilus*," described by Elliot (1899a), proved to be a juvenile *Phenacomys*.

Specimens examined.—Total number, 60, as follows:

Oregon: Deschutes River, 1[19]; Mount Hood, 1; Three Sisters, 4[20].
Washington: Boulder Lake, 1[21]; Buck Creek, 1; Cat Creek, Olympic Mountains, 10[22]; Dosewallips, 1; Happy Lake, Olympic Mountains, 7[21] (including the type, and the type of "*pumilus*"); Canyon Creek, Olympic Mountains, 1[23]; Mount Adams, 2; Mount Rainier, 21[24]; Olympic Mountains, 9; Snoqualmie Pass, 1[25].

PHENACOMYS INTERMEDIUS CELSUS A. B. HOWELL

SIERRAN PHENACOMYS

(Pl. 2, fig. 5)

Phenacomys intermedius celsus A. B. Howell, Proc. Biol. Soc. Washington, 36: 158, 1923.

Type.—Collected in Muir Meadow at 9,300 feet altitude, Tuolumne Meadows, Yosemite National Park, Calif., August 13, 1901, by J. H. Gaut; male adult; No. 109103, U. S. Nat. Mus. (Biol. Surv. coll.); original number, 250.

Geographic distribution.—The Sierra Nevada of California from the Lake Tahoe region south probably as far as Tulare County (fig. 5, *4*).

Habitat.—Chiefly among low cover such as grassy meadows and patches of heather in high Hudsonian Zone.

General characters.—A very pale form, slightly smaller than *olympicus*, with large skull but faintly ridged and with a robust rostrum. Incisive foramina very short and narrow, and molars very stout. Sexes of equal size.

Color.—Rather close to the wood brown of Ridgway but somewhat variable. In typical skins there are relatively few dark-tipped hairs and there is no tendency towards an accentuation of grayness anteriorly. Underparts whitish, ordinarily with a strong tinge of buffy. Tail bicolored in varying degree.

Skull.—The skull of *celsus* is large with well-expanded brain case, and the rostrum robust, though not long. Temporal ridges poorly developed. Incisive foramina very small, and molariform teeth very broad and heavy. Palatal spine practically absent.

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[19] Game Dept. Oregon.
[20] U. S. Nat. Mus., 3; Game Dept. Oregon, 1.
[21] Field Mus. Nat. Hist.
[22] U. S. Nat. Mus., 9; Wash. State College, 1.
[23] Wash. State College.
[24] U. S. Nat. Mus., 18; Wash. State College, 3.
[25] D. R. Dickey coll.

Dentition.—The enamel pattern is perfectly normal except for its great width, and the trefoil of the first lower molar is even more variable than usual.

Measurements.—Average of five adults from the Yosemite Park: Total length, 148; tail, 39; hind foot, 18. *Skulls*: Average measurements of three adults from this region: Condylobasilar length, 24.1; nasals, 7.8; interorbital breadth, 4; zygomatic breadth, 15.8; lambdoidal width, 11.9; incisive foramina, 4.3; maxillary tooth row, 6.2; height, 9.4.

Remarks.—The relationship of *celsus* is apparently with *olympicus*, and it is undoubtedly nearer that race at the present day than to *intermedius*. As definite infusion of Great Basin–Rocky Mountain tendencies, however, is exhibited by the examples from northern California and southern Oregon, and the ranges of the Washington and central California races are thereby separated, the similarity of

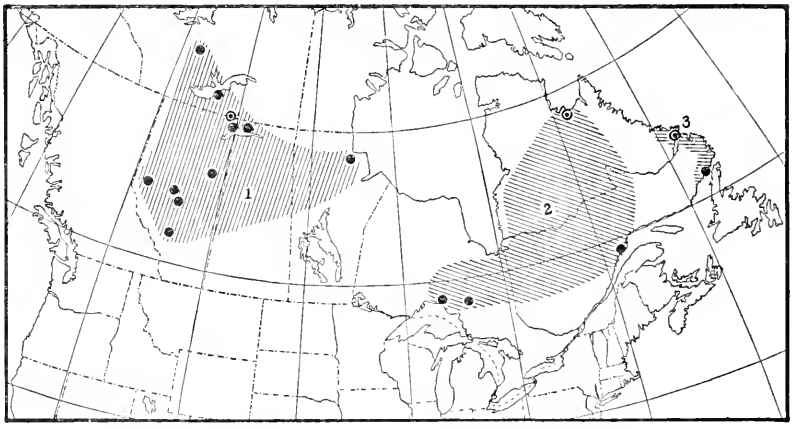

FIG. 6.—Distribution of the *Phenacomys ungava* group:
1. *P. mackenzii.*
2. *P. u. ungava.*
3. *P. u. crassus.*
Type locality of each form shown by circle.

characters of *olympicus* and *celsus* may be largely fortuitious. It is therefore probable that such similarity is the result of evolutional stimuli that happened to be the same in the two areas in question. Although *celsus*, however, is readily distinguishable and intergradation can not occur with other races because of low-zone barriers to the north, the trinomial had better be employed for it.

Typical examples of *celsus* are evidently somewhat smaller and much paler than *olympicus;* in fact, in coloration they are comparable to the palest *intermedius*, but with less buffiness than is usually exhibited by the latter. The skulls need comparison only with *olympicus*, than which they have a larger brain case, stouter though no longer rostrum, and very little indication of interorbital ridging. The incisive foramina are considerably smaller; indeed, they are relatively smaller than in any other race, and the molars are much heavier. It is worthy of note that, proportional to size, *olympicus* has the lightest, narrowest molars of the genus, and *celsus* the widest. The latter has bullae a shade the larger.

Two adult skins with good skulls from the vicinage of Lake Tahoe, Calif., are a trifle darker, and the rostra are definitely longer and not quite so robust as in typical examples. On these characters they are separable from Yosemite specimens, but it certainly is not advisable to differentiate the animals of these regions subspecifically on the basis of the present material.

Specimens examined.—Total number, 12, as follows:

California: Echo, 3[26]; Fletcher Creek, Yosemite Park, 1[27]; Lyell Canyon, 1[27]; Mono Pass, 1; Mount Lyell 2; Muir Meadow, Tuolumne Meadows, 2 (including the type); Pyramid Peak, 1[28]; Ten Lakes, Yosemite Park, 1[27].

Phenacomys ungava Group

Geographic distribution.—Nonmountainous portions of the Canadian and Hudsonian Zones of Canada. (See map, fig. 6.)

General characters.—A group the members of which are chiefly characterized by a distinctly yellowish nasal area; skull well ridged and palate normally with a well-defined, rather blunt, median process, but with some variation in the degree of development. Rostrum markedly depressed. Size greatest and color darkest in Labrador; smallest and palest in Alberta.

PHENACOMYS UNGAVA Merriam

Geographic distribution.—The Canadian and Hudsonian Zones of Labrador, Quebec, and Ontario at least as far west as the north shore of Lake Superior (fig. 6, *2* and *3*).

General characters.—A species whose external characters are not well understood, on account of the poor quality of the available material representing the typical race. A medium to large phenacomys of bright to dark coloration, with no decided tendency toward an increase of grayness anteriorly. Skull medium to large, with rather large bullae. Larger and evidently darker eastward.

PHENACOMYS UNGAVA UNGAVA Merriam

Ungava Phenacomys

(Pl. 3, fig. 1)

Phenacomys ungava Merriam, North Amer. Fauna No. 2, p. 35, October 30, 1889.

Phenacomys celatus Merriam, North Amer. Fauna No. 2, p. 33, October 30, 1889. Type from Godbout, Quebec, Canada. Male adult; No. 186486, U. S. Nat. Mus. (formerly No. $\frac{2}{5}\frac{8}{9}\frac{5}{8}\frac{1}{8}$, Merriam coll.); collected by N. A. Comeau, June 10, 1886.

Phenacomys latimanus Merriam, North Amer. Fauna No. 2, p. 34, October 30, 1889. Type from Fort Chimo, Ungava, Canada. Male immature; No. 186487, U. S. Nat. Mus. (No. $\frac{5}{6}\frac{1}{1}\frac{8}{5}\frac{4}{9}$ Merriam coll); collected by L. M. Turner.

Type.—Collected at Fort Chimo, Ungava, Canada, by L. M. Turner; male old adult; No. 186488, U. S. Nat. Mus. (No. $\frac{5}{6}\frac{4}{1}\frac{6}{5}\frac{8}{5}$ Merriam coll.).

Geographic distribution.—Probably suitable places throughout the whole of Quebec, including Ungava, and at least as far west as central Ontario (fig. 6, *2*).

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[26] Mus. Comp. Zool.
[27] Mus. Vert. Zool.
[28] Field Mus. Nat. Hist.

General characters.—A medium-sized, short-tailed, yellow-nosed species of bright coloration: incisive foramina small.

Color.—The type specimen of this form is of a bright chestnut brown, close to the Prout brown of Ridgway but a shade brighter on the dorsal surface, with the underparts pale buffy gray, all hairs plumbeous at base; tail indistinctly bicolor, and feet pale buff. Face somewhat paler and pronouncedly yellowish, this being brightest on the nose.

Skull.—Of medium size, with rather short rostrum, small incisive foramina and with relatively large brain case, broad posteriorly.

Dentition.—The molar pattern of the specimens examined exhibits no peculiarities. The anterior trefoil of the first lower molar is quite variable, as is usual in this genus.

Measurements.—Of the following three alcoholics before making over into study skins, as given by Miller: Type of *ungava*: Total length, 138; tail, 31; hind foot, 19. Type of "*latimanus*": 116; 28; 18. Type of "*celatus*": 130; 32; 17.5. Subadult male from Ontario (in flesh): 138; 33; 19. *Skull* (type): Condylobasilar length, 23.6; nasals, 7.4; interorbital breadth, 3.7; zygomatic breadth, 15; lambdoidal width, 11.7; incisive foramina, 4.6; maxillary tooth row, 6; height, 9.2. Type of "*celatus*": Condylobasilar length, 23.5; nasals, 7.2; interorbital breadth, 3.6; zygomatic breadth, 14.5; lambdoidal width, 11.4; incisive foramina, 4.7; maxillary tooth row, 5.6; height, 9.

Remarks.—The material from the range assigned to this species, consisting only of the types of *ungava*, "*latimanus*," "*celatus*," and two other immature examples from Godbout, is too scanty to admit of the final working out of its relationship. All five of these specimens were originally alcoholics, so neither the coloration nor the external proportions are reliable. The three above types are entirely indistinguishable from one another in color, and are of an unusually bright shade of brown such as is found in no other race of this genus, but this condition may well be due to the action of the alcohol. The only external differences are that of size, undoubtedly due partly to age and partly to shrinking by the preservative; and the noticeable broadness of the forefeet of "*latimanus*," but this last seems to be occasioned by drying in an extended position. The types of both *ungava* and "*latimanus*" are from Fort Chimo. The former is an old individual and the latter an immature; therefore the skull of "*latimanus*" is the smaller, especially in the rostral region, and without interorbital ridging, but these differences are such as are normally to be found in animals of corresponding ages, and it is considered extremely unlikely that they can be referable to different races.

The skull of the type of "*celatus*" is of about the same age as that of *ungava*, but a trifle smaller and slightly more ridged; the difference is slight and well within the range of individual variation, as exhibited in series of other forms of the genus from a single locality. An immature from Godbout, originally alcoholic, was "made up" very small, but even taking into consideration the consequent crowding of the dorsal hairs, it is distinctly darker.

The immature male from Ontario is paler and grayer than Quebec examples, and the tail is more sharply bicolor. Until adult skulls

are available, or topotypes of *ungava* have been taken, the significance of this difference can not be interpreted.

Phenacomys "latimanus" is now placed in synonymy rather than *ungava* because the former is not adult and is a much less desirable specimen to be the type of a species. For the use of the name *ungava* in preference to that of "*celatus*," see Miller (1897 b, p. 77).

Specimens examined.—Total number, 7, as follows:

Ontario: Frantz, 1[29]; Peninsula (north shore of Lake Superior), 1[30].
Quebec: Fort Chimo, 2 (type of *ungara* and type of "*latimanus*"); Godbout, 3 (including type of "*celatus*").

PHENACOMYS UNGAVA CRASSUS Bangs

Labrador Phenacomys

(Pl. 3, fig. 2)

Phenacomys celatus crassus Bangs, Proc. New Eng. Zool. Club, 2: 39, 1900.

Type.—Collected at Rigolet, Hamilton Inlet, Labrador, August 15, 1895, by C. H. Goldthwaite; male old adult; No. 3959, E. A. and O. Bangs coll. (now in Mus. Comp. Zool.).

Geographic distribution.—Southern Labrador: Limits of range unknown (fig. 6, *3*).

General characters.—A large, rather dull-colored race with long, well-ridged skull, heavy rostrum, and large incisive foramina.

Color.—Above brownish, close to the snuff brown of Ridgway but a trifle darker, with a rather circumscribed nasal area pronouncedly yellowish. Underparts grayish without any tinge of buffiness and tail quite sharply bicolor. The young are darker and less brownish than the normal adult, with the plumbeous hair bases showing more.

Skull.—Large and long with heavy rostrum; interorbital ridging and supraorbital processes well developed. Incisive foramina and bullae large.

Dentition.—The enamel pattern of the molars is normal with only slight variation in the form of the trefoil of the anterior lower molar. In one or two examples of topotypes there is a tendency for the triangles of the lower teeth to remain open.

