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SYSTEMATIC RESULTS OF THE STUDY OF NORTH AMERICAN LAND MAMMALS TO THE CLOSE OF THE YEAR 1900.

By Gerrit S. Miller, Jr., and James A. G. Rehn.

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No. 1.— SYSTEMATIC RESULTS OF THE STUDY OF NORTH AMERICAN LAND MAMMALS TO THE CLOSE OF THE YEAR 1900.

BY GERRIT S. MILLER, JR., AND JAMES A. G. REHN.

THREE distinct phases or periods may be distinguished in the recent history of the study of North American mammals. The first was characterized by scanty material for investigation, and by the prevalence of the conception of fixity of species. Under these conditions it was inevitable that variation should have been ignored or at least thoroughly misunderstood, and that a large number of species should have been described. The close of this period may be placed at about the years 1860 to 1865. The next phase came as the result of the accumulation of more extensive though still inadequate material and the abandonment of the idea of fixity of species. It was naturally a period of sweeping reductions. Variation had been discovered and was henceforth to be the chief object of study; but its extent and limits were still vaguely outlined, and the important distinctions between the different kinds of variation had not been made. This period continued until the year 1889. The existing phase is the direct outgrowth of the last, and represents no new conceptions or tendencies such as distinguished the latter from its predecessor. But, chiefly through the acquirement of vastly more extensive series of specimens than have ever before been brought together, the distinction between geographic variation and individual variation has been made. This is the essential characteristic of the period. The effects of this distinction are more far-reaching than might at first be expected, for instead of continued reduction in the recognized number of North American mammals, it has brought an almost bewildering increase.[1]

The present paper is intended to summarize the systematic results

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[1] The number of North American land mammals known in 1885 was 363. About 1450 are now recognized. While it is certain that some of these will eventually prove to have been established on insufficient characters, there can be no doubt that the number to be eliminated is an insignificant fraction of the whole, a quantity that may be ignored in view of the equally certain further increase that will take place before the fauna of North America is completely known.

of the study of North American land mammals to the close of the year 1900, and to furnish an index to the literature of the subject for the past fifteen years. It is not an expression of individual opinion; and no revisionary work has entered into its preparation. North America, as here understood, is the entire American continent north of a line drawn across the Isthmus of Panama from Colon to the City of Panama, together with Greenland, and those islands of the West Indies the fauna of which is not purely South American in its affinities.

In 1885[1] Mr. F. W. True published 'A provisional list of the mammals of North and Central America and the West Indian Islands,' a summary of the North American mammal fauna as then known. To the species included in it are here added those since recognized, the status of which at the end of the year 1900 had not been questioned in some recent work of definite monographic character, where full synonymy and references may readily be consulted. Forms in regard to whose standing there is difference of opinion, but which have not been treated in such a monographic paper, are included; but in cases of this kind references are given to the conflicting views. The sequence of groups is essentially that of Trouessart's 'Catalogus mammalium tam viventium quam fossilium' (Berlin, 1897–1899) with the order reversed to conform with the prevalent opinion that enumeration should begin with the more generalized types rather than with the more specialized. The arrangement of species is alphabetic except in the case of genera that have been recently monographed; here the sequence adopted by the reviser is followed, and any additions made subsequently to the publication of the revision are entered in accordance with their supposed affinities. Under every species and subspecies reference is made to the first publication of the specific or subspecific name. To this, when necessary, is added (a) reference to first use of current binomial or trinomial name, (b) in the case of species described before 1885, but not at that date admitted as valid, reference to establishment as members of the North American fauna, and (c) reference to True's list.[2] The species included by

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[1] Proceedings of the United States National Museum, VII (1884), pp. 587–611 (appendix). 1885.

[2] No attempt is made in the case of the many species which prove to have been composite, as understood in 1885, to apportion the name then used to each of the component parts as they now stand. The word 'part' in parentheses after the reference indicates that segregation has taken place.

True are marked with an asterisk, so that the increase in each genus during the past fifteen years may be made the more apparent. References to alterations in generic names are also given, but the concordance with the nomenclature of 1885, being sufficiently indicated by the citations under species, is here omitted. The type locality of each form is stated with all possible exactitude; but in the present lack of definite information on the subject, no attempt is made to indicate the boundaries of geographic ranges.

Among the many persons who have given valuable aid and advice during the preparation of this paper, Mr. Witmer Stone, Dr. J. A. Allen and Dr. Edgar A. Mearns are particularly to be mentioned.

Class MAMMALIA.

Subclass EUTHERIA.

Superorder **DIDELPHIA**.

Order MARSUPIALIA.

Suborder POLYPROTODONTIA.

Family **DIDELPHIIDAE**.[1]

Genus **CHIRONECTES** Illiger.

1811. *Chironectes* ILLIGER, Prodr. syst. mamm. et avium, p. 76. Type.—*Lutra minima* ZIMMERMANN.

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[1] For discussions of the nomenclature of certain genera of this family see Rehn, Amer. nat., XXXIV, pp. 576–577, July, 1900; Allen, Bull. Amer. mus. nat. hist., XIII, pp. 185–190, October 12, 1900; Thomas, Amer. nat., XXXV, pp. 144–145, February, 1901.

* **Chironectes minimus** (Zimmermann).

1780. *Latra* (sic) *minima* ZIMMERMANN, Geogr. Gesch., II, p. 317.

1885. *Chironectes variegatus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 587. 1885.

1887. *Chironectes minimus* LYDEKKER, Catal. foss. mamm. Brit. mus., pt. V, p. 289.

TYPE LOCALITY. — Guiana.

Genus **MARMOSA** Gray.

1821. *Marmosa* GRAY, London med. repos., XV, p. 308. April 1, 1821. Type.— *Didelphis murina* LINNAEUS.

For use of this name in place of *Micoureus* LESSON (Nouv. tabl. règne animal, p. 186, 1842) see Thomas, Ann. and mag. nat. hist., 6th ser., XVI, p. 58, July, 1895.

Marmosa canescens (Allen).

1893. *Didelphis* (*Micoureus*) *canescens* ALLEN, Bull. Amer. mus. nat. hist., V, p. 235. September 22, 1893.

1897. *Marmosa canescens* ALLEN, Bull. Amer. mus. nat. hist., IX, p. 58. March 15, 1897.

TYPE LOCALITY. — Santo Domingo de Guzman, Isthmus of Tehuantepec, Mexico.

* **Marmosa cinerea** (Temminck).

1827. *Didelphis cinerea* TEMMINCK, Monogr. mamm., I, p. 46.

1885. *Didelphys cinerea* TRUE, Proc. U. S. nat. mus., VII (1884), p. 587. 1885.

1897. *Marmosa cinerea* ALLEN, Bull. Amer. mus. nat. hist., IX, p. 43. March 11, 1897.

TYPE LOCALITY.— Brazil.

Marmosa insularis Merriam.

1898. *Marmosa insularis* MERRIAM, Proc. biol. soc. Washington, XII, p. 14. January 27, 1898.

TYPE LOCALITY. — Maria Madre Island, Tres Marias Islands, State of Jalisco, Mexico.

* **Marmosa murina** (Linnaeus).

1758. [*Didelphis*] *murina* Linnaeus, Syst. nat., x ed., I, p. 55.

1885. *Didelphys murinus* True, Proc. U. S. nat. mus., VII (1884), p. 587. 1885.