Measurements.—Three adult males from Labrador: Total length, 153; tail, 38; hind foot, 20. Three adult females from Labrador: 151; 36; 16. *Skull*: Average measurements of the three best adults from Labrador: Condylobasilar length, 24.4; nasals, 7.6; interorbital breadth, 3.5; zygomatic breadth, 15.2; lambdoidal width, 11.4; incisive foramina, 5.1; maxillary tooth row, 5.8; height, 9.3.

Remarks.—A well-marked race but unlikely to prove to be specifically distince from *ungava*. From the latter it differs in being more soberly colored dorsally, grayer (less buffy) beneath, tail more sharply bicolor, darker above, and in having the yellow area of the face somewhat more restricted. Longer feet also seem to be indicated, but this difference may be illusory because of all typical specimens of *ungava* available having been in spirits. The same cause may be partially, though probably not wholly, responsible for the fact that these Labrador skins have more prominent ears with

[29] W. E. Saunders coll. [30] Mus. Comp. Zool.

a lighter growth of hair. The skulls of *crassus* are larger and longer than those of *ungava*, with rostrum proportionately longer and much more robust. The jugals are deeper supero-inferiorly and the postorbital borders slightly more square. There is some little difference in the interparietals, but they vary, and this part of the skull is usually of little value in diagnosis, as it is extremely variable in most forms. The incisive foramina are longer and wider, especially anteriorly, in the case of the Labrador animals, and the bullae distinctly larger.

Of the two skulls from Grosswater Bay (on Hamilton Inlet), one is badly broken and the other is little better. What is left shows it to be a very old male of a remarkable size, and far larger than any other specimen of this race.

Specimens examined.—Total number, 16, as follows:

Labrador: Grosswater Bay, 2 (skulls only); Hamilton Inlet, 13[31]; L'Anse au Loup, 1[32].

PHENACOMYS MACKENZII PREBLE

MACKENZIE PHENACOMYS

(Pl. 2, fig. 1; pl. 3, fig. 3)

Phenacomys mackenzii Preble, Proc. Biol. Soc. Washington, 15: 182, 1902.

Type.—Collected at Fort Smith (near Athabaska-Mackenzie boundary line), Slave River, Canada, June 29, 1901, by E. A. and A. E. Preble; male old adult; No. 110625, U. S. Nat. Mus. (Biol. Surv. coll.); original number, 4271.

Geographic distribution.—The territory east of the mountains in Alberta, north almost to Great Bear Lake, and east to Hudson Bay (fig. 6, *1*).

Habitat.—Canadian and Hudsonian Zones; in strips of forest along the bottom lands, and grassy glades.

General characters.—A rather small phenacomys with short tail and small feet compared with other members of the *ungava* group. Coloration brightest on rump and palest anteriorly; face yellowish; rostrum markedly depressed.

Color.—Rather pale, the coloration of the rump being close to the snuff brown of Ridgway, but paler and grayer anteriorly. Underparts grayish white, superficially darkened by the plumbeous bases of the hairs showing through, but without buffiness. Facial area yellowish and feet pale; bicoloration of the tail fairly well defined. Juveniles are slightly darker and duller.

Skull.—Rather small, narrow interorbitally and with slender rostrum. Bullae small and molars light. Rostrum more decidedly depressed than in any other species.

Dentition.—There is no peculiarity of molar pattern in this race. The trefoil of the anterior lower molar is variable, as is usual in the genus (fig. 7).

Measurements.—Collectors' figures for adult topotypes are as follows: Eleven males: Total length, 138 (133–144); tail, 32 (29–34);

[31] Mus. Comp. Zool., 12; U. S. Nat. Mus., 1. [32] Mus. Comp. Zool.

hind foot, 17 (17–18). Three females: 143; 32; 17. *Skulls* of 11 adult topotypes average as follows: Condylobasilar length, 22.7; nasals, 7.4; interorbital breadth, 3.1; zygomatic breadth, 14; lambdoidal width, 11.1; incisive foramina, 4.5; maxillary tooth row, 5.7; height, 9.1.

Remarks.—The relationship of the present form lies with *ungava*, and it is thought that the difference between them will finally prove to be only subspecific in degree. This as yet, however, can not be demonstrated, and so it seems better to retain the binomial for the present.

As previously mentioned, no confidence can be placed in the external characters of *ungava* as embodied in existing skins, but in comparison with them, topotypes of *mackenzii* are very much duller and considerably paler, especially anteriorly, with underparts clear gray instead of being tinged with buffiness. In coloration, skins of *mackenzii* are much more comparable to *crassus*, from which they differ only slightly, being a trifle paler, grayer on the head, tail darker and face slightly less yellowish. They are also smaller in all dimensions. The skulls of *mackenzii*, however, differ from *ungava* in a direction opposite to that shown by *crassus*. The first mentioned may be distinguished from the others by the degree to which the rostrum is depressed.

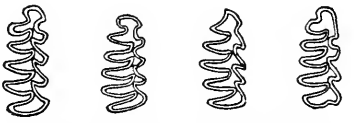


FIG. 7.—First lower molars, right-hand series, of *Phenacomys mackenzii*, selected to show extremes of variation in the anterior trefoil and in the extent of closure of the triangles. Enlarged

Measurements of available skins indicate that the females are appreciably larger than the males, but this disparity in size does not extend to the skulls. The material is adequate, however, to demonstrate that the interorbital ridging is much more pronounced in the case of males—to such an extent that the sex of an adult may usually be told from the skulls alone. The single exception to this is the specimen from Fort McMurray, marked male; but as it is adult and totally without ridging, the correctness of sex determination is doubtful.

The adult from Fort Churchill, a female, has slightly larger bullae but is otherwise normal.

A subadult female from Muskeg Creek, west-central Alberta, is very aberrant in coloration, being a bright brown without the usual tinge of grayish. Its yellowish nose places it in the present group, but the damaged skull, too young to exhibit pronounced characters, cuts short further speculation.

The specimen from Red Deer River is considerably paler than any other at hand, but its skull is smashed to bits.

Specimens examined.—Total number, 42, as follows:

Alberta: Athabaska Landing, 1; Athabaska River, 1; Fort McMurray, 1[33]; Muskeg Creek, 1; Pierre au Calumet, 1; Red Deer River, 1[34]; Slave River (10 miles below Peace River), **1.**

Keewatin: Fort Churchill, 3.

Mackenzie: Fort Resolution, 3; Fort Smith, 25 (including type); Lake Saint Croix, 1.

Saskatchewan: Crackingstone Point, Athabaska Lake, 3[35].

[33] Mus. Comp. Zool.
[34] Field Mus. Nat. Hist.
[35] Mus. Comp. Zool., 2; U. S. Nat. Mus., 1.

Phenacomys albipes Group

(Characters under the species)

PHENACOMYS ALBIPES Merriam

Coast Phenacomys

(Pl. 3, fig. 4)

Phenacomys albipes Merriam, Proc. Biol. Soc. Washington, 14: 125, 1901.

Type.—Collected at Arcata, Humboldt County, Calif., May 24, 1899, by W. K. Fisher; male adult; No. 97236, U. S. Nat. Mus. (Biol. Surv. coll.); original number, 821.

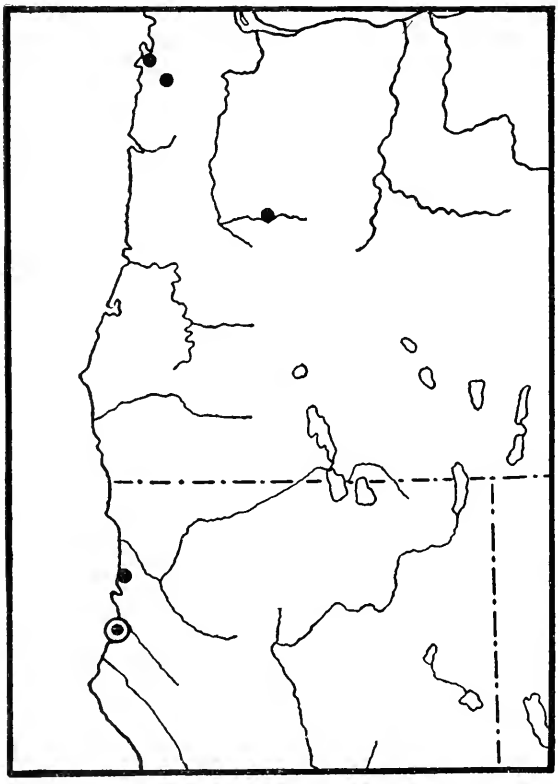


Fig. 8.—Distribution of *Phenacomys albipes*. Type locality in circle

Geographical distribution.—Occurs in a coastal strip of unknown width from Arcata, Humboldt County, Calif., north to the vicinity of the Columbia River probably, and east as far as Vida, Oreg. (fig. 8).

Habitat.—Usually the vicinity of little streams in the humid coast forests. Evidently terrestrial.

General characters.—A phenacomys of a dark, rich brown with long tail rather scantily haired. Skull relatively long, slender, and rounded.

Color.—The dorsal coloration of this species is of a darker, richer brown (close to the Prout brown of Ridgway) than any other member of the genus, and there is a plentiful admixture of black-tipped hairs. The pelage is everywhere plumbeous at base, and the ventral surface is clear gray in spring skins, but those taken in fall have this part strongly washed with pinkish buff. The tail is distinctly bicolor and the face sooty. In some specimens the ear tips are practically naked and in others they are covered with fine black hairs. The feet are rather light, their exact shade depending, as usual, upon the quantity of grease present in the dried skin, but they are no paler than in most other species, if as pale.

Skull.—The cranium of this species is strongly characterized by its relative slenderness, especially anteriorly. It is high and full posteriorly; there is no elevation of the interorbital region, and the zygomatic expansion is slight. The skull is perhaps as distinctive as that of any member of the genus.

Dentition.—The incisors of *albipes* are only moderately curved—about as in the short-tailed races—and the molariform teeth are somewhat light and narrow, though less so than in *longicaudus*. The anterior trefoil of the first lower molar is even more variable than usual, and there is often considerable and unusual distortion of the first outer triangle of the second lower molar, this then being compressed and twisted, and remaining open. The third lower molar is usually simple, with distinct crenulation upon the buccal side, but in two instances there is a small outer triangle indicated, and there is a distinct tendency for the anterior loop to be reduced in size.

Measurements.—Average of six adult males: Total length, 171 (165–181); tail, 63 (62–71); hind foot, 19.5 (19–20). Subadult female: 159; 67; 21. *Skull*: Average of five adult males (two imperfect): Condylobasilar length, 23.2; nasals, 7.6; interorbital breadth, 3.6; zygomatic breadth, 13.9; lambdoidal width, 11.4; incisive foramina, 4.8; maxillary tooth row, 6.2; height, 9.3.

Remarks.—This species can be confused with no other member of the genus, but it bears a striking superficial resemblance to *Microtus mordax angusticeps*. The length of its tail at once distinguishes it from other terrestrial phenacomys, and the lesser diameter and unpronounced hairiness of this member, from the two arboreal forms. It is totally different in color from *longicaudus*, and although the coloration is close to that of *silvicola*, the only specimens of the latter have much longer pelage of a different quality.

The brain case of the males is strikingly full and rounded, especially the posterior portion, which is well elevated. The frontal region is noticeably more depressed than in the arboreal, or indeed any other, species. The rostrum is comparatively long and slender, and the zygomatic processes of the maxillae are weaker and more sloping than in other forms. The incisive foramina are slightly longer and narrower posteriorly than in either arboreal species, and the palatal pits are a trifle smaller in their antero-posterior dimension. The molariform teeth are very narrow, but the tooth rows are long.

In the present state of knowledge, the relationship of *albipes* is in some doubt. Whether or not the degree of curvature of the incisors of the two arboreal species is a character recently brought about by food habits, or whether it is of deeper significance, it is, at any rate, an excellent group character, and one that is not shared by *albipes*. Both the latter and *silvicola*, however, have pronouncedly sooty faces, and this may or may not be of more than simple specific significance. No positive assertions can be made, but it is felt that the points of external resemblance of *albipes* to the *longicaudus* group are not so profound as might at first be imagined.

Specimens examined.—Total number, 8, as follows:

California: Arcata, 1 (the type); Orick, 1 [35].
Oregon: Blaine, 2 [36]; Netarts, 3 [37]; Vida, 1 [38].

[35] D. R. Dickey coll.
[36] D. R. Dickey coll., 1; A. Walker coll., 1.
[37] S. G. Jewett coll.
[38] Game Dept. Oregon.

Phenacomys longicaudus Group

Geographic distribution.—Forests of the humid coast district from Mendocino County, Calif., north probably to the Columbia River (fig. 9).