1895. *Marmosa murina* Thomas, Ann. and mag. nat. hist., 6th ser., XVI, p. 58. July, 1895.

Type locality. — Brazil.

Marmosa murina mexicana Merriam.

1897. *Marmosa murina mexicana* Merriam, Proc. biol. soc. Washington, XI, p. 44. March 16, 1897.

Type locality. — Juquila, State of Oaxaca, Mexico.

Marmosa oaxacae Merriam.

1897. *Marmosa oaxacae* Merriam, Proc. biol. soc. Washington, XI, p. 43. March 16, 1897.

Type locality. — City of Oaxaca, Oaxaca, Mexico.

Marmosa sinaloae Allen.

1898. *Marmosa sinaloae* Allen, Bull. Amer. mus. nat. hist., X, p. 143. April 12, 1898.

Type locality. — Tatemales, State of Sinaloa, Mexico.

Genus **CALUROMYS** Allen.

1900. *Caluromys* Allen, Bull. Amer. mus. nat. hist., XIII, p. 189. October 12, 1900. Type. — *Didelphis philander* Linnaeus.

Caluromys alstoni Allen.

1900. *Caluromys alstoni* Allen, Bull. Amer. mus. nat. hist., XIII, p. 189. October 12, 1900.

Type locality. — Tres Rios, Costa Rica.

* **Caluromys derbianus** (Waterhouse).

1841. *Didelphys derbianus* Waterhouse, Jardine's natur. library, mamm., XI, p. 97.

1885. *Didelphys derbianus* True, Proc. U. S. nat. mus., VII (1884), p. 587. 1885.

1900. *Caluromys derbianus* Allen, Bull. Amer. mus. nat. hist., xiii, p. 189. October 12, 1900.

Type locality. — Unknown.

Caluromys laniger pallidus (Thomas).

1899. *Philander laniger pallidus* Thomas, Ann. and mag. nat. hist., 7th ser., iv, p. 286. October, 1899.

1900. *Caluromys laniger pallidus* Allen, Bull. Amer. mus. nat. hist., xiii, p. 189. October 12, 1900.

Type locality. — Bogava, Chiriqui, Panama. Altitude, 250 meters.

Genus **METACHIRUS** Burmeister.

1854. *Metachirus* Burmeister, Thiere Brasil., i, p. 135. Based (by elimination) on the species *myosurus* Temminck (= *nudicaudata* E. Geoffroy) and *quica* Temminck.

* **Metachirus fuscogriseus** Allen.

1885. *Didelphys quica* True, Proc. U. S. nat. mus., vii (1884), p. 587. 1885. (Not of Temminck.)

1900. *Metachirus fuscogriseus* Allen, Bull. Amer. mus. nat. hist. xiii, p. 194. October 23, 1900.

Type locality. — Central America.

Metachirus nudicaudatus (E. Geoffroy).

1803. *Didelphys nudicaudata* E. Geoffroy, "Cat. mus. p. 42."

1888. *Didelphys nudicaudata* Thomas, Catal. marsup. and monotr. Brit. mus., p. 332.

1900. *M*[*etachirus*] *nudicaudatus* Allen, Bull. Am. mus. nat. hist., xiii, p. 197. October 23, 1900.

Type locality. — Cayenne, French Guiana (see Allen, Bull. Amer. mus. nat. hist., xiii, p. 197, October 23, 1900).

Genus **DIDELPHIS** Linnaeus.

1758. *Didelphis* LINNAEUS, Syst. nat., x ed., I, p. 54. Type. — *Didelphis marsupialis* LINNAEUS.

* **Didelphis aurita** Wied.

1826. *Didelphys aurita* WIED, Beitr. Naturgesch. Brasil., II, p. 395.

1885. *Didelphys aurita* TRUE, Proc. U. S. nat. mus., VII (1884), p. 587. 1885.

TYPE LOCALITY.—Villa Vicoza, Parahyba River, Brazil.

* **Didelphis marsupialis** Linnaeus.

1758. [*Didelphis*] *marsupialis* LINNAEUS, Syst. nat., x ed., I, p. 54.

1885. *Didelphys virginiana* TRUE, Proc. U. S. nat. mus., VII (1884), p. 587. 1885.

1888. *Didelphys marsupialis* THOMAS, Catal. marsup. and monotr. Brit. mus., p. 323.

TYPE LOCALITY. — Virginia.

According to Thomas (Amer. nat., XXXV, pp. 144–145, February, 1901) this species should stand as *D. virginiana*.

Didelphis marsupialis californica (Bennett).

1833. *Didelphis californica* BENNETT, Proc. zool. Soc. London, p. 40.

1894. *Didelphis marsupialis californica* ALLEN, Bull. Amer. mus. nat. hist., VI, p. 168. May 31, 1894.

TYPE LOCALITY. — "That part of California which adjoins Mexico."

Didelphis marsupialis pigra (Bangs).

1898. *Didelphis virginiana pigra* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 172. March, 1898.

TYPE LOCALITY.— Oak Lodge, opposite Micco, Brevard County, Florida.

Superorder **MONODELPHIA**

Order EDENTATA.

Family **BRADYPODIDAE.**

Genus **CHOLOEPUS** Illiger.

1811. *Choloepus* Illiger, Prodr. syst. mamm. et avium, p. 108. Type.—*Bradypus didactylus* Linnaeus.

* **Choloepus hoffmanni** Peters.

1858. *Choloepus hoffmanni* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 128.

1885. *Cholopus hoffmani* True, Proc. U. S. nat. mus., vii (1884), p. 588. 1885.

Type locality. — Costa Rica.

Genus **BRADYPUS** Linnaeus.

1758. *Bradypus* Linnaeus, Syst. nat., x ed., i, p. 34. Type.—*Bradypus tridactylus* Linnaeus.

* **Bradypus castaneiceps** (Gray).

1871. *Arctopithecus castaneiceps* Gray, Proc. zool. soc. London, p. 444.

1882. *Bradypus castaneiceps* Alston, Biol. Centr.-Amer., mammals, p. 184.

1885. *Bradypus castaneiceps* True, Proc. U. S. nat. mus., vii (1884), p. 588. 1885.

Type locality. — Chontales, Nicaragua.

*[**Bradypus infuscatus** Wagler.

1831. *Bradypus infuscatus* Wagler, Isis, p. 611.

1885. *Bradypus infuscatus* True, Proc. U. S. nat. mus., vii (1884), p. 588. 1885.

Type locality.—Western Brazil.

Family **MYRMECOPHAGIDAE.**[1]

Genus **CYCLOPES** Gray.

1821. *Cyclopes* Gray, London med. repos., xv, p. 305. Type.—*Myrmecophaga didactyla* Linnaeus.

For use of this name in place of *Cyclothurus* Lesson (Nouv. tabl. règne animal, p. 152, 1846) see Thomas, Ann. and mag. nat. hist., 6th ser., xv, p. 191, February, 1895; Palmer, Proc. biol. soc. Washington, xiii, p. 72, September 28, 1899.

* **Cyclopes didactylus** (Linnaeus).

1758. [*Myrmecophaga*] *didactyla* Linnaeus, Syst. nat., x ed., i, p. 35.

1885. *Cycloturas didactylus* True, Proc. U. S. nat. mus., vii (1884), p. 587. 1885.

1900. *Cyclopes didactylus* Rehn, Amer. nat. xxxiv, p. 576. July, 1900.

Type locality. — Surinam.

Genus **MYRMECOPHAGA** Linnaeus.

1758. *Myrmecophaga* Linnaeus, Syst. nat., x ed., i, p. 35. Type—*Myrmecophaga tetradactyla* Linnaeus.

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[1] For studies of the Linnaean species in relation to their present generic standing, see Rehn, Amer. nat., XXXIV, pp. 575-576, July, 1900; Thomas, Amer. nat., XXXV, pp. 143-144, February, 1901.

For use of this name in place of *Uroleptes* see Rehn, Amer. nat., xxxiv, p. 576, July, 1900. For substitution of *Uroleptes* (Wagler, Nat. Syst. der Amphibien, p. 36, 1830) for *Tamandua* (Lesson, Nouv. tabl. règne animal, p. 152, 1842) see Palmer, Proc. biol. soc. Washington, xiii, p. 73, September 28, 1889.

According to Thomas (Amer. nat., xxxv, p. 144, February, 1901) this genus should stand as *Uroleptes* Wagler.

Myrmecophaga sellata Cope.

1889. *Myrmecophaga sellata* Cope, Amer. nat., xxiii, p. 133. February, 1889.

Type locality.—Honduras.

* **Myrmecophaga tetradactyla** Linnaeus.

1758. [*Myrmecophaga*] *tetradactyla* Linnaeus, Syst. nat., x ed., i, p. 35.

1885. *Myrmecophaga quadridactyla* True, Proc. U. S. nat. mus., vii (1884), p. 588. 1885.

Type Locality.—Brazil.

Genus **FALCIFER** Rehn.

1900. *Falcifer* Rehn, Amer. nat., xxxiv, p. 576. July, 1900.
Type.—*Myrmecophaga jubata* Linnaeus.

According to Thomas (Amer. nat. xxxv, p. 143, February, 1901) this genus should stand as *Myrmecophaga* Linnaeus.

* **Falcifer jubata** (Linnaeus).

1756. [*Myrmecophaga*] *jubata* Linnaeus, Syst. nat., xii ed., i, p. 52.

1885. *Myrmecophaga jubata* True, Proc. U. S. nat. mus., vii (1884), p. 588. 1885.

1900. *Falcifer jubata* Rehn, Amer. nat., xxxiv, p. 576. July, 1900.

Type Locality.—Brazil.

According to Thomas (Amer. nat., xxxv, p. 143, February, 1901), the proper name for this species is *Myrmecophaga tridactyla* Linnaeus (Syst. nat., x ed., i, p. 35, 1758).

Family DASYPODIDAE.

Subfamily Dasypodinae.

Genus CABASSOUS McMurtrie.

1831. *Cabassous* McMurtrie, Cuvier's anim. kingd., i, p. 164. Type.—*Dasypus unicinctus* Linnaeus.

For use of this name in place of the preoccupied *Xenurus* (Wagler, Nat. Syst. d. Amphibien, p. 36, 1830), see Palmer, Proc. biol. soc. Washington, xiii, p. 71, September 28, 1899.

Cabassous centralis (Miller).

1899. *Tatoua* (*Ziphila*) *centralis* Miller, Proc. biol. soc. Washington, xiii, p. 4. January 31, 1899.

1899. *C*[*abassous*] *centralis* Palmer, Proc. biol. soc. Washington, xiii, p. 72. September 28, 1899.

Type locality.—Chamelicon, Honduras.

Subfamily Tatuinae.

Genus TATU Blumenbach.

1799. *Tatu* Blumenbach, Handb. der Naturgesch., p. 73. Type. —*Dasypus novemcinctus* Linnaeus.

For use of this name in place of *Tatusia* (Lesson, Man. de mammalogie, p. 309, 1827), see Palmer, Proc. biol. soc. Washington, xi, p. 174, June 9, 1897.

* **Tatu novemcinctum** (Linnaeus).

1758. [*Dasypus*] *novemcinctus* Linnaeus, Syst. nat., x ed., i, p. 51.

1799. [*Tatu*] *novemcinctus* Blumenbach, Handb. der Naturgesch., p. 73.

1885. *Tatusia novemcinctus* True, Proc. U. S. nat. mus., vii (1884), p. 588. 1885.

Type locality.—Brazil.

Order UNGULATA.

Suborder Artiodactyla.

Family **TAYASSUIDAE**.

Genus **TAYASSU** Fischer.

1814. *Tayassu* Fischer, Zoognosia, iii, p. 284. Type.—*Tayassu pecari* Fischer, = *Sus albirostris* Illiger.

For use of this name in place of *Dicotyles* (Cuvier, Règne animal, i, p. 237, 1817) see Palmer, Proc. biol. soc. Washington, xi, p. 174, June 9, 1897.

Tayassu angulatum (Cope).

1889. *Dicotyles angulatus* Cope, Amer. nat., xxiii, p. 147. February, 1889.

1898. *T*[*ayassu*] *angulatus* Bangs, Proc. biol. soc. Washington xii, p. 164. August 10, 1898.

Type locality.—Guadelupe River, Texas.

Tayassu angulatum sonoriense (Mearns).

1897. *Dicotyles angulatus sonoriensis* Mearns. Preliminary diagnoses of new mammals of the genera Mephitis, Dorcelaphus and Dicotyles from the Mexican border of the

United States, p. 3. February 11, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 469. December 24, 1897.)

Type locality.—San Bernardino River, Sonora, Mexico, near monument, no. 77, Mexican boundary line.

* **Tayassu albirostre** (Illiger).

1815. *Sus albirostris* Illiger, Abhandl. k. Akad. Wissensch. Berlin, p. 115.

1885. *Dicotyles labiatus* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

1900. *Tayassu albirostris* Berg, Comunicaciones del Museo nacional de Buenos Aires, i, no. 6, p. 222. May 23, 1900.

Type locality. — Paraguay.

* **Tayassu tajacu** (Linnaeus).

1758. [*Sus*] *tajacu* Linnaeus, Syst. nat., x ed., i, p. 50.

1885. *Dicotyles tajacu* True, Proc. U. S. nat. mus., vii (1884), p. 591. 1885. (Part.)

1898. *T*[*ayassu*] *tajacu* Bangs, Proc. biol. soc. Washington xii, p. 164. August 10, 1898.

Type locality. — "Mexico, Panama and the mountains of Brazil."

Family **CERVIDAE**.

Subfamily Cervinae.

Lydekker has recently published an elaborate popular account of the American deer (The deer of all lands, London, 1898) but his work cannot be regarded as constituting a revision of the group.

Genus **ODOCOILEUS** Rafinesque.

1832. *Odocoileus* Rafinesque, Atlantic journal, i, p. 109. Autumn of 1832. Type. — *Odocoileus speleus* Rafinesque = *Cervus dama americanus* Erxleben, or a closely related subfossil form.

For use of this name in place of *Cariacus* (Lesson, Nouv. tabl. règne animal, p. 173, 1842) and *Dorcelaphus* (Gloger, Gemeinn. Hand.- u. Hilfsb. der Naturgesch., p. 140, 1841) see Merriam, Proc. biol. soc. Washington, XII, p. 99, April 30, 1898.

Regarded by Lydekker (The deer of all lands, p. 243, 1898) as forming part of the genus *Mazama.*

Odocoileus acapulcensis (Caton).

1877. *Cervus acapulcensis* Caton, Antelope and deer of America, p. 113.

1890. *O[docoileus] acapulcensis* Merriam, Proc. biol. soc. Washington, XII, p. 104. April 30, 1898 (in text under *O. nelsoni*).