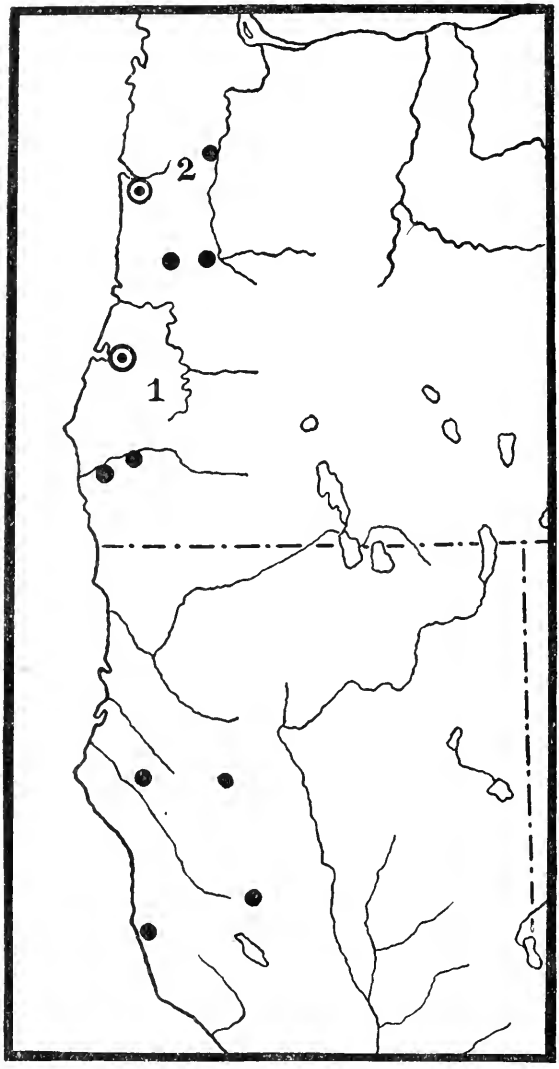


FIG. 9.—Distribution of the *Phenacomys longicaudus* group: 1. General distribution of *P. longicaudus*, as shown by specimens examined.
2. Distribution of *P. silvicola;* known from two localities only.
Circles show type localities of species

General characters.—Species chiefly arboreal in habitat and characterized by long, stout tails, black above, and relatively heavily haired, and long toes fitted for climbing. Upper incisors more sharply decurved than in other groups.

PHENACOMYS LONGICAUDUS TRUE

RED TREE MOUSE

[Pl. 1 (frontispiece); pl. 3, fig. 5]

Phenacomys longicaudus True, Proc. U. S. Nat. Mus., 13: 303, 1890.

Type.—Collected at Marshfield, Coos County, Oreg., August, 1890; immature; No. $\frac{19071}{25883}$, U. S. Nat. Mus.

Geographic distribution.—Locally in humid coast district from Mendocino County, Calif., into central Oregon, and possibly to the Columbia River (fig. 9, *1*).

Habitat.—Largely arboreal and found practically always in coniferous trees (except redwoods).

General characters.—A bright reddish species with long, blackish, rather hairy tail and long toes. Skull short and thickset with post-orbital processes well developed. Incisors sharply decurved.

Color.—Above, of a uniform cinnamon, close to the ochraceous tawny of Ridgway, many of the hairs sparingly tipped with black;

slightly paler on the sides. Pelage everywhere plumbeous at base, showing through the whitish of the underparts to some extent. Tail blackish and rather plentifully haired, and the ears and feet sparingly covered with hairs of the same color as is the dorsal surface. Late spring and summer adults, as well as juveniles, are much duller, and because of the wearing away of the tips of the hairs in the case of these adults, the plumbeous bases of the hairs show through to a great extent, darkening and dulling the general tone. The oldest two specimens have many pale and whitish hairs dorsally, and in the Mount Sanhedrin skin this is so pronounced that a distinctly grizzled appearance is produced.

Skull.—Brain case rather short and squarish, maxillary processes of the zygoma flaring slightly but jugals compressed and parallel, the whole giving a squat, robust appearance to the skull. Postorbital processes of the squamosals exceedingly well developed. The shape of the interpterygoid fossa is not at all constant and varies from U to V shaped. The ascending branches of the maxillae usually project a full millimeter beyond the nasals and are very narrow.

Dentition.—The maxillary dentition of *longicaudus* presents no peculiarities except for the presence of a tendency for the posterior outer triangle of the third molar to be larger and more completely segregated from the posterior loop than is usual in the short-tailed forms. In the mandibular teeth there is little or no tendency toward the formation of an external triangle on the third molar. The variation in the pattern of the first molar is so great, especially in its anterior portion, that no dependency can be placed upon its form (fig. 10).

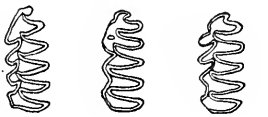


FIG. 10.—First lower molars, left-hand series, of *Phenacomys longicaudus*, selected to show extremes of variation in enamel pattern. Enlarged

Measurements.—The averages of adults of the two sexes is as follows: Six males: Total length, 166 (158–176); tail, 67 (60–72); hind foot, 20 (19–21). Five females: 182 (170–187); 73 (66–83); 21 (21–22). *Skull*: Averages of six adult males as follows: Condylobasilar length, 21.9; nasals, 7.2; interorbital breadth, 3.5; zygomatic breadth, 14; lambdoidal width, 11.5; incisive foramina, 4.6; maxillary tooth row, 5.7; height, 9. The averages of five skulls of adult females are as follows: Condylobasilar length, 22.5; nasals, 7.8; interorbital breadth, 3.3; zygomatic breadth, 14.2; lambdoidal width, 11.9; incisive foramina, 4.6; maxillary tooth row, 5.8; height, 9.4.

Remarks.—A very distinct species, needing comparison with no other. Its reddish coloration is distinctive, and its short, robust skull is readily distinguishable from those of others. The degree of hairiness of the tail and the arboreal habitat is shared with *silvicola*, from which *longicaudus* differs externally only in its much redder color and smaller size, ears that are apparently more conspicuous, pelage that is shorter and slightly harsher, and face without sootiness. There are available no thoroughly adult skulls from Oregon but the material seems to indicate that the species varies little, if any, within its range.

S. G. Jewett informed the writer that there are specimens of *longicaudus* in the University of Oregon from Spencer Butte, near

Eugene, and that unmistakable evidence was found in old nests near the Bonneville Fish Hatchery, at Bonneville on the Columbia River. Though this sign may possibly have been of *longicaudus*, it is considered more likely to have been of *silvicola*.

Measurements both of skins and skulls indicate that there is a difference in size between the sexes, in favor of the females, too great to be ignored. It is consequently inferred that there is a difference of size between the sexes in *silvicola* as well.

It seems that the females of *longicaudus* always build larger, more readily discernible, and probably lower nests than the arboreal shelters of the males. Recent data, discussed in Part II, point to the hypothesis that the adult males normally live in terrestrial holes or under rubbish at the bases of the food trees and probably construct small, temporary, arboreal nests only when they have found females that are ready for their attention. This difference in habits according to sex seems to be the reason that females so far outnumber males in collection. In fact, the six adult males mentioned above seem to be the only specimens, whereas a considerably greater number of females and young have been available than were actually assembled during the present study.

Specimens examined.—Total number, 40, as follows:

California: Bridgeville, 2[39]; Carlotta, 2♂[40]; Mendocino City, 1[41]; Mount Sanhedrin, 1[42].

Oregon: Agness, 3[43]; Eugene, 1; Gold Beach (20 mi. east), 2; Marshfield, 1 (the type); Meadow, 1.

PHENACOMYS SILVICOLA A. B. HOWELL

FOREST TREE MOUSE

(Pl. 3, fig. 6)

Phenacomys silvicolus, A. B. Howell, Jour. Mamm., 2: 98, 1921.

Type.—Collected 5 miles southeast of Tillamook, Tillamook County, Oreg., October 25, 1916, by Peter P. Walker; female young adult; No. 1214, S. G. Jewett coll.; original number, 40, A. Walker coll.

Geographic distribution.—Known only from the type locality, and from Corvallis, Oreg.; undoubtedly confined to the forested area of the humid coast belt (fig. 9, *2*).

Habitat.—Chiefly arboreal.

General characters.—A large species with sooty nose, a long tail rather well haired, long pelage of a warm tone of brown, and long toes. Skull rather weak but with lateral ridges of the brain case better developed than in any other form of the genus. Incisors sharply decurved.

Color.—The dorsal coloration of the type is of a warm brown, close to the cinnamon brown of Ridgway, with many of the hairs tipped with black; a trifle paler on the sides. The ventral surface is whitish, these and all other body hairs being plumbeous prox-

[39] D. R. Dickey coll.
[40] D. R. Dickey coll., 2; Mus. Vert. Zool., 3; Mus. Comp. Zool., 5; U. S. Nat. Mus., 18.
[41] Mus. Vert. Zool.
[42] Acad. Nat. Sci. Philadelphia.
[43] S. G. Jewett coll.

imally. The hairs of the tail are blackish, darker on the upper side, and the nasal area is noticeably sooty in contrast to the remainder of the face.

Skull.—The brain case is very flat, especially posteriorly, and the temporal ridges unusually pronounced, being largely parallel; but the rest of the skull is weak in appearance. The ascending branches of the premaxillae resemble those of *longicaudus* in the degree to which they project beyond the nasals.

Dentition.—The incisors of this species are short and light, and if anything more sharply decurved than in *longicaudus*. The molars of the type are unusually heavy and broad, and the triangles of the lower teeth tend to remain open to a marked degree, but in the second specimen these characters are less pronounced. The two topotypes were examined too late to compare them with the type.

Measurements.—Type: Total length, 191; tail, 81; hind foot, 22. Male: 193; 87; 20. *Skull* (type): Condylobasilar length, 23.3; interorbital breadth, 3.4; zygomatic breadth, 14.4; lambdoidal width, 11.9; incisive foramina, 4.4; maxillary tooth row, 6; height, 9.

Remarks.—Coloration, combined with sooty face and the character of the tail, readily distinguishes this species externally, while the presence of the parallel temporal ridges is sufficient to characterize the skull. Furthermore, it may be distinguished from *longicaudus* by the almost entire suppression of the postorbital processes. A unique character possessed by the two arboreal species is the great extent to which the upper incisors are decurved, and the ascending branches of the premaxillae project beyond the nasals to a greater degree in these two than in any other species of the genus. For this reason, as well as because of the close similarity of external points, *silvicola* is here placed with *longicaudus*. It is of interest to note, however, that in several less noticeable characters, as sootiness of nasal area, the resemblance is closest to *albipes*.

In some respects, the case of *silvicola* is a puzzling one. The first impulse is to consider it as a subspecies of *longicaudus*. A closer scrutiny of the evidence, however, argues for full specific separation of the two, at least for the present.

The type was found dead on a log in dense, virgin forest, and the second specimen was taken from a nest in a tree.

Specimens examined: Total number, 4, as follows:

Oregon: Tillamook, 3 [44]; Corvallis, 1 [45].

[44] S. G. Jewett coll., 1 (the type); A. Walker coll., 2.
[45] Oregon Agr. College coll.

Explanation of Plate 2

[All skulls about twice natural size]

Fig. 1.—*Phenacomys intermedius intermedius*, female, Beartooth Mountains, Mont. (No. 66727, U. S. Nat. Mus., Biological Survey collection).

Fig. 2.—*Phenacomys intermedius intermedius*, female, Nelson, British Columbia (No. 69052, U. S. Nat. Mus., Biological Survey collection).

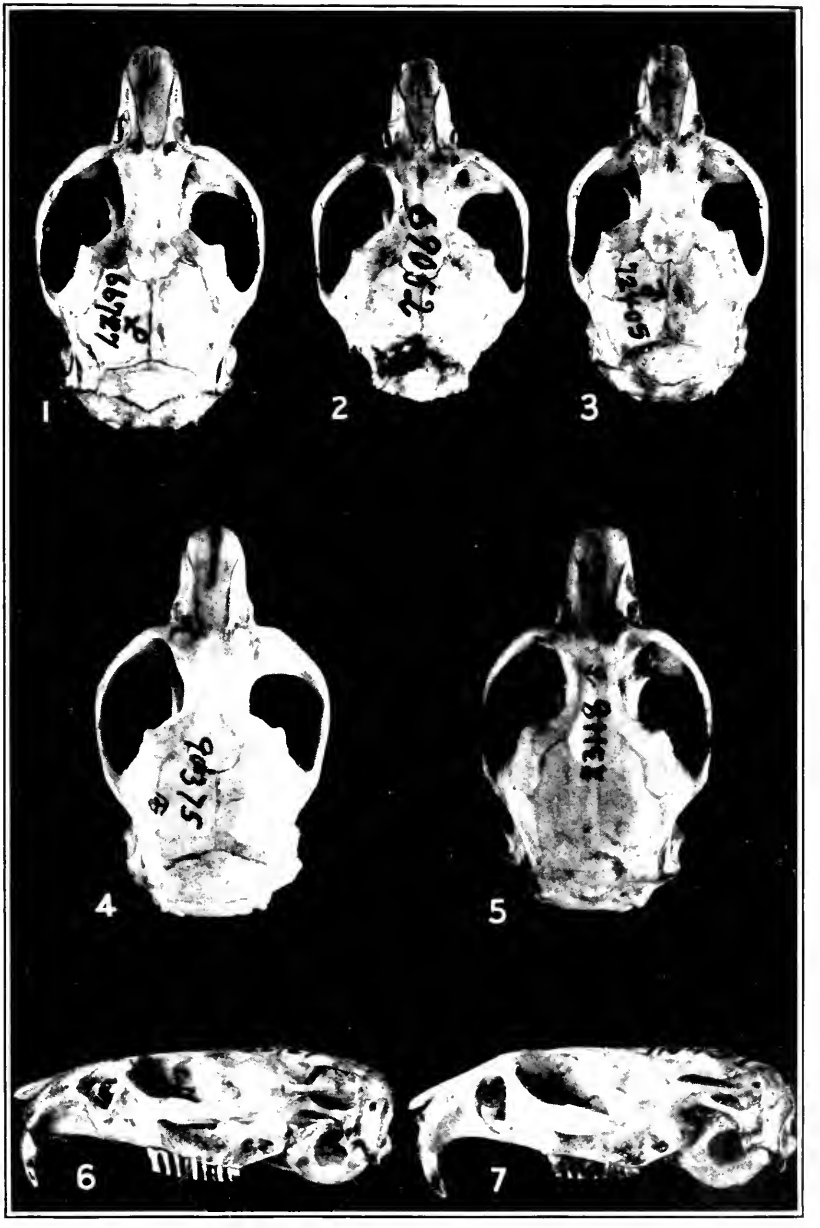
Fig. 3.—*Phenacomys intermedius levis* (type), male, Saint Marys Lake, Mont. (No. 72405, U. S. Nat. Mus., Biological Survey collection).

Fig. 4.—*Phenacomys intermedius olympicus*, male, Soleduc River, Olympic Mountains, Wash. (No. 90375, U. S. Nat. Mus., Biological Survey collection).

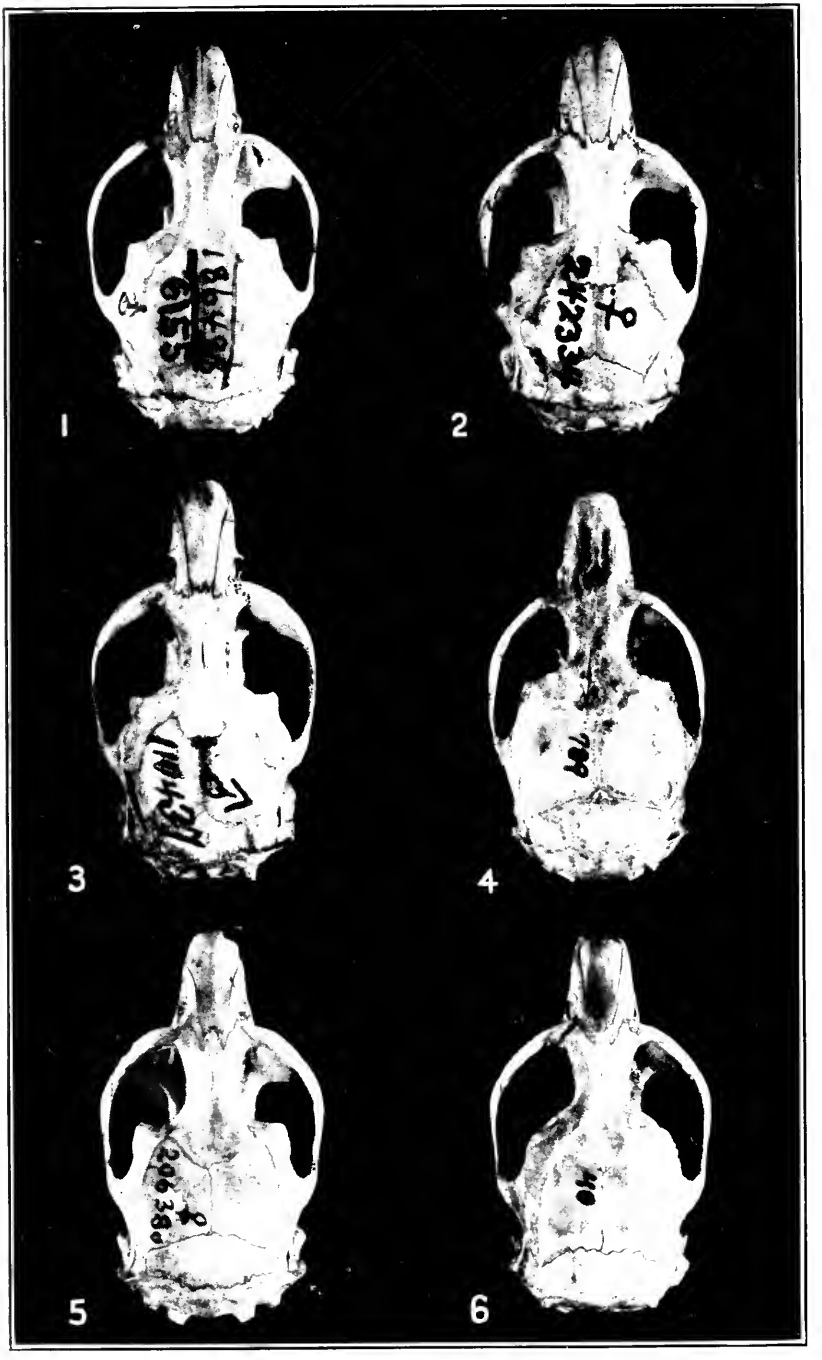
Fig. 5.—*Phenacomys intermedius celsus*, male, Yosemite National Park, Calif. (No. 23118, Mus. Vert. Zool.).

Fig. 6.—*Phenacomys intermedius intermedius*, female, Beartooth Mountains, Mont. (No. 66727, U. S. Nat. Mus., Biological Survey collection).

Fig. 7.—*Phenacomys mackenzii*, male, Fort Smith, Mackenzie, Canada (No. 110437, U. S. Nat. Mus., Biological Survey collection).



SKULLS OF PHENACOMYS



SKULLS OF PHENACOMYS

Explanation of Plate 3

[All skulls about twice natural size]

Fig. 1.—*Phenacomys ungava ungava* (type), male, Fort Chimo, Ungava, Canada (No. 186487, U. S. Nat. Mus., Biological Survey collection).

Fig. 2.—*Phenacomys ungava crassus*, female, Hamilton Inlet, Labrador (No. 242334, U. S. Nat. Mus.).

Fig. 3.—*Phenacomys mackenzii*, male, Fort Smith, Mackenzie, Canada (No. 110437, U. S. Nat. Mus., Biological Survey collection).

Fig. 4.—*Phenacomys albipes*, male, Netarts, Oreg. (No. 789, S. G. Jewett collection).

Fig. 5.—*Phenacomys longicaudus*, female, Carlotta, Calif. (No. 206380, U. S. Nat. Mus., Biological Survey collection).

Fig. 6.—*Phenacomys silvicola* (type), female, Tillamook County, Oreg. (No. 1214, S. G. Jewett collection).

II. LIFE HISTORY OF THE RED TREE MOUSE *PHENACOMYS LONGICAUDUS* TRUE

By A. Brazier Howell

INTRODUCTION

In accordance with a general plan for the study both in the field and in the laboratory of the rodent subfamily Microtinae, particular attention has been paid, as opportunity has offered, to the red phenacomys (*Phenacomys longicaudus*)—which may be more popularly known as the red tree mouse (see frontispiece)—of the more southern portion of the humid faunal area of the Pacific coast. Opportunity for this work occurred during a part of July, 1919, when it was prosecuted by the writer merely in conjunction with investigations regarding other mammals of the region, and in July and August, 1923, when, on a special trip made by him for this purpose, a life-history study was undertaken as circumstances permitted. In an excellent report on this species by W. P. Taylor (1915b), there was much valuable information concerning its life habits. The present contribution, however, is believed to be justified in that it approaches the subject from a somewhat different angle. The illustrations in Plates 1 and 6, made from photographs taken by the author, are of captive mice placed amid natural surroundings.

Although every effort has been made to avoid theorizing, it has been necessary to advance some hypotheses, for the reason that it has not been possible to observe all desired phases of the life history of the species. It is believed that in the light of present knowledge these are correct; but the cases in point have been indicated and the reader may draw independent conclusions if he desires.[1]

Phenacomys longicaudus is a small rodent largely of arboreal habits, is related to the common meadow mouse, and occurs throughout a portion of the humid coast belt in California and Oregon. Its distribution is discontinuous to a certain extent, but it is found locally in some numbers in forested areas of Douglas and grand firs. In these trees it largely makes its home, descending to the ground when it must do so to reach some other tree or for other activity of an unknown extent. Although it may eat the tenderest bark, its chief food in the wild state consists of the fleshy portion of fir needles, the fibrous part of which is not consumed but is used almost exclusively for constructing the nests. It gathers twigs at night and piles a supply upon the nest for consumption during the day.

[1] In this work the writer has had the active cooperation of H. E. Wilder, who during his residence of 13 years in this region has had better opportunity to become familiar with the habits of the tree mice than anyone else. It is strongly felt that his name should have appeared as coauthor of the present contribution, but as he has declined this course grateful acknowledgment is made of his invaluable aid in gathering the data presented and for criticism of the manuscript.

Structurally, tree mice exhibit only slight modifications for an arboreal habitat, at least as far as may be stated without careful anatomical studies. The length and hairiness of the tail and the stout feet with long claws are apparently the only characters that have developed in this direction. The writer's opinion, however, is that the slightness of this structural modification is not due to an arboreal life for a short length of time, geologically speaking, but rather to the probability that the species has had very little competition ecologically and few predaceans with which to contend.

These mice are now confined to a rather humid area, for the most part covered with luxuriant forests. As dense, humid forests were in remote times far more extensive than at present, it is not unlikely that arboreal mice identical with or closely related to the species under discussion were once of much greater importance in the American fauna than is the remnant now surviving.

Distributional Factors

The geographic range of *Phenacomys longicaudus* is indicated on the map (fig. 9). Although the range is discontinuous from the very nature of the case, the mice may very well be more uniformly distributed over suitably timbered territory than has yet been proved. In general, the species occupies the humid coast faunal area from Mendocino County, Calif., north through the corresponding portion of Oregon. There is apparently no reason why it should not occur in similar parts of Washington as well, but it has never been detected within the boundaries of that State.

It is difficult to make precise statements regarding the distributional preferences of the species. It is not to be found in pure stands of redwood, for it will not feed upon this tree; but it does occur in its favorite trees along the edges of these pure stands, and where there is mixed timber. In Oregon the mice are presumed to occur here and there throughout most of the coastal belt where this is suitably forested; but stations of capture are lacking in the extreme northwestern portions of the State. The easternmost records are from localities with considerably greater tendencies toward aridity than is the case over the greater portion of the range of the species. It occurs in both the Transition and Canadian Zones, but in certain parts of the coast belt where it is to be found between densely timbered hillsides and gulches on the one hand, and bare or brushy slopes and bottom lands on the other, many zonal indicators normally dependable are here so inextricably interwoven that one is forced to be cautious in making exact statements.

Within the general area studied the tree mice may occur wherever there is a stand, not too dense, either of Douglas or grand fir or both. This condition, as previously indicated, is often to be found upon the borders of dense redwood forests, notably upon the shoulders of southward-facing hills (pl. 4). Elsewhere than in redwood country their preferences, according to information published by others, may be more difficult of proper interpretation. One distributional factor of paramount importance is that of accessibility. The species will seldom or never be found in naturally isolated patches of timber, even though these be of comparatively large extent. Theoretically at least a considerable expanse of brushy

or open land without suitable trees is an absolute barrier to the species. As with all animals, there are doubtless other distributional factors not discernible, but which nevertheless operate to prevent the tree mice from occupying certain territory that would seem ideal for them. So far as the writer's experience goes, however, as well as that of others with whom he has talked, the species is indiscriminate in its choice of north or south slopes, hilly or level ground.

The technical description of the species and details of its relationships are given in Part I.

Investigational Methods

The methods employed in the present investigation may be divided into observation, experimentation, and deduction. Especially during 1923 the most careful observations were made of all phases of the life and ecology of the mice that it was possible to discover, and their habits carefully studied. An area was selected and every accessible nest within it, and many without, was dissected. Several of the mice were caught and kept in captivity for varying lengths of time, and feeding and other experiments conducted. As the mice are normally abroad only at night, certain details of their habits can only be deduced, sometimes with the aid of captive individuals. Though it is admitted that the actions of captives are not perfectly normal, data from such a source are of much value when so stated. They are often the best to be had, and need only be accepted by the reader for what he deems they are worth. It must also be borne in mind that the writer has studied *Phenacomys longicaudus* in detail in only one part of its range, and it is very possible, or probable, that many of the conclusions reached will not be found to apply with equal force to the mice of all other sections.

AREA INVESTIGATED

The present study was made chiefly on the hillside surrounding the home of H. E. Wilder, 1 mile east of Carlotta, Humboldt County, Calif. This hillside faces toward the south, and the lower portion consists of open pasture and meadowland adjoining the cultivated fields of the valley of the Van Duzen River (pl. 4). Above this there is considerable brush, clumps, or single specimens of rather small and occasional large conifers, with a few stumps showing where others have been cut off. This strip, extending in some places to the floor of the valley, and in others for a distance of 200 to 300 feet up the hillside, is interspersed with small patches and tongues of open grassland; but this is not true "cut-over" land, Mr. Wilder says. Rather is it a natural, transitional strip in which many trees remain small, located between the originally open or somewhat brushy bottom lands and the dense redwood forest of the higher hills and upper gulches.

The tract studied (fig. 11) is perhaps 5 acres in extent; but the mice are probably as numerous in another tract of about the same size immediately beyond a small gulch to the east, where the trees average larger. They also occur in scattered, outlying clumps of trees beyond the confines of these areas. Eastward they were ob-

tained several miles up the river, and Wilder has found others elsewhere in this general region. Nowhere near by are they so numerous, at least in the smaller trees, as upon the area studied, and it was selected as much for this reason as because it is the most accessible. The trees occupied are also smaller than usual, and most of the specimens in the collections of North America have come from just this spot.