Type locality. — Acapulco, Guerrero, Mexico.

* **Odocoileus americanus** (Erxleben).

1777. [*Cervus dama*] *americanus* Erxleben, Syst. regni anim., I, p. 312.

1885. *Cariacus virginianus* True, Proc. U. S. nat. mus., VII (1884), p. 592. 1885 (part).

1899. *Odocoileus americanus* Miller, Bull. N. Y. State mus., VI, p. 299. November 18, 1899.

Type locality.— Eastern Virginia.

According to Allen (Amer. nat., XXXIV, p. 318, April, 1900) the specific name *americanus* is not tenable.

Odocoileus americanus borealis Miller.

1900. *Odocoileus americanus borealis* Miller, Bull. N. Y. State museum, VIII, p. 83. November 21, 1900.

Type locality. — Bucksport, Maine.

Odocoileus americanus macrourus (Rafinesque).

1817. *Corvus* (sic) *macrourus* Rafinesque, American monthly magazine, I, p. 436. October, 1817.

Type locality. — Plains of Kansas River, Upper Mississippi Valley.

Odocoileus cerrosensis Merriam.

1898. *Odocoileus cerrosensis* Merriam, Proc. biol. soc. Washington, XII, p. 101. April 30, 1898.

Type locality. — Cerros Island, off Lower California, Mexico.

* **Odocoileus columbianus** (Richardson).

1829. *Cervus macrotis*, var. *columbiana* RICHARDSON, Fauna Boreali-Americana, I, p. 257.

1885. *Cariacus columbianus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 592. 1885.

1898. *Odocoileus columbianus* MERRIAM, Proc. biol. soc. Washington, XII, p. 100. April 30, 1898.

TYPE LOCALITY. — Mouth of the Columbia River, Oregon.

Odocoileus columbianus scaphiotus Merriam.

1898. *Odocoileus columbianus scaphiotus* MERRIAM, Proc. biol. soc. Washington, XII, p. 101. April 30, 1898.

TYPE LOCALITY. — Laguna Ranch, Gabilan Range, Riverside County, California.

Odocoileus columbianus sitkensis Merriam.

1898. *Odocoileus columbianus sitkensis* MERRIAM, Proc. biol. soc. Washington, XII, p. 100. April 30, 1898.

TYPE LOCALITY. — Sitka, Alaska.

Odocoileus couesi (Coues and Yarrow).

1875. *Cariacus virginianus* var. *couesi* COUES and YARROW, Rep. upon geogr. and geol. expl. and surv., west of 100th meridian (Wheeler), V, p. 72.

1898. *Odocoileus couesi* THOMPSON, Forest and stream, LI, p. 286. October 8, 1898.

TYPE LOCALITY. — Camp Crittenden, Pima County, Arizona.

Odocoileus crooki (Mearns).

1897. *Dorcelaphus crooki* MEARNS. Preliminary diagnoses of new mammals of the genera Mephitis, Dorcelaphus and Dicotyles, from the Mexican border of the United States, p. 2. February 11, 1897. (Reprint: Proc. U. S. nat. mus., XX, p. 468. December 24, 1897.)

1898. *Odocoileus crooki* THOMPSON, Forest and stream, LI, p. 286. October 8, 1898.

TYPE LOCALITY. — Summit of the Dog Mountains, Grant County, New Mexico.

* **Odocoileus hemionus** (Rafinesque).

1817. *Cervus hemionus* RAFINESQUE, American monthly magazine, I, p. 436. October, 1817.

1885. *Cariacus macrotis* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

1897. *Odocoileus hemionus* Merriam, Proc. biol. soc. Washington, xii, p. 100. April 30, 1897.

Type locality. — Sioux River, South Dakota.

Odocoileus hemionus californicus (Caton).

1876. *Cervus macrotis* var. *californicus* Caton, Amer. nat., x, p. 464. August, 1876.

1898. *Odocoileus hemionus californicus* Thompson, Forest and stream, li, p. 286. October 8, 1898.

Type locality. — Near Gaviota Pass, forty miles from Santa Barbara, California.

Odocoileus hemionus eremicus (Mearns).

1897. *Dorcelaphus hemionus eremicus* Mearns, Preliminary diagnoses of new mammals of the genera Mephitis, Dorcelaphus and Dicotyles from the Mexican border of the United States, p. 4. February 11, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 470. December 24, 1897.)

1898. *Odocoileus hemionus eremicus* Thompson, Forest and stream, li, p. 286. October 8, 1898.

Type locality. — Sierra Seri, near the Gulf of California, Sonora, Mexico.

Odocoileus hemionus peninsulae (Lydekker).

1898. *Mazama hemionus peninsulae* Lydekker. Proc. zool. soc. London, (1897), p. 900.

Type locality. — La Paz, Lower California.

Odocoileus leucurus (Douglas).

1828. *Cervus leucurus* Douglas, Zool. journ., iv, p. 330.

1898. *Odocoileus leucurus* Thompson, Forest and stream, li, p. 286. October 8, 1898.

Type locality. — Lower Columbia River, Oregon.

Odocoileus mexicanus (Gmelin).

1788. [*Cervus*] *mexicanus* Gmelin, syst. nat., i, p. 179.

Type locality. — Mexico.

Odocoileus nelsoni Merriam.

1898. *Odocoileus nelsoni* Merriam, Proc. biol. soc. Washington, xii, p. 103. April 30, 1898.

Type locality. — San Cristobal, highlands of Chiapas, Mexico.

Odocoileus osceola (Bangs).

1896. *Cariacus osceola* Bangs, Proc. biol. soc. Washington, x, p. 26. February 25, 1896.

Type locality. — Citronelle, Citrus County, Florida.

Odocoileus texensis (Mearns).

1898. *Dorcelaphus texensis* Mearns, Proc. biol. soc. Washington, xii, p. 23. January 27, 1898.

1898. *Odocoileus texensis* Thompson, Forest and stream, li, p. 286. October 8, 1898.

Type locality. — Fort Clark, Kinney County, Texas.

Odocoileus thomasi Merriam.

1898. *Odocoileus thomasi* Merriam, Proc. biol. soc. Washington, xii, p. 102. April 30, 1898.

Type locality. — Huehuetan, Chiapas, Mexico.

* **Odocoileus toltecus** (Saussure).

1860. *Cervus toltecus* Saussure, Revue et magasin de zoologie, 2d ser., xii, p. 247.

1885. *Cariacus toltecus* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

Type locality. — Near Orizaba, Vera Cruz, Mexico.

Odocoileus truei Merriam.

1898. *Odocoileus truei* Merriam, Proc. biol. soc. Washington, xii, p. 103. April 30, 1898.

Type locality. — Segovia River, Eastern Honduras.

Genus **MAZAMA** Rafinesque.

1817. *Mazama* Rafinesque, American monthly magazine, i, p. 363. September, 1817. Type.— *Cervus rufinus* Illiger (see Merriam, Science, n. s., i, p. 208, February 22, 1895.)

* **Mazama sartorii** (Saussure).

1860. *Cervus sartorii* Saussure, Revue et magasin de zoologie, 2d ser., xii, p. 252.

1885. *Cariacus rufinus* True, Proc. U. S. nat. mus., vi (1884), p. 592. 1885.

1898. *Mazama sartorii* Lydekker, The deer of all lands, p. 303.

Type locality.—Mirador, State of Vera Cruz, Mexico.