Throughout their range these mice usually frequent the taller trees, and for this reason it is extremely difficult to estimate their

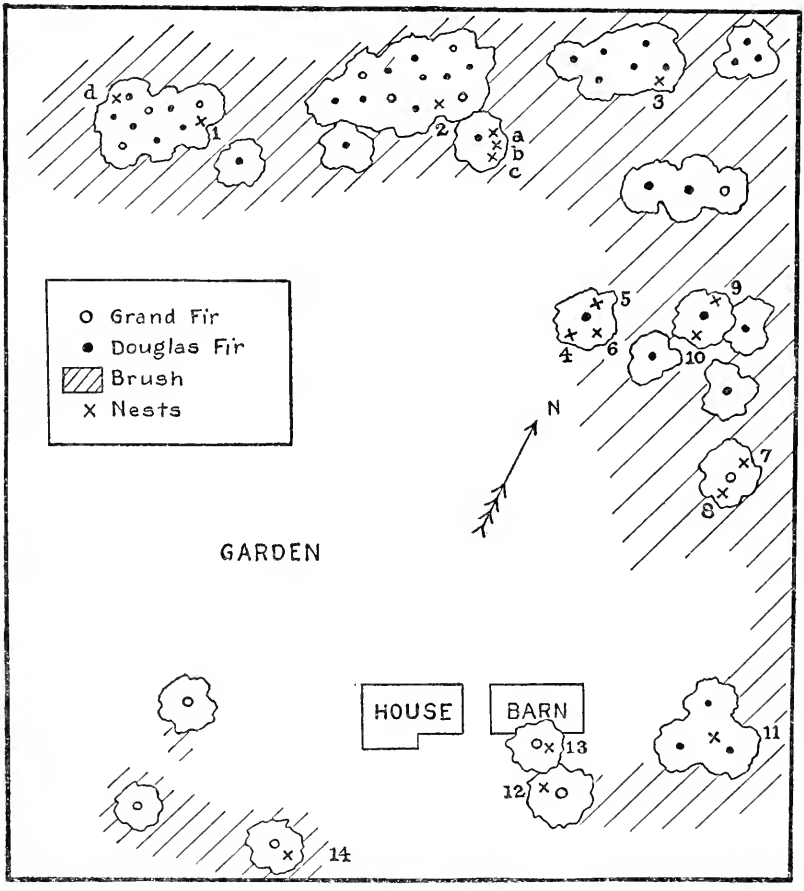


FIG. 11.—Diagram of area near Carlotta, Calif., harboring colony of *Phenacomys longicaudus*, showing major details, with positions of nests and nesting trees

numbers, for an immense Douglas fir might harbor a dozen nests that can not be recognized as such from the ground. In cutting a number of these trees for firewood, Wilder found that practically every one contained the nest of a mouse. It is logical to assume, therefore, that a large proportion of trees in localities favored by the mice are occupied, and it seems probable that the majority of specimens have been collected from smaller trees simply because nests in lofty situations are well nigh inaccessible. It may well be that very often such

TYPICAL HABITAT OF PHENACOMYS LONGICAUDUS

View eastward up the Van Duzen River Valley, showing habitat of red tree mouse between untimbered bottom lands and dense forests of the hills

TYPICAL NESTING TREE OF PHENACOMYS LONGICAUDUS

Douglas fir (*Pseudotsuga taxifolia*) in the Carlotta, Calif., area, in which were nests numbered 4, 5, and 6 in the text. Approximate location of nests shown by arrows

lesser growth harbors the overflow population from more lofty neighbors. On the other hand, Wilder states that he has walked for many miles beneath large trees that seemed eminently suitable as habitations of the mice, without seeing a sign of their presence, although he usually had them in mind. This evidence further accentuates the degree to which the species is localized.

It seems safe to state that in no place yet investigated by a mammalogist are the tree mice so numerous as they originally were at Carlotta. In two successive mornings during 1913 Wilder and C. I. Clay captured more than 50 individuals on this hillside, and fully as many more have since been obtained there. They are not now so abundant as at first, although few have been collected in the past three or four years, and Wilder considers that they are slow to recover from any check.

The trees[2] within the area covered by the investigation (fig. 11) consist of—

Pseudotsuga taxifolia	Douglas fir (pl. 5).
Abies grandis	Grand fir.
Sequoia sempervirens	Redwood.
Arbutus menziesii	Madrone.
Pasania densiflora	Tan oak.
Umbellularia californica	California bay laurel.

The first two of these predominate, and are the only species of tree indicated on the diagram. Among scattered individuals are small redwoods, but there are several very large madrones.

The "brush," as indicated on the diagram, is in the form of rather open thickets and clumps, from 8 to 15 feet tall, of—

Ceanothus thyrsiflorus	California lilac.
Corylus rostrata californica	Hazel.
Holodiscus discolor ariaefolia	Spiraea, or arrowwood.

NESTS

The largest conifers in this area could be prospected for nests only from the ground and many nests surely escaped detection. Similarly, it is doubtful whether all the smaller, inconspicuous nests in the tops of the denser trees, even when these were small enough to be readily explored, were discovered. The approximate position of each of the nests that could be found and reached is shown in the diagram by a cross, and by a number when the nest could be examined. Letters denote inaccessible bunches of débris which seemed to be the nests of mice when viewed through binoculars from the ground.

Nest No. 1.—In a 10-inch grand fir 16 feet from the ground and 8 feet from the trunk on a slender limb; at an angle, taken with a compass, of 100°, south of east. This nest was excessively flattened and about 4 inches deep by 16 in diameter, with many green twigs on top. Occupied by a fully grown female without sign of having suckled young, which when released ran off over the surface of the ground without attempting to enter the numerous holes and crannies beneath fallen logs.

Nest No. 2.—In an 8-inch Douglas fir 30 feet from the ground and 4 feet from the trunk. It was at an angle of 230°, southwest from the trunk, upon a slender branch midway toward another somewhat smaller fir. The nest was fairly new and loosely put together; consequently, entry was possible almost anywhere and the passages were difficult to define. There was a great quantity of green twigs on the nest and a wad of them pulled into the burrow from

[2] All botanical identifications have been kindly furnished by Mrs. H. E. Wilder.

the top toward the center. The whole mass was about 8 inches deep by 10 in diameter, and far down was the true nest chamber, in which was a single young about 3 days old. Female not seen until it had left the nest. When released upon the tree trunk it ran half way to the nest, crossed over to the next tree, then back at a level above the nest, and off out of sight.

Nest No. 3.—This nest could not be reached but was investigated by poking it with a pole from beneath. It was 14 feet above the ground in a 12-inch Douglas fir on the hillside, and 15 feet from the trunk, at an angle of 140°, southeast. This was a medium-sized nest, about 6 inches deep and 10 by 12 in diameter, with green twigs on top. There was much débris under it, indicating that it had been at least partially destroyed and then rebuilt. The mouse, which must have been a female, judging from the size of the nest, ran out and then up through the foliage.

Nest No. 4.—Situated with the two following nests in a large, 2-foot Douglas fir (see pls. 5 and 6), 10 feet above the ground and 14 feet from the trunk, at an angle of 180°, south. This was a large nest and rather new, 8 inches deep and 12 by 14 in diameter but was unoccupied.

Nest No. 5.—In the same tree with Nos. 4 and 6, 50 feet above the ground and 15 from the trunk, at an angle of 20°, east of north. This was a small nest, looking much like that of a male, but unoccupied.

Nest No. 6.—In the same tree with the last two, 25 feet above the ground and 12 from the trunk, at an angle of 160°, east of south. This was rather large, perhaps 12 inches in diameter, with many green twigs on top, but nothing appeared when it was shaken to pieces.

Nest No. 7.—In a grand fir about 2 feet in diameter, 35 feet above the ground and 15 from the trunk, at an angle of 240°, south of west. This was a medium-sized nest, apparently with green twigs upon it, but inaccessible. There was communication only with surrounding hazel and spiraea brush.

Nest No. 8.—In the same tree as No. 7, 50 feet above the ground and 15 from the trunk, at an angle of 190°, south. Slightly smaller than No. 7, and also inaccessible, but with many green twigs on the ground beneath.

Nest No. 9.—In a 2-foot Douglas fir, 40 feet up and 20 from the trunk, at an angle of 40°, northeast. A medium-sized nest, 10 or 12 inches in diameter, but old and abandoned.

Nest No. 10.—In the same tree as No. 9, 35 feet above the ground and 15 feet out on a limb, at an angle of 200°, west of south. This was a medium to large nest, a foot or more in diameter, with plenty of green twigs on top. No mouse appeared, however, when it was shaken down.

Nest No. 11.—In a 14-inch Douglas fir, 50 feet above the ground and 5 from the trunk, at an angle of 330°, north of northwest; 4 inches deep and 10 by 15 inches in diameter. It was in a thick bunch of twigs and very shallow, with the nest chamber barely covered, but well protected above by live twigs. Occupied by an adult female.

Nest No. 12.—In a grand fir 2 feet in diameter, about 45 feet above the ground and 3 from the trunk, at an angle of 290°, north of west. The nest was a few inches from a 3-inch limb, between a flat piece of dense, live, parasitic growth above and a dead platform of the same below. It was exceedingly flat, being 3 inches deep and 10 by 12 in diameter. Occupied by an adult female.

Nest No. 13.—In a 2-foot grand fir about 45 feet up at an angle of 140°, southeast, not more than 20 feet from, and precisely on the same level with, nest No. 12. At about 38 feet from the ground the old trunk had been severed 10 years before in order to make it more branching, and the nest was a foot from the several small shoots resulting. It was a mere platform, slightly cupped, 1½ inches deep and 4 by 5 in diameter, unroofed but well sheltered immediately above by a dense little cluster of twigs. When the writer was yet 3 feet away the mouse sprang into space and descended without having its fall broken by intervening twigs. It was lying perfectly still when picked up, but fully recovered in a few seconds. It proved to be an adult female with signs of having suckled young. Its nest must have been temporary, and was surprisingly small for an adult female; but it could hardly have been the beginning of a family nest, for there was not sufficient foundation for the support of one.

Nest No. 14.—In a grand fir 10 inches thick but only 30 feet high because the top was once cut off. This operation has been followed by the usual concentric new growth and little platform, upon which was the nest, 20 feet above the ground. It was a large, family affair, 10 inches deep and 12 by 14 inches in diameter, and comparatively new, with an unusual number of

stripped twigs entering into its composition.[3] There was communication only with low hazel brush on two sides, thence to a small redwood and a grand fir; but this whole clump is well segregated from the nearest brush 25 feet across a road, and an animal reaching it would have to travel over bare ground for at least that distance.

Nests a, b, and c.—These were in a large Douglas fir well segregated from surrounding growth because of the great height of the limbs. The three nests, or what appeared from the ground to be nests, were at heights ranging from 60 to 100 feet or more. Numerous twig cuttings on the ground beneath made it certain that this tree was inhabited by at least one mouse, and possibly more.

Nest d.—This was the remains, 10 feet up in a small Douglas fir, of a very old and very large nest which Wilder says was inhabited several years ago; but when observed it was merely a substantial platform of punk and fine débris with a few twigs intermingled, the whole about 12 by 15 inches in diameter and 3 or 4 inches deep.

It can not be said that every nest within the area surveyed was discovered and studied. It is certain that a number in the largest trees escaped observation, and it is extremely probable—indeed, practically certain—that several nests situated even at moderate heights did also, especially the smaller ones of males. It would not be at all surprising if these undiscovered nests should constitute 40 per cent of the total within the area and if the tree-mouse population should be nearly double that indicated by the investigations.

Construction and Site of Nests

The average measurements of the 15 nests dissected were as follows: Height above ground, 31 feet; distance out from trunk, 9 feet, at an angle of 169°, barely east of south. It is believed, however, that this evidence of the propensity of tree mice to construct nests on the south sides of trees should not be accepted without reservation until substantiated by observations in other districts. It is fully as likely that the southern aspect was selected merely because that happened to be the downhill side as for any other reason. Similarly, no preference seems to have been shown as regards open or densely shaded situations, sites evidently having been chosen at random or with a view to obtaining the most suitable foundation.

Only two of the nests dissected were placed against the trunks of trees, the remainder being at varying distances away. The majority of the nests discovered by Taylor in Mendocino County were situated immediately adjacent to the trunks, as also were those found by Shelton in Oregon (Taylor, 1915b, p. 145), but these were built chiefly upon old squirrel nests, so that the situation had to a considerable extent already been chosen for the mice.

In the Carlotta district typical family nests were about 12 inches in diameter by 9 in depth, while the arboreal nests of the males and subadult females were smaller. Rarely were they larger, the most bulky one which the writer has seen being hardly twice that mass; but Taylor states that nests observed by his Museum of Vertebrate Zoology party varied in dimensions from about 18 inches in length, breadth, and height, to 3 feet in the horizontal diameter and 2 or 3 feet in the vertical. Evidently, in districts in which such enormous

[3] In January, 1924, Wilder discovered the small, inconspicuous nest of a male well out toward the end of a limb on this tree. It may or may not have been there during the visit of the writer.

structures occur certain conditions are more favorable for the long occupancy of a nest than about Carlotta. As long as a nest is undisturbed it will naturally grow in size because of the daily accumulation of food refuse. If it does not increase to considerable dimensions, it is either because the mice object to nests of such size and abandon them after they reach a certain stage, or else because some agency that may be classed as an enemy destroys the nests before these have time to grow to great size.

Arboreal nests may be placed at any height above the ground and in trees of any size. Wilder has found two nests—of both male and female—a few feet above the ground in fir saplings well segregated from other trees, and in larger growth they occur up to a great height.

Nests of the tree mice in the Carlotta district are normally constructed entirely by the animals themselves, and consist only of the discarded portion of the fir needles used for food, among which may occur a few of the stripped twigs from which the needles were obtained. Very rarely one may find that a mouse has utilized as the foundation of a nest a chance accumulation of fallen twigs and rubbish which has lodged in a favorable situation, or a clump of parasitic growth may be similarly employed.

Indications were found farther east along the Van Duzen River, where squirrels (*Sciurus*) are more plentiful, that the abandoned nests of these rodents are occasionally used as a scaffolding on which homes of the tree mice are constructed. Taylor (1915b, p. 146) records that near the Hearst and Lierly ranch, Mendocino County, Calif., all nests of the tree mice were in old homes of gray squirrels and that some were of large proportions. Undoubtedly the nests of the larger animals had first been abandoned and then were readily appropriated as foundations on which the more specialized homes of the mice were erected. This indicates that the tree mice are ready to adapt themselves to circumstances to some extent, and that they may build upon anything that offers suitable foundation; but it is not unlikely that they are very slow to adopt any such innovation.

Of the 15 nesting sites studied in detail, 9 were in Douglas and 6 in grand firs, the former evidently being more often favored where they are equally abundant; but preference probably varies to some extent according to locality. Clay has taken several nests in Sitka spruces (*Picea sitchensis*) (Taylor, 1915b, p. 140), but this experience seems to be unique among observers, and it is not known to what extent this tree is so utilized. He has stated in a letter that these nest trees were situated close to Douglas firs and it may well be that the mice did not use the spruces as food. In a letter to the Biological Survey he has also stated that he observed nests in both myrtle and redwood trees, but it is probable that in these cases conditions were similar to the single instance observed by Wilder of a nest in a small redwood, the branches of which interlaced with those of a fir. The latter undoubtedly furnished the food supply.

Nests sometimes appear unexpectedly in situations where there were none before, according to Wilder, so that old material must at times be utilized in the construction of a new home. In fact, this must be the usual procedure when it is at all possible, for it would take several days for sufficient fresh refuse to accumulate from an animal's

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FIG. 1.—FEMALE RED TREE MOUSE AT NEST

The nest, No. 4 in the tree in Plate 5, was partly dissected

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FIG. 2.—FEMALE RED TREE MOUSE IN FIR TREE

Photographed on drooping limb of Douglas fir, near Carlotta, Calif.

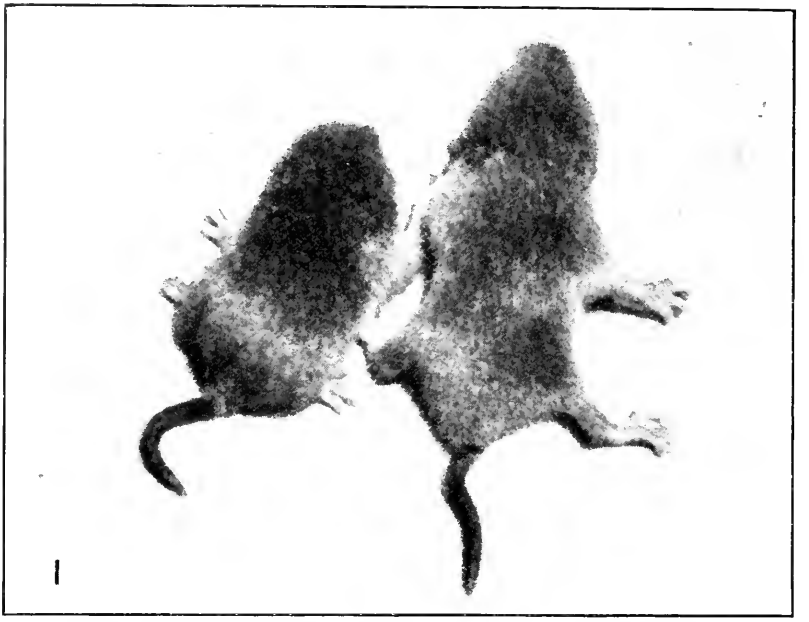

FIG. 1.—YOUNG OF RED TREE MOUSE, ABOUT 18 DAYS OLD

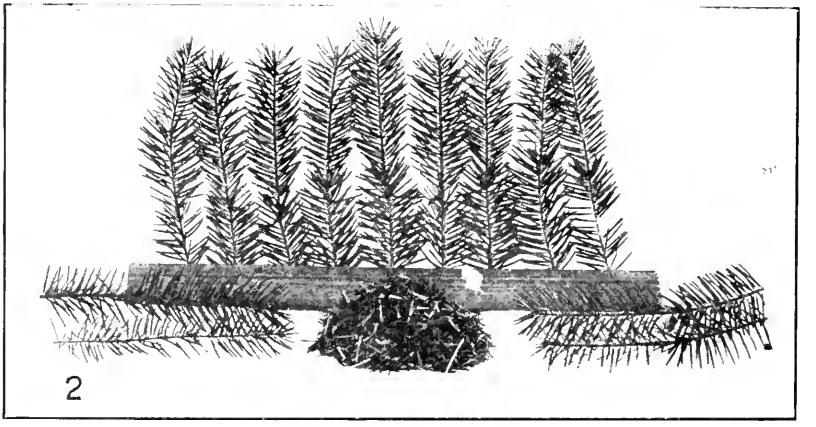

FIG. 2.—DAY'S FOOD OF ONE RED TREE MOUSE

Twigs of Douglas fir aggregating 70 inches and weighing 19 grams, and beneath them a pile of needles weighing 7.9 grams, stripped from 70 inches of similar twigs by one individual in 24 hours

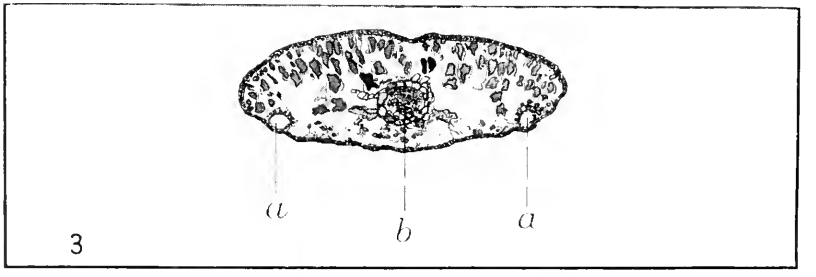

FIG. 3.—CROSS SECTION OF FIR NEEDLE

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From Douglas fir (*Pseudotsuga taxifolia*); greatly magnified. *a*, Lateral resin ducts; *b*, vascular bundles

food to afford it protection and shelter. It may then be assumed that after a site has been selected, material from some abandoned structure is transported in the mouth, as the writer has often observed captives do, and a small platform of this is deposited. As this grows to sufficient size the animal scratches surplus material upward on all sides, until finally, by twisting the body first to one side and then the other and scratching above the head, a roof is formed. The further construction of a larger home is merely incidental to this. There is no definite plan—no interweaving of twigs, nor even so much uniformity as is often to be found in other mammalian tree nests—apparently nothing but a haphazard dropping of nesting material in all directions, and a pushing and pulling to fill up vacant spaces.

In the usual nest, at least during the drier months, the nest chamber proper is near the top, and rises as the whole structure increases in height and the floor is elevated by the gradual addition of a part of the daily food refuse. Such a nest chamber, with its slight covering, will be placed beneath any available shelter, as a limb or dense little cluster of twigs. In some cases this chamber is buried deep in the whole mass, probably by the occupant's dropping food refuse upon the top.

In structures of sufficient size there is, in addition to the nest proper, a second small chamber used for excretory purposes. It can not be stated at just what stage this is added, but from the actions of captive animals it would seem that when the nest is of sufficient size, the original chamber is often used for depositing the feces and that new sleeping quarters are formed. During prolonged rains the animals undoubtedly seek the lowest, driest parts of the nests.

In the matter of passages, as in other respects, the nests seem to follow no fixed plan, but the runways are formed or abandoned, especially in loosely built structures, as the animal desires. There is practically always an exit immediately above for easy access to the diurnal food pile, and another at an inconspicuous point of egress, as directly beneath a small, protruding branch. The degree of compactness of a nest depends partly upon whether it is new or old, and probably to a great extent upon whether its basic structure has recently been altered by the mouse or some extraneous agent.

There may be many exceptions to the rule, but in the writer's experience the large nests and those of medium size belong to females, whereas the arboreal nests of the males are more likely to be small, often only a ball of material little larger than one's fist. Furthermore, in addition to being less conspicuous on account of size, the nests of males are usually better hidden—either higher, in the tops of the trees, or farther out upon the limbs.

In pulling nests to pieces one may often note small insects crawling about in profusion, which the uninitiated are inclined to pronounce parasitic. These, according to H. E. Ewing, of the Bureau of Entomology, are the young of one of the species of millipeds belonging to the group that is scaly and hairy. He states that these are often found in the nests of mice and in other places where there is fecal and decaying vegetable matter; hence, they are not parasites of the

mice. The writer has noted mites, but no fleas, on mice previously collected, but unfortunately none of these were preserved and his captive specimens are apparently free from them.

YOUNG

The young (pl. 7, fig. 1) are probably brought forth practically throughout the year. Wilder has often found them in the nests during January and February; but they are perhaps more common in spring, summer, and early fall. The average number to a litter is two, although there are often one or three, and they are naked, blind, and helpless at birth, as one would expect.

Repeated efforts to ascertain the length of the gestation period thus far have been unsuccessful. After trying in vain to breed two females that were reared in captivity, the writer left them permanently with the male on February 13. Some six weeks later, or 10 days before a family of young appeared, the gravid condition of one female was plainly apparent and this one was then segregated from the others. A few days later it was noted that her nest was growing in size, until finally it was more than twice as large as the single nest shared by the male and the other female.

On April 7, when the female was at the approximate age of 8⅓ months, two young were born. An endeavor was made to breed the dam on the day following, and weekly thereafter, but unsuccessfully. When the pair was placed together in a fresh cage the female was totally indifferent to the decided attentions of the male; but when either the male or the other female was introduced into the cage with the young—even when these were a month old—the mother viciously attacked the intruder and speedy interference was necessary.

At birth the young were indistinguishable from newly born meadow mice. Four days later there was a distinct suggestion of fuzz all over their bodies and the tails were conspicuously blackish. By the fifteenth day they were completely clothed in a short coat of the usual coloration. On this date the female inflicted on the writer her first severe bite, drawing blood from the finger, and thereafter was so belligerent whenever the nest was invaded that no more chances were taken, but she was poked away from the young with the aid of a pencil whenever it was desired to examine them. What scant hair is present upon the tail is ochraceous—it is the skin of the tail that is black. There are also dusky areas of skin upon the naked ears, the entire hind feet, and about the ankles of the forefeet.

Until 2 weeks of age the young were usually firmly attached to the nipples of the dam whenever they were disturbed, and so tenaciously did they retain their grip that it was with a deal of trouble that they could be detached. They dragged along after the female when she ran about the cage endeavoring to elude capture, and if one of them were lifted, it would pull the female along with it while she kicked about, and she could break loose only by grabbing something stationary with her forefeet and pulling vigorously. After the age of 2 weeks the young relinquished this habit.

During the nestling stage it was noted that these mice have a strong propensity to remain where placed. They will crawl about over one's hand after the eyes have opened, and at this stage their clinging ability develops rapidly, but until well grown they are willing to sit quietly in the pan of the balance while being weighed. None were detected leaving the nest until they were 29 days old, although they could have accomplished this feat merely by crawling over a wire partition 1 inch high. All this is in marked contrast with the actions of the young of *Peromyscus*, which develop decided restlessness, at least when disturbed, well before the eyes have opened.

That sedentary habits in the young of *Phenacomys* are of advantage to the species is easily understood, and this has undoubtedly been developed by its arboreal habitat. If they were prone to become agile and inquisitive at an early age, large numbers would most assuredly meet with disaster by falling from the nests.

On the assumption that the mice were born April 7, although it is possible that they may have put in an appearance late the previous evening, the eyes had fully opened at the age of 19 days, on April 26. The writer is familiar with the timed stages of growth of very few small mammals, but the length of the sightless period in this species seems to be remarkable. Young meadow mice, for instance, are able to shift for themselves at less than 3 weeks of age, and even such a large mammal as the domestic rabbit is more precocious as regards duration of the period of sightlessness, although the latter case is not strictly comparable.

An attempt was made to weigh the young mice every second day at the same hour, but continuity was unavoidably interrupted on one occasion for three days. There was no means of distinguishing between the two individuals, nor could their sex be determined. In fact, one can hardly be positive regarding sex until an individual has passed the juvenile stage. At all ages the males are far less developed sexually than in *Microtus*, and it is even very often difficult to be positive of the sex of an adult at first glance.

TABLE 1.—*Increasing weights, in grams, from date of birth of two juveniles of* Phenacomys longicaudus, *born in captivity*

Date	Weights		Date	Weights	
	No. 1	No. 2		No. 1	No. 2
Apr. 7	3.1	3.1	Apr. 24	6.4	6.5
Apr. 9	3.1	3.4	Apr. 26	7.0	7.0
Apr. 11	3.1	3.2	Apr. 28	7.4	7.4
Apr. 15	4.1	4.6	Apr. 30	8.2	8.7
Apr. 16	4.5	4.8	May 2	9.2	9.7
Apr. 18	5.0	5.3	May 4	10.5	10.7
Apr. 20	5.4	5.5	May 6	11.2	11.5
Apr. 22	6.1	6.2			

It is seen from the data in Table 1 that the young mice did not double their natal weights until 16 days old, nor triple these weights until more than 25 days old. After three weeks the gain was rapid, and this fact suggests that this was perhaps the time when they began eating an appreciable quantity of solid food from

the needles kept on or in the nest by the parent. At the age of 27 days there occurred a sudden change in the attitude of these youngsters, for they then refused to remain in one place but would scramble out of the pan of the balance, out of a cardboard box with sides 2 inches high, and would even leap to the floor and make off with almost the agility and speed of an adult. They were not detected out of the nest, however, until the 29th day, although they may well have ventured on short excursions earlier. At this age they at once began spending much time out of the nest, and ate fir needles freely.