Genus **CERVUS** Linnaeus.

1758. *Cervus* Linnaeus, Syst. nat., x ed., i, p. 66. Type.—*Cervus elaphus* Linnaeus.

* **Cervus canadensis** (Erxleben.)

1777. [*Cervus elaphus*] *canadensis* Erxleben, Syst. regni anim., i, p. 305.

1783. *Cervus canadensis* Schreber, Säugth, v, pl. 246 a.

1885. *Cervus canadensis* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

Type locality.—Eastern Canada.

Cervus canadensis occidentalis (Smith).

1827. *C*[*ervus*] *occidentalis* H. Smith, Griffith's Cuvier, animal kingdom, iv, p. 101.

1865. *C*[*ervus*] *canadensis occidentalis* Blyth, Proc. zool. soc. London, 1865, p. 618.

1897. *Cervus rooseveldti* Merriam, Proc. biol. soc. Washington, xi, p. 272. December 17, 1897.

1898. *Cervus canadensis occidentalis* Lydekker, The deer of all lands, p. 101.

Type locality.—Extreme western North America.

Genus **ALCES** Jardine.

1835. *Alces* Jardine, Nat. library, xxi (mammalia: deer, antelopes, camels, etc.), p. 125. Type.—*Alces americanus* Jardine.

For use of this name in place of *Alce* H. Smith (Griffith's Cuvier, animal kingdom, v, p. 303, 1827) see Lydekker, The deer of all lands, pp. 49, 51, 1898.

* **Alces americanus** Jardine.

1835. *Alces americanus* Jardine, Nat. library, xxi (mammalia: deer, antelopes, camels, etc.), p. 125.

1885. *Alces machlis* True, Proc. U. S. nat. mus., vii (1884), p. 592, 1885.

Type locality.— North America.

Alces gigas Miller.

1899. *Alces gigas* Miller, Proc. biol. soc. Washington, xiii, p. 57. May 29, 1899.

Type locality.—North side of Tustumena Lake, Kenai Peninsula, Alaska.

Genus **RANGIFER** Hamilton Smith.

1827. *Rangifer* Hamilton Smith, Griffith's Cuvier, Animal kingdom, v, p. 304. Type.— *Cervus tarandus* Linnaeus.

* **Rangifer arcticus** (Richardson).

1829. *Cervus tarandus* var. *arctica* Richardson, Fauna Boreali-Americana, i, p. 241.

1885. *Rangifer tarandus* and *R. tarandus groenlandicus* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

1896. *Rangifer arcticus* Allen, Bull. Amer. mus. nat. hist., viii, p. 234. November 21, 1896.

Type locality.—Arctic coast of America.

* **Rangifer caribou** (Gmelin).

1788. [*Cervus tarandus*] *caribou* Gmelin, Syst. nat., i, p. 177.

1854. *Rangifer caribou* Audubon and Bachman, Quadr. N. Amer., iii, p. 111.

1885. *Rangifer tarandus caribou* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

Type locality.—Eastern Canada.

Rangifer dawsoni Seton-Thompson.

1900. *Rangifer dawsoni* Seton Thompson, Ottawa naturalist, xiii, p. 260. February, 1900.

TYPE LOCALITY.—Graham Island, Queen Charlotte Group, British Columbia, Canada.

Rangifer groenlandicus (Gmelin).

1788. [*Cervus tarandus*] *groenlandicus* GMELIN, Syst. nat., I, p. 177.

1857. *Rangifer groenlandicus* BAIRD, Mam. N. Amer., p. 634.

TYPE LOCALITY.—Greenland.

Rangifer montanus Seton-Thompson.

1899. *Rangifer montanus* SETON-THOMPSON, Ottawa naturalist, XIII, No. 5, pp. 129–130. August, 1899.

TYPE LOCALITY.—Illecillewaet watershed, near Revelstoke, Selkirk Range, British Columbia, Canada.

Rangifer terraenovae Bangs.

1896. *Rangifer terraenovae* BANGS, Preliminary description of the Newfoundland caribou, p. 1. November 11, 1896.

TYPE LOCALITY.—Codroy, Newfoundland.

Family ANTILOCAPRIDAE.

Genus ANTILOCAPRA Ord.

1818. *Antilocapra* Ord, Journ. de physique, LXXXVII, p. 149.
Type. — *Antilope americana* ORD.

***Antilocapra americana** (ORD).

1815. *Antilope americana* ORD, Guthrie's geography, 2d Amer. ed., II, p. 292 (described on p. 308).

1818. *Antilocapra americana* ORD, Journ. de physique, LXXXVII, p. 149.

1885. *Antilocapra americana* TRUE, Proc. U. S. nat. mus., VII (1884), p. 592. 1885.

TYPE LOCALITY. — "On the plains and the highlands of the Missouri."

Family **BOVIDAE.**

For a recent account of the American *Bovidae* see Lydekker, Wild oxen, sheep and goats of all lands, London, 1898.

Genus **BISON** Hamilton Smith.

1827. *Bison* Hamilton Smith, Griffith's Cuvier, Animal kingdom, v, p. 373. Type. — *Bos bison* Linnaeus.

* **Bison bison** (Linnaeus).

1758. [*Bos*] *bison* Linnaeus, Syst. nat., x ed., i, p. 72.

1885. *Bison americanus* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

1888. *B*[*ison*] *bison* Jordan, Manual of the vertebrate animals of the northern United States, 5th ed., p. 337.

Type locality. — Mountains of southeastern United States.

Bison bison athabascae Rhoads.

1898. *Bison bison athabascae* Rhoads, Proc. acad. nat. sci. Phila., (1897), p. 498. January 18, 1898.

Type locality. — Great Slave Lake, Mackenzie, Canada.

Genus **OVIBOS** Blainville.

1816. *Ovibos* Blainville, Bull. soc. philom., p. 76. Type. — *Bos moschatus* Zimmermann.

The genus *Ovibos* has been removed from the typical *Bovidae* to form, together with the Asiatic *Budorcas*, the subfamily *Ovibovinae* (Matschie, Sitzungsber. der Gesellsch. naturforsch. Freunde zu Berlin, 1898, pp. 30–31.)

* **Ovibos moschatus** (Zimmermann).

1780. *Bos moschatus* Zimmermann, Geogr. Geschichte, ii, p. 86.

1822. *Ovibos moschatus* Desmarest, Mammalogie, ii, p. 492.

1885. *Ovibos moschatus* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

Type locality. — Churchill River, Kewatin, Canada.

Ovibos moschatus wardi Lydekker.

1900. *Ovibos moschatus wardi* Lydekker, Nature, lxiii, p. 157. December 13, 1900.

Type locality. — East Greenland.

Genus **OVIS** Linnaeus.

1758. *Ovis* Linnaeus, Syst. nat., x ed., i, p. 70. Type. — *Ovis aries* Linnaeus.

* **Ovis canadensis** Shaw.

1804. *Ovis canadensis* Shaw, Naturalists' miscell., xv, p. 610.

1885. *Ovis montana* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

1891. *Ovis canadensis* Merriam, North Amer. fauna, no. 5, p. 81. July 30, 1891.

Type locality.— Interior of Canada.

Ovis canadensis liardensis Lydekker.

1898. *Ovis canadensis liardensis* Lydekker, Wild oxen, sheep and goats of all lands, p. 215.

Type locality.— Liard River, British Columbia, Canada.