The conclusion reached from observation of the growth of the young is that development is remarkably slow, a state of affairs doubtless brought about by habits that are largely arboreal.

On one occasion in one nest were a single juvenile about 3 weeks old and another immature mouse, perhaps two-thirds grown. The latter had nonfunctional mammary glands and was too undeveloped to have borne young at any rate. This is the only certain evidence at hand that one litter may remain with the adult female until after another has arrived. In this case it was probably a state of affairs tolerated by the mother only because both litters were small and hence did not crowd the nest. Young larger than about half grown are seldom found with an adult female; but there are no data at hand regarding the movements of immatures immediately after they abandon the maternal abode. The possibility must be considered, however, that they then live a partly terrestrial existence, as seems to be the case with adult males, until the approach of sexual maturity urges the females into the trees.

No other microtine is known to have litters of such small size, and this is a further indication that the adverse life conditions encountered by the species are not severe. Although more than one family of young a year is probably the rule, these undoubtedly appear with far less frequency than is the case with meadow mice.

FOOD

Although *Phenacomys longicaudus* is not highly specialized in structure it is exceedingly so in habits. The normal food apparently consists solely of the fleshy part of the needles and the bark from the tenderest growth of the twigs of fir trees, and in captivity it will accept no items other than coniferous even though reduced to dire straits of hunger. Experiments with various fare, including cereals, fruits, vegetables, grasses, and twigs of deciduous trees and of redwood, failed to show that any of these was sampled or even noticed.

The mouse's manner of obtaining food is to cut from the tree tender, terminal twigs 3 to 8 inches long. Some of these are inadvertently dropped to the ground, many are probably eaten upon the spot, and some are carried to the nest, if near by, for more leisurely consumption. A supply is kept on top of the nest as a diurnal larder, and the refuse from it constitutes the building material. There is no unnecessary waste in eating, and every needle is eaten from a twig one after another, no portion being dropped until the edible part is consumed.

The mouse ordinarily approaches a twig, already cut, and bites off a needle at the very base. Occasionally with one foot, but more

often with two, it grasps the needle as we would an ear of corn. Sometimes this is run between the lips with a single motion so rapidly as to defy analysis of the movements. Again, more leisurely tactics are employed and one may clearly note the animal neatly split off one side of the needle and eat the smaller portion from one "hand," while holding the remainder with the other. The "midrib" is then split off and discarded, and the remainder quickly consumed. Thus, from each needle there is discarded a medullary core in the form of a slender, greenish thread, and it is of these that the nests are wholly composed. Taylor (1915b) states that "all the fleshy substance of the needle including the vascular bundles is eaten away by the tree mouse, the only portions left being the two resin ducts which traverse the entire length of each needle." Such may possibly be the case at times or with certain mice, but the writer's investigations of the subject, including microscopical examinations of cross sections of the needles and of a reasonable quantity of the threadlike refuse, cleanly indicate that the lateral resin ducts (*a*, in pl. 7, fig. 3) are eaten with the remainder of the fleshy portion, and that the tougher, central, vascular bundles (*b*), together with a small but varying quantity of surrounding tissue, constitute the portion discarded.

A great deal of this provender is consumed, probably because it is rather low in nutrient value. For the same reason, digestion must be rapid in order to care for the quantity. Food is invariably available within a few inches, or at most a few feet, of the arboreal nests of the mice. Like all mammals whose food is always to be had in quantity, they have lost all ability to withstand hunger and will exhibit signs of distress within an hour or two after having been deprived of food. It is for this reason that a supply of twigs is piled upon the nest each night, so that the inmate shall not want for food during the ensuing day.

The writer has ascertained, by an exact arrangement of twigs upon a nest during the morning and subsequent examinations throughout the day, that the mice draw from their supply at frequent intervals, pulling the twigs down into the nest one by one as desired. The quantity so stored varies from 3 or 4 to 12 or 15 twigs, and they are either piled in haphazard fashion upon the nest, as is usual, or a part of them, in a tight little bundle, is pulled within one of the entrances. Very rarely are any of these twigs wilted to the slightest degree, and as a surplus above the needs of the animal must often be gathered, all but the freshest twigs must be dropped from the nest.

The following feeding experiments were conducted with a subadult female about four-fifths grown and weighing 20 grams, selected in preference to older subjects because she was by all odds superior in tractability and because the only other fully adult animal available at the time was with a litter of young:

Three terminal twigs were selected, each 6 inches long, from a large branch of a Douglas fir, and a count made of the needles upon them. The results were 209, 213, and 218, for which a conservative average of 210 is taken. It is important here to note that the number of needles upon such a twig varies widely for different trees, and according to the light received by the portion of the tree from which taken. All twigs used in these experiments were from

the same part of this one fir and were strictly comparable in condition and size. The method followed was to remove all food from the cage and then to introduce fresh twigs of an aggregate number of inches, carefully measured. After a certain number of hours the quantity remaining was measured and discarded, and a fresh supply of measured twigs introduced. Tests were made upon this individual, then and subsequently in good health, for two successive periods of 24 hours each, with the results given in Table 2.

TABLE 2.—*Lengths, in inches, of twigs of Douglas fir* (Pseudotsuga taxifolia) *consumed by one red tree mouse in comparable periods of successive days*

Period	First day	Second day
	Inches	*Inches*
12 m. to 6 p. m.	15.75	17.25
6 p. m. to 6 a. m.	34.00	40.00
6 a. m. to 12 m.	16.25	13.50
Total (24 hours)	66.00	70.75

Of the first lot, 52 per cent, and of the second, 57 per cent of the totals was eaten from 6 p. m. to 6 a. m., and at least some of this slight disparity is probably due to the fact that as the animals take nearly all of their exercise during the hours of darkness, they would then be more voracious. A total of 66 inches of these twigs supports about 2,310 needles, weighing 17.5 grams; and of 70.75 inches, 2,476 needles, weighing 19 grams (see pl. 7, fig. 2). It is thus seen that a subadult mouse eats about 100 fir needles an hour, day and night. In the case of an old female with a family, this number must be augmented considerably. The fresh food refuse could not be weighed, for it is indistinguishable from the older, more desiccated material of which the nest is formed, and if deprived of a nest the mouse would soon have fretted itself to death. It is believed, however, that the weight of this refuse is fully offset by the quantity of bark eaten from the twig tips, of which no account was taken during the investigation. Hence, it seems probable that the normal tree mouse will consume about nine-tenths of its weight in food every 24 hours. For the sake of comparison, it may be well to mention that a larger animal—an apparently full-grown male—after having been in captivity for several weeks, weighed 27 grams. Additional weights of animals fully grown at the time of capture are not available.

Three adult or subadult mice, which the writer kept in captivity for some time, showed a marked preference for needles of Douglas fir to those of grand fir. Tests were made by placing equal portions of twigs of the two species with an animal, and invariably the Douglas fir was consumed practically completely before the other would be more than nibbled; but the grand fir would then be eaten readily. This preference was really so marked that it was greatly puzzling, for individuals were found in segregated grand firs that could obtain other provender only by crossing open patches of ground, and grand-fir twigs were found upon the nests. The writer is therefore forced to accept the hypothesis, since substantiated

through experiments with captive mice, that the tastes of individual mice differ to some extent, and that all those kept alive in captivity happened to prefer the Douglas-fir needles.

Clay (Taylor, 1915b, p. 145) took several mice from nests in Sitka spruces, as previously mentioned, and states that these trees were so close to Douglas firs that the food supply may have been obtained from the latter. The mice may or may not have been feeding on spruce needles.

Clay (Taylor, 1915b, p. 145) also found, near Maplecreek, Humboldt County, certain trees that had bushed out as if the tops had previously been killed, and that invariably contained the nest of a tree mouse and furrowlike marks at the points of damage, a condition inferred to have been caused by *Phenacomys*. Careful search was made for any such condition near Carlotta, and although two nests were located at points where the tops of the trees had long since been broken in some manner, and new leaders had consequently started, no sign was found of recent injury to the bark. There is a possibility that the damage discovered by Clay was caused by gray squirrels or rodents other than the mice, yet it seems not unlikely that the mice of that particular area may have developed a preference for feeding largely on bark.

That such change in diet may be brought about seems to be proved by captive tree mice which the writer has had in southern California. At first, clippings from every available species of conifer grown in Pasadena as ornamentals were offered to them, including 3 species of pine, 2 of spruce, 1 fir, 3 of cypress, a redwood, and several cedars. The needles of *Abies nordmanniana*—a native fir of the Caucasus—were eaten sparingly, but seemed not to be greatly relished. All the others were utterly ignored except the deodar (*Cedrus deodara*), and this was adopted as a permanent and exclusive diet, one upon which the mice will evidently thrive indefinitely. Several months subsequently, however, the same mice welcomed twigs from the exotic fir and ate them to a limited extent only in preference to other fare, but they soon grew tired of them and returned to the deodar. The needles of the latter grow in clusters of two dozen. The mice bite off one cluster at a time, and consume several needles and drop the remainder, to which they may or may not return. Hence, there is much waste and it is impossible to estimate the quantity eaten. The needles, unlike those of Douglas fir, have no central vascular bundles, but are roughly circular in transverse section, with succulent medullary tissue and a somewhat more fibrous cortex. There is no part of this discarded, but the mice munch the needles, held often in one paw, as we would stalks of celery. The bark, however, seems to be as much favored as the needles and it is stripped clean even from year-old twigs as large as a pencil. It is loosened chiefly with the teeth, but the forefeet sometimes aid in pulling a section from a twig.

A male which Wilder sent the writer during January would have nothing to do with the deodar, even after it had finally been reduced to sore straits of hunger, and it was necessary for weeks to keep it supplied with twigs of the exotic fir previously mentioned, with the needles of which it seemed well content, though none of the bark was consumed. When these are eaten, the center of the needle

is bitten through, rapidly split the entire length, and the medullary core then skilfully taken from the half to which it was attached. This is dropped and the two remaining sections are munched. Finally, after persistent effort, this mouse became reconciled to the deodar.

After the mice in captivity had thrived for two months upon a diet of deodar, twigs of the big-cone spruce (*Pseudotsuga macrocarpa*) from the San Bernardino Mountains of southern California were offered. They did not prove acceptable as long as deodar was available, but when the latter was removed the spruce needles were at once eaten in the usual manner, while the bark was left untouched. When these facts are taken into consideration, together with the indicated probability that individual wild mice may prefer either Douglas or grand fir, it does not seem at all improbable that the tree mice of certain districts may prove regularly to feed upon bark. The resulting damage, however, is at present entirely too restricted and unimportant to merit economic consideration.

A study of the species at once indicates that the tree mice have no regular water supply, and the trees they inhabit may, in fact, be at any distance from water. That they require very little moisture is indicated by the fact that the quantity of urine voided is very small. Cages in which the animals were kept remained fresh and clean almost indefinitely without being emptied, a state of affairs which would not be possible were *Microtus* the captive, without a liberal supply of some absorbent. In much of the range of the tree mice, heavy fogs are very frequent and the consequent condensation upon the foliage is probably used to some extent at the season when rains do not occur. Such free water does not seem to be absolutely necessary, however, and it is believed that the species can at all times obtain enough water from the succulent new growth of the trees to meet their moderate needs.

Mice kept in captivity by the writer were usually fed perfectly dry twigs, but about once every week these were dipped in water, in case such might be relished. For a long time there was no evidence that this attention was appreciated; but once, during an especially hot spell in September, and on a number of occasions thereafter, an individual was seen to lap a few drops from the needles, and one would occasionally lick a wet finger. The writer did not succeed in getting the mice to drink water from an open container, but taking his cue from seeing them lick wet needles, he contrived a small, inverted bottle from which the mice could get water by lapping at the end of a slender glass tube. To this they had regular though sparing recourse. As no evaporation from this receptacle could take place and there was no waste, the quantity of water used by the mice was readily ascertained, and found to average 6 grams a day for each mouse (for two subadults weighing 17 and 19 grams). This is decidedly less than the similar demands of *Microtus*, as observed in the case of captives.

This evidence substantiates the deductions of Bailey (1923) that some rodents obtain sufficient moisture from their regular food to carry on normal bodily functions without recourse to a supply of free water, but that the same animals may use liberal quantities of water when this is to be had. Nineteen grams of fresh needles from

the exotic fir in Pasadena—probably comparable in texture to those of the Douglas fir—were air-dried for a week and then heated in an oven at a temperature of 250° F. for one hour. They were then found to weigh 8.7 grams. Not all of this loss in weight can be due to evaporation of moisture content, for the volatile oils were also driven off during the heating process. The evidence shows, then, that a nearly full-grown tree mouse probably requires a minimum moisture supply of about 11 grams a day to maintain itself in good health, but that as much as 17 grams a day may be used when available.

The feces were abundant, to conform to the large bulk of food eaten, but rather dry in consistency.