* **Ovis dalli** (Nelson).

1884. *Ovis montana dalli* Nelson, Proc. U. S. national mus., vii, p. 12. June 3, 1884.

1885. *Ovis montana dalli* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

1897. *Ovis dalli* Allen, Bull. Amer. mus. nat. hist., ix, p. 112. April 8, 1897.

Type locality. — Mountains south of Fort Yukon, Alaska.

Ovis stonei Allen.

1897. *Ovis stonei* Allen, Bull. Amer. mus. nat. hist., ix, p. 111. April 8, 1897.

Type locality.— Headwaters of the Stikeen River, British Columbia, Canada, near Alaskan boundary. Altitude, about 6500 feet.

Ovis nelsoni Merriam.

1897. *Ovis nelsoni* Merriam, Proc. biol. soc. Washington, xi, p. 218. July 15, 1897.

Type locality.— Grapevine Mountains, on boundary between California and Nevada, just south of lat. 37°.

Genus **OREAMNOS** Rafinesque.

1817. *Oreamnos* Rafinesque, Amer. monthly magazine, ii, p. 44. November, 1817. Based on *Mazama dorsata* Rafinesque (=*Ovis montana* Ord), *M. sericea* Rafinesque (=*Ovis montana* Ord), and *M. puda* Rafinesque (a South American deer).

Oreamnos kennedyi Elliot.

1900. *Oreamnos kennedyi* Elliot, Field Columb. mus., publication 46, zool. ser., iii, p. 3. June, 1900.

Type locality.—Mountains at mouth of Copper River, opposite Kyak Island, Alaska.

* **Oreamnos montanus** (Ord).

1815. *Ovis montanus* Ord, Guthrie's geography, 2d Amer. ed., p. 292 (described on pp. 309–310).

1885. *Mazama montana* True, Proc. U. S. nat. mus., vii (1884), p. 592. 1885.

1895. *Oreamnos montanus* Merriam, Science, n. s., i, p. 19. January 4, 1895.

Type locality.—Cascade Range, near the Columbia River, in Oregon or Washington.

Suborder PERISSODACTYLA.

Family TAPIRIDAE.

Genus **ELASMOGNATHUS** Gill.

1865. *Elasmognathus* GILL, Proc. acad. nat. sci. Phila., p. 183.
Type.—*Elasmognathus bairdii* GILL.

* **Elasmognathus bairdii** Gill.

1865. *Elasmognathus bairdii* GILL, Proc. acad. nat. sci. Phila., p. 183.
1885. *Elasmognathus bairdii* TRUE, Proc. U. S. nat. mus., VII (1884), p. 593. 1885.

TYPE LOCALITY.—Isthmus of Panama.

* **Elasmognathus dowii** Gill.

1870. *Elasmognathus dowii* GILL, Amer. journ. sci. and arts, L, p. 142.
1885. *Elasmognathus dowii* TRUE, Proc. U. S. nat. mus., VII (1884), p. 593. 1885.

TYPE LOCALITY.—Guatemala.

Order GLIRES.[1]

Suborder SIMPLICIDENTATA.

Family SCIURIDAE.

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[1] Tullberg has recently published an elaborate work on the genera and families of rodents, entitled "Ueber das System der Nagethiere, eine phylogenetische Studie" (Nova acta reg. soc. scient. Upsala, (III), XVIII, fasc. II, sect. 2, 1900). In this he recognizes as families a number of groups which are usually considered of lower rank. The North American groups affected are the *Cricetinae*, *Microtinae* and *Murinae*, which he names, respectively, *Hesperomyidae*, *Arvicolidae* and *Muridae*.

Subfamily SCIURINAE.

Genus **SCIURUS** Linnaeus.

1758. *Sciurus* LINNAEUS, Syst. nat., x ed., I, p. 63. Type.—*Sciurus vulgaris* LINNAEUS.

Subgenus ECHINOSCIURUS Trouessart.[1]

1880. *Echinosciurus* TROUESSART, Le naturaliste, II, no. 37, p. 292. October, 1880. Type.—*Sciurus hypopyrrhus* WAGLER.

* **Sciurus aureogaster** F. Cuvier.

1829. [*Sciurus*, by implication] *aureogaster* F. CUVIER, Hist. nat. mammiféres, VI, livr. LIX, pl. with text. September, 1829. (Binomial published at end of work only, vol. VII, table générale et méthodique, p. 4, 1842.)

1885. *Sciurus aureogaster* TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885. (Part.)

TYPE LOCALITY.—"California"—really eastern Mexico (see Nelson, Proc. Washington acad. sci., I, p. 38, May 9, 1899).

According to Canon XXXVIII of the American Ornithologists' Union code, the name *aureogaster* is not tenable as published in 1829.

* **Sciurus aureogaster hypopyrrhus** (Wagler).

1831. *Sciurus hypopyrrhus* WAGLER, Oken's Isis, pp. 510–511.

1885. *Sciurus hypopyrrhus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885. (Part.)

1899. *Sciurus aureogaster hypopyrrhus* NELSON, Proc. Washington acad. sci., I, p. 42. May 9, 1899.

TYPE LOCALITY.—Mexico, probably in Vera Cruz.

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[1] Revised by Nelson, Proc. Washington acad. sci., I, pp. 38–83. May 9, 1899.

Sciurus aureogaster frumentor Nelson.

1898. *Sciurus aureogaster frumentor* Nelson, Proc. biol. soc. Washington, xii, p. 154. June 3, 1898.

Type locality.—Las Vigas, State of Vera Cruz, Mexico.

Sciurus poliopus (Fitzinger).

1867. [*Sciurus variegatus*] *poliopus* Fitzinger, Sitzungsber. k. Akad. Wissensch. Wien, math.-naturw. Cl., lv, i Abth., p. 478. March, 1867.

1899. *Sciurus poliopus* Nelson, Proc. Washington acad. sci., i, p. 46. May 9, 1899.

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

Sciurus poliopus hernandezi (Nelson).

1898. [*Sciurus albipes*] *hernandezi* Nelson, Science, n. s., viii, p. 783. December 2, 1898.

1899. *Sciurus poliopus hernandezi* Nelson, Proc. Washington acad. sci., i, p. 48. May 9, 1899.

Type locality.—Mountains 15 miles west of the city of Oaxaca, State of Oaxaca, Mexico.

Sciurus poliopus nemoralis (Nelson).

1898. *Sciurus albipes nemoralis* Nelson, Proc. biol. soc. Washington, xii, p. 151. June 3, 1898.

1899. *Sciurus poliopus nemoralis* Nelson, Proc. Washington acad. sci., i, p. 50. May 9, 1899.

Type locality.—Patzcuaro, State of Michoacan, Mexico.

Sciurus poliopus cervicalis (Allen).

1890. *Sciurus cervicalis* Allen, Bull. Amer. mus. nat. hist., iii, p. 183. December 10, 1890.

1899. *Sciurus poliopus cervicalis* Nelson, Proc. Washington acad. sci., i, p. 51. May 9, 1899.

Type locality.—Hacienda San Marcos, Tonila, State of Jalisco, Mexico.

Sciurus poliopus colimensis (Nelson).

1898. *Sciurus albipes colimensis* Nelson, Proc. biol. soc. Washington, xii, p. 152. June 3, 1898.

1899. *Sciurus poliopus colimensis* Nelson, Proc. Washington acad. sci., i, p. 52. May 9, 1899.