Although the species may eat other substances upon occasion, as insects or seeds, the writer very much doubts that they touch anything under normal conditions other than the needles and tender bark of their favorite trees.

Efforts of the writer to trap these mice have never been successful, with the exception of two individuals caught by setting unbaited mouse traps upon the limbs of trees beneath the nests. As it is probably impossible to offer any bait that would attract the mice, the specimens taken in traps would be merely individuals which happened to run across the trigger.

HABITS

From lack of observation in a number of diverse localities, no statements regarding the preferences of *Phenacomys longicaudus* as to slope exposure can at present carry much weight. As mentioned, the preference within the area studied appears to be for the south side of the tree but this may not apply to other parts of the range. Taylor (1915b) found the mice living in grand firs at Mendocino City; but they have usually been recorded from the Douglas firs.

Among the specimens heretofore collected there is a great preponderance of females, the exact ratio between the sexes being undetermined. Adult males especially are greatly in the minority, and Taylor (1915a, 1915b) is of the opinion that this numerical discrepancy is the actual state of affairs at birth. In perhaps 80 per cent of the microtines which the writer has examined, females have outnumbered males, and it seems certain that any such possible natal difference between the sexes is not substantially greater in the present species than among other forms of this subfamily. One fact accounting for the greater number of females so far captured is that the males often elude the collector, because they seem to be more wary and their arboreal nests are both smaller and better concealed. Another is that the life habits of adult males are apparently radically different from those of adult females.

Startling as this last assertion may seem, recent discoveries by Wilder point to this conclusion. Several years ago he noted a hole near the base of a decayed stump beneath a live fir, and digging into it, discovered a tree mouse in a small nest of the usual composition; but the animal escaped and he was unable to ascertain its sex. He supposed at the time that it had been blown or frightened from the tree above and had sought temporary shelter near the ground. On another occasion he was clearing away débris preparatory to spreading his blankets when a red tree mouse ran from

between his hands. It proved to be a male. He did not know whether it had been beneath the rubbish or had fallen from the trees above.

Late one fall a red mouse took up residence in a woodpile at the foot of a fir tree, and remained there all winter in a nest of ordinary construction. This was also a male, but the writer was unaware until recently of the sex of these specimens captured on the ground. Some time ago Wilder's cat brought in another male. Under different dates he has written that early in February, 1924, "while working back of the barn I noticed the pup digging in some rubbish at the foot of one of the trees where you camped last summer, and soon a red mouse ran out. I caught it—a male." Again, "February 16, while cutting brush out back of the garden I noted our 'mousedale' barking and digging at the base of a fir tree and upon going to him, found that he was following a shallow burrow, like that of a meadow mouse, and he soon dug up the nest of a red mouse—the usual ball of midribs of fir needles. Following the burrow about a foot farther he threw out a fine, big red mouse, a male. It was plain that this mouse was regularly living in the burrow." Under date of March 9, 1924, he wrote, "The dog located a red mouse under the remains of an old rat nest. The pup followed it along a runway in the loose rubbish to a hole under the tree, where he could dig no farther, but was close to the mouse and much excited."

The facts seem to indicate that most males, after attaining sexual maturity, spend the major portion of their time below ground, or at least beneath rubbish, foraging among the branches of the trees at night. At certain times, which probably depend upon sexual impulse, they do construct small, temporary, or arboreal nests.

In hunting for the mice one searches for their nests, which often are visible from the ground, especially when situated in trees of moderate size. Green fir twigs on the nest are a sure sign that mice are in either that tree or an adjoining one, usually in the nest itself, and a further indication of their presence is the finding of a moderate number of short, green twigs on the ground beneath. In the case of lofty or especially dense trees, the presence of such twigs on the ground is of use to the investigator. Of less practical value is the presence of droppings, for the surface is rarely of such nature as to permit these to be found without difficulty. Such evidence is usually present each morning, however, upon table and sleeping bag when one is encamped beneath a tree in which they live.

Any opinion regarding the abundance of tree mice in a given area is little more than a haphazard guess. A densely forested area, of course, could support a greater population than thinly wooded slopes, as at Carlotta. An estimate of the number of tree mice to the acre or square mile would be utterly without value under present circumstances.

One who is familiar with the tree mouse is prone to refer to an aggregation of individuals in any well-defined area as a colony; but the animals really have no colonizing tendency and are not at all sociable in the strict sense of the word. Their gradual dispersal over a territory, usually of limited extent, in which they experience favorable conditions is in such marked contrast to a closely adjacent territory, which may be unsuited for lack of proper trees or some

other reason, that tree-mouse populations seem upon casual examination, to be colonial in character. In reality the mice are of a markedly solitary disposition, the females usually being truculent and intolerant of other individuals.

The only evidence indicating that two adults may occupy the same nest is that offered by Taylor (1915b, p. 153), who states that Clay once caught a female in a nest from which another mouse, assumed to be a male, escaped. As the writer has found a large, immature female, with no signs of having suckled, in the nest with a young mouse, the mother of which undoubtedly had been present but had escaped, he considers that Taylor's example was of this kind and that a female will not tolerate another adult even in the same tree with her, if this be small, except during the mating period. It is probable, however, that large trees may often permanently harbor more than a single individual. At times, which it is thought last only during the breeding period, the small, evidently temporary nest of a male may be found several feet directly above the more substantial family home of its mate, but each animal occupies its respective domicile during the day.

The present species is nocturnal, but has no aversion to moderate light. The urge for eating very frequently necessitates diurnal activity within the nest, and to a certain extent upon it, for captive individuals would habitually crawl upon the pile of food twigs for the purpose of stripping off a supply of fodder at all hours of the day. The writer seriously doubts, however, whether mice if undisturbed ever voluntarily leave the nests during daylight.

A factor that probably largely inhibits diurnal activity is the lack of suitable cover upon the branches. To survive the dangers of foraging by daylight an arboreal rodent would have to be extremely quick and decisive in its actions, which tree mice are not. The most tractable and confiding of the individuals that the writer has kept in captivity was not at all averse at any hour to exercising on its wheel in his presence, in this respect being entirely comparable to the average meadow mouse—an animal normally living amid ample cover and showing a propensity for being fully as diurnal as nocturnal. The average tree mouse, however, is relatively inactive as long as there is light, either natural or artificial, even when raised from birth in captivity.

OTHER BEHAVIOR

As anyone who has kept them in captivity knows, even mice possess individuality to a surprising extent, and it is difficult to predict just what any example will do under a given set of circumstances. Some tree mice will leap into space before the nest is touched, apparently regardless of where they may land; others will tarry until the structure has been half demolished; a few will hide until there remains only a handful of material and one has already pronounced the nest uninhabited. Those individuals which leap boldly from the nest are somewhat in the minority, the remainder preferring to slip out and away at the most unexpected time and spot, run or leap a short distance and then remain motionless upon the chance of escaping observation. At this method of escape the mice are experts, and

if more than an occasional specimen is to be secured it is necessary to have a companion on the ground beneath.

Having sprung to a slender dead twig several feet below the nest, the animal will usually remain motionless for a few moments. On being approached it will teeter and balance, endeavoring to crawl to an adjoining twig several feet below, which it will perhaps clutch with a single foot. If it has the chance to get among the denser needle growth, it will try to escape through this; but if jarred to the ground it will make off at a poor gait, which enables one to catch it with ease.

Some individuals will not bite even while being seized, whereas others, especially males and old females, may struggle and are very ready to nip the captor. After being "cuddled" in the hands for a few moments some will quiet down and run over one's arms without making any determined efforts at escape, while others leap to the ground repeatedly.

Some will run over the surface of the ground, taking no notice of holes beneath logs and rubbish; others slip into the first cranny they come upon. When placed upon the trunk of a tree they "shin" or hitch themselves upward as would a boy, often making not more than a couple of feet in three seconds, with frequent short pauses for a look about.

Although tree mice are gifted with a certain sort of acrobatic agility, one is continually impressed with their slowness, clumsiness, and apparent helplessness, and feels that the average white-footed mouse (*Peromyscus*) or chipmunk (*Eutamias*) would be far quicker and more agile in any situation except upon the slenderest twigs. The chief ground on which to attribute to *Phenacomys* an arboreal expertness seems to be its cautiousness and the sure-footed manner with which it grasps with widespread toes all objects. One really can not escape the conviction that the species has survived, not because of equipment that is efficient for coping with its environment, but rather for the reason that it has occupied a habitat in which it encounters little competition, and hence, that it has been enabled to survive even while its agility and speed have not improved.

It is certain that even the females descend to the ground upon occasion, but it is doubtful whether the average individual of this sex does so very often.

So far as the writer is aware, no other naturalist has succeeded in keeping *Phenacomys longicaudus* long in captivity. In all other attempts, including his own early ones, the animals died within a day or two. It is thought that this has been due to intolerance of the species for all conditions except such as closely approximate those to which it is accustomed, and to misguided efforts of the captors to furnish warm nests of cotton. If the regular nesting material be withheld, especially in new and strange surroundings, the mice soon fret themselves to death. If, however, the mice be supplied with an abundance of their usual nesting material and of their natural food, it is easy to maintain them in a captive state. After having become accustomed to confinement they are somewhat more tolerant of any irregularity.

Most individuals are content to remain relatively quiet during the day, but their periods of sleep are of short duration and they fre-

quently climb among and feed upon the twigs constituting the food supply. The smaller twigs are bitten off, carried to the nest, and there stripped of bark. The nest, in a wire pocket in one corner of the cage, is not usually arched over but is left open, provided that it is shielded in some way a few inches above from a too direct view of persons moving about the room. The animals sleep after the usual rodent mode—squatted upon the hind feet with the head tucked between the toes; but they are quick to awaken, and resent the close approach of a peering face, pulling the loose needles up over their sides and backs.

If there is no revolving wheel in the cage the mice spend a large portion of the night in scrambling about, upside down, on the upper side of the wire cover to the cage, and it is while thus engaged that their special kind of agility is displayed to best advantage. Though not particularly quick, they will then turn and twist in a variety of intricate evolutions, "skinning the cat" suspended by the hind feet, twirling about suspended by a single leg, and performing many other feats. Such play is apparently abandoned entirely when a revolving wheel is given them. The mice will discover the purpose of this after a very few minutes of investigation, and thereafter, during the hours of darkness, the slight noise of the twirling wheel will be almost incessant. In fact, there is nothing capricious about this form of exercise, and it is often sustained without pause for such a length of time that one is forced to the conclusion that in nature tree mice are more wide ranging and active during the hours of darkness than one would give them credit for judging by other criteria.

One of the twin females that the writer raised from birth took weeks to get over the habit of leaping from his hand every time it was picked up; the other would invariably slightly nip a finger whenever it was poked into the nest. The latter trait is rather common, captive individuals usually showing resentment of an intrusion of the nest either in this manner or by rapidly pushing against the offending finger with the forefeet. At times a mouse will begin assiduously licking one's hand in a very droll manner, the attraction possibly being a slight taste of saltiness.

ENEMIES

Enemies of tree mice may be considered to include adverse climatic conditions. Some of these conditions are very difficult to interpret, for there may be several critical factors which can not be known. Thus, we do not know why the coastal region of Washington, apparently eminently suitable, is entirely uninhabited by the species, although we can readily understand that the winter cold of a higher altitude and a greater distance from the sea might prevent it from having taken up a residence in the extensive forests of the more mountainous regions of the Pacific Coast States.

It is probable that any normal dry cold experienced within the habitat of the species is readily endured, and captive individuals apparently do not suffer during rather high summer temperatures; but it is not unlikely that there is considerable discomfort, and very possibly some mortality, at least among the younger animals, during the severe rainstorms of the winter months. The nests are often so

shallow, exposed, and pervious to a soaking rain as to indicate that a hard winter storm might reduce half the tree-mouse population to a state of dripping misery; but the writer has had no experience with them at that season. In the experience of Wilder, the lower parts of the nests usually remain snug and fairly dry, and he has found only one individual that appeared disturbed by a sodden condition of its home.

There is comparatively little evidence of the depredations of active enemies among tree mice. The marten is apparently absent from the territory inhabited by them, else the mice would quickly be exterminated, and this carnivore may very well constitute one reason why the range of the *Phenacomys* is not extended in certain directions. It is logical to assume that raccoons must occasionally blunder upon a nest, and bobcats possibly destroy many mice when other food is scarce; but the species has no other mammalian enemies of which the writer knows.

Raptorial birds must be the chief active enemy with which tree mice have to contend. Hawks can not do them much damage; but owls, especially the screech owl, would be attracted by the mice foraging among the foliage of a tree. Fortunately for the mice, these little owls are not particularly abundant. Whether they have learned to pull a nest to pieces after seeing the fleeing owner escape into it remains for some other investigator to discover.

The sudden disappearance of a nest long established and the equally sudden appearance of a nest in another portion of the same tree or in an adjacent one for a long time puzzled Wilder. One day, however, while he was standing beneath a tree, bits of nest came falling about him, and looking up, he discovered a crested jay (*Cyanocitta*) busily engaged in demolishing the home of a tree mouse. He has since learned that this is a regular procedure and that while one jay is thus engaged in the tree above, a companion will often remain on the ground beneath carefully searching the falling débris for young mice. This must constitute a real drain upon the *Phenacomys* population, and perhaps the jay is the most serious enemy of the tree mice, especially during years which are unfavorable for the production of other food for the jay, and this bird might well prove to be the critical factor operating for the extermination of the mice over certain areas.

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