Type locality.—Hacienda Magdalena, State of Colima, Mexico.

Sciurus poliopus effugius (Nelson).

1898. *Sciurus albipes effugius* Nelson, Proc. biol. soc. Washington, xii, p. 152. June 3, 1898.

1899. *Sciurus poliopus effugius* Nelson, Proc. Washington acad. sci., i, p. 54. May 9, 1899.

Type locality.—High mountains west of Chilpancingo, State of Guerrero, Mexico.

Sciurus nelsoni Merriam.

1893. *Sciurus nelsoni* Merriam, Proc. biol. soc. Washington, viii, p. 144. December 29, 1893.

Type locality.—Huitzilac, State of Morelos, Mexico.

Sciurus nelsoni hirtus Nelson.

1898. *Sciurus nelsoni hirtus* Nelson, Proc. biol. soc. Washington, xii, p. 153. June 3, 1898.

Type locality.—Tochimilco, State of Puebla, Mexico.

Sciurus colliaei Richardson.

1839. *Sciurus colliaei* Richardson, Voy. H. M. S. Blossom; zool., p. 8.

Type locality.—San Blas, State of Tepic, Mexico.

Sciurus colliaei nuchalis Nelson.

1899. *Sciurus colliaei nuchalis* Nelson, Proc. Washington acad. sci., i, p. 59. May 9, 1899.

Type locality.—Manzanillo, State of Colima, Mexico.

Sciurus sinaloensis Nelson.

1899. *Sciurus sinaloensis* Nelson, Proc. Washington acad. sci., i, p. 60. May 9, 1899.

Type locality.—Mazatlan, State of Sinaloa, Mexico.

Sciurus truei Nelson.

1899. *Sciurus truei* Nelson, Proc. Washington acad. sci., i, p. 61. May 9, 1899.

Type locality.—Camoa, Rio Mayo, State of Sonora, Mexico.

Sciurus socialis Wagner.

1837. *Sciurus socialis* Wagner, Abhandl. math.-phys. Cl. k. bayerisch. Akad. Wiss. München, ii, p. 504.

Type locality.—Vicinity of Tehuantepec City, State of Oaxaca, Mexico.

Sciurus socialis cocos Nelson.

1898. *Sciurus socialis cocos* NELSON, Proc. biol. soc. Washington, XII, p. 155. June 3, 1898.

TYPE LOCALITY. — Acapulco, State of Guerrero, Mexico.

* **Sciurus griseoflavus** (Gray).

1867. *Macroxus griseoflavus* GRAY, Ann. and mag. nat. hist., 3d ser., XX, p. 427. December, 1867.

1878. *Sciurus griseoflavus* ALSTON, Proc. zool. soc. London, p. 660.

1885. *Sciurus griseoflavus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

TYPE LOCALITY. — Guatemala.

Sciurus griseoflavus chiapensis Nelson.

1899. *Sciurus griseoflavus chiapensis* NELSON, Proc.. Washington acad. sci., I, p. 69. May 9, 1899.

TYPE LOCALITY. — San Cristobal, State of Chiapas, Mexico.

* **Sciurus yucatanensis** (Allen).

1877. *Sciurus carolinensis* var. *yucatanensis* ALLEN, Monogr. N. Amer. rodentia, p. 705. August, 1877.

1885. *Sciurus carolinensis yucatanensis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

1897. *Sciurus yucatanensis* ALLEN, Bull. Amer. mus. nat. hist., IX, p. 5. February 23, 1897.

TYPE LOCALITY. — Merida, Yucatan.

Sciurus thomasi Nelson.

1899. *Sciurus thomasi* Nelson, Proc. Washington acad. sci., I, p. 71. May 9, 1899.

TYPE LOCALITY. — Talamanca, Costa Rica.

Sciurus adolphei (Lesson).

1842. *Macroxus adolphei* LESSON, Nouv. tabl. règne animal, mamm., p. 112.

1899. *Sciurus adolphei* NELSON, Proc. Washington acad. sci., I, p. 73. May 9, 1899.

TYPE LOCALITY. — Realejo, Nicaragua.

Sciurus adolphei dorsalis (Gray).

1848. *Sciurus dorsalis* GRAY, Proc. zool. soc. London, p. 138.

1899. *Sciurus adolphei dorsalis* Nelson, Proc. Washington acad. sci., I, p. 74. May 9, 1899.
Type locality. — "Erroneously given as Caracas, Venezuela. (Specimens from Liberia, Costa Rica, are typical.)"—Nelson.

Sciurus boothiae Gray.
1843. *Sciurus boothiae* Gray, List spec. mamm. Brit. mus., p. 139.
Type locality. — Honduras.

Sciurus boothiae belti Nelson.
1899. *Sciurus boothiae belti* Nelson, Proc. Washington acad. sci., I, p. 78. May 9, 1899.
Type locality— Escondido River, fifty miles above Bluefields, Nicaragua.

Sciurus variegatoides Ogilby.
1839. *Sciurus variegatoides* Ogilby, Proc. zool. soc. London, p. 117.
Type locality. — Salvador, west coast of Central America.

Sciurus managuensis (Nelson).
1898. *Sciurus boothiae managuensis* Nelson, Proc. biol. soc. Washington, XII, p. 150. June 3, 1898.
1899. *Sciurus managuensis* Nelson, Proc. Washington acad. sci., I, p. 81. May 9, 1899.
Type locality. — Managua River, Guatemala.

Sciurus goldmani Nelson.
1898. *Sciurus goldmani* Nelson, Proc. biol. soc. Washington, XII, p. 149. June 3, 1898.
Type locality. — Huehuetan, State of Chiapas, Mexico.

Subgenus HESPEROSCIURUS Nelson.[1]

1899. *Hesperosciurus* Nelson, Proc. Washington acad. sci., I, p. 27. May 9, 1899. Type. —*Sciurus griseus* Ord.

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[1] Revised by Nelson, Proc. Washington acad. sci., I, pp. 83-85. May 9, 1899.

* **Sciurus griseus** Ord.

1818. *Sciurus griseus* Ord, Journ. de phys., lxxxvii, p. 152.

1885. *Sciurus fossor* True, Proc. U. S. nat. mus., vii (1884), p. 595. 1885.

1894. *Sciurus griseus* Rhoads, Amer. nat., xxviii, p. 525. June, 1894.

Type locality. — The Dalles, Wasco County, Oregon.

Sciurus griseus nigripes (Bryant).

1889. *Sciurus fossor nigripes* Bryant, Proc. California acad. sci., 2d ser., ii, p. 25. June 20, 1889.

1894. [*Sciurus*] *griseus nigripes* Rhoads, Amer. nat. xxviii, p. 525. June, 1894.

Type locality. — Coast region of San Mateo County, California.

Subgenus Neosciurus Trouessart.[1]

1880. *Neosciurus* Trouessart, Le naturaliste, ii, no. 37, p. 292. October, 1880. Type. — *Sciurus carolinensis* Gmelin.

* **Sciurus carolinensis** Gmelin.

1788. [*Sciurus*] *carolinensis* Gmelin, Syst. nat., i, p. 148.

1885. *Sciurus carolinensis carolinensis* True, Proc. U. S. nat. mus., vii (1884), p. 595. 1885.

Type locality. — 'Carolina.'

Sciurus carolinensis extimus Bangs.

1896. *Sciurus carolinensis extimus* Bangs, Proc. biol. soc. Washington, x, p. 158. December 28, 1896.

Type locality. — Miami, Dade County, Florida.

Sciurus carolinensis fuliginosus (Bachman).

1838. *Sciurus fuliginosus* Bachman, Proc. zool. soc. London, p. 97.

1895. *Sciurus carolinensis fuliginosus* Bangs, Proc. Boston soc. nat. hist., xxvi, p. 543. July 31, 1895.

Type locality. — Near New Orleans, Louisiana.

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[1] Revised by Bangs, Proc. biol. soc. Washington, X, pp. 153–159. December 28, 1896.

Sciurus carolinensis hypophaeus Merriam.

1886. *Sciurus carolinensis hypophaeus* Merriam, Science, VIII, p. 351. April 16, 1886.

Type locality. — Elk River, Sherburne County, Minnesota.

* **Sciurus carolinensis leucotis** (Gapper).

1830. *Sciurus leucotis* Gapper, Zool. journ., V, p. 206.

1877. *Sciurus carolinensis* var. *leucotis* Allen, Monogr. N. Amer. rodentia, p. 701. August, 1877.

1885. *Sciurus carolinensis leucotis* True, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

Type locality. — Region between York and Lake Simcoe, Ontario, Canada.

Subgenus Otosciurus Nelson.

1899. *Otosciurus* Nelson, Proc. Washington acad. sci., I, p. 28. May 9, 1899. Type. — *Sciurus aberti* Woodhouse.

* **Sciurus aberti** Woodhouse.

1852. *Sciurus aberti* Woodhouse, Proc. acad. nat. sci. Phila., VI, p. 220. December, 1852.

1885. *Sciurus aberti* True, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

Type locality. — San Francisco Mountain, Coconino County, Arizona.

Sciurus aberti ferreus True.

1894. *Sciurus aberti concolor* True, Diagnoses of new North American mammals, p. I. April 26, 1894. (Reprint: Proc. U. S. nat. mus., XVII, p. 241. November 15, 1894).

1900. [*Sciurus aberti*] *ferreus* True, Proc. biol. soc. Washington, XIII, p. 183. November 30, 1900.

Type locality. — Loveland, Larimer County, Colorado.

Sciurus durangi (Thomas).

1893. *Sciurus aberti durangi* Thomas, Ann. and mag. nat. hist., 6th ser., XI, p. 49. January, 1893.

1899. *Sciurus durangi* Nelson, Proc. Washington acad. sciences, I, p. 85. May 9, 1899.

Type locality. — Cuidad ranch, one hundred miles west of Durango City, State of Durango, Mexico.

Subgenus TAMIASCIURUS Trouessart.[1]

1880. *Tamiasciurus* TROUESSART, Le naturaliste, II, no. 37, p. 292. October, 1880. Type.— *Sciurus hudsonicus* Erxleben.

* **Sciurus hudsonicus** (Erxleben).

1777. [*Sciurus vulgaris*] *hudsonicus* ERXLEBEN, Syst. regni anim., I, p. 416.

1885. *Sciurus hudsonius hudsonius* TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885. (Part.)

1894. *Sciurus hudsonicus* ALLEN, Bull. Amer. mus. nat. hist., VI, p. 325. November 7, 1894.

TYPE LOCALITY. — Hudson Strait.

Sciurus hudsonicus gymnicus Bangs.

1899. *Sciurus hudsonicus gymnicus* BANGS, Proc. New England zool. club, I, p. 28. March 31, 1899.

TYPE LOCALITY. — Greenville (near Moosehead Lake), Maine.

Sciurus hudsonicus loquax Bangs.

1896. *Sciurus hudsonicus loquax* BANGS, Proc. biol. soc. Washington, X, p. 161. December 28, 1896.

TYPE LOCALITY. — Liberty Hill, New London County, Connecticut.

Sciurus hudsonicus minnesota Allen.

1899. *Sciurus hudsonicus minnesota* Allen, Amer. nat., XXXIII, p. 640. August, 1899.

TYPE LOCALITY. — Fort Snelling, Hennepin County, Minnesota.

Sciurus hudsonicus dakotensis, Allen.

1894. *Sciurus hudsonicus dakotensis* ALLEN, Bull. Amer. mus. nat. hist., VI, p. 325. November 7, 1894.

TYPE LOCALITY. — Squaw Creek, Black Hills, South Dakota.

Sciurus hudsonicus baileyi Allen.

1898. *Sciurus hudsonicus baileyi* ALLEN, Bull. Amer. mus. nat. hist., X, p. 261. July 22, 1898.

TYPE LOCALITY. — Bighorn Mountains, Wyoming. Altitude, 8400 feet.

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[1] Revised by Allen, Bull. Amer. mus. nat. hist., X, pp. 249–298. July 22, 1898.

Sciurus hudsonicus ventorum Allen.

1898. *Sciurus hudsonicus ventorum* ALLEN, Bull. Amer. mus. nat. hist., x, p. 263. July 22, 1898.

TYPE LOCALITY. — South Pass City, Wind River Mts., Fremont County, Wyoming.

* **Sciurus hudsonicus richardsonii** (Bachman).

1838. *Sciurus richardsonii* BACHMAN, Proc. zool. soc. London, p. 100.

1885. *Sciurus hudsonius richardsoni* TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

1898. *Sciurus hudsonicus richardsonii* ALLEN, Bull. Amer. mus. nat. hist., x, p. 265. July 22, 1898.

TYPE LOCALITY. — Head of Big Lost River, Idaho.

Sciurus hudsonicus streatori Allen.

1898. *Sciurus hudsonicus streatori* ALLEN, Bull. Amer. mus. nat. hist., x, p. 267. July 22, 1898.

TYPE LOCALITY. — Ducks, British Columbia, Canada.

Sciurus hudsonicus vancouverensis Allen.

1890. *Sciurus hudsonicus vancouverensis* ALLEN, Bull. Amer. mus. nat. hist., III, p. 165. November 14, 1890.

TYPE LOCALITY. — Duncan Station, Vancouver Island, British Columbia, Canada.

Regarded by Osgood (North Amer. fauna, no. 19, p. 27, October 6, 1900) as a distinct species.

Sciurus hudsonicus petulans Osgood.

1900. *Sciurus hudsonicus petulans* OSGOOD, North Amer. fauna, No. 19, p. 27. October 6, 1900.

TYPE LOCALITY. — Glacier, White Pass, southern Alaska. Altitude, 1870 feet.

* **Sciurus douglasii** Bachman.

1838. *Sciurus douglasii* BACHMAN, Proc. zool. soc. London, p. 99.

1885. *Sciurus hudsonius douglassi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

1898. *Sciurus douglasii* ALLEN, Bull. Amer. mus. nat. hist., x, p. 273. July 22, 1898.

TYPE LOCALITY. — Columbia River.

Sciurus douglasii mollipilosus (Audubon and Bachman).

1841. *Sciurus mollipilosus* Audubon and Bachman, Proc. acad. nat. sci. Phila., I, p. 102. October, 1841.

1898. *Sciurus douglasii mollipilosus* Allen, Bull. Amer. mus. nat. hist., X, p. 276. July 22, 1898.

Type locality. — Coast of northern California.

Sciurus douglasii cascadensis Allen.

1898. *Sciurus douglasii cascadensis* Allen, Bull. Amer. mus. nat. hist., X, p. 277. July 22, 1898.

Type locality. — Mount Hood, Oregon.

Sciurus douglasii albolimbatus Allen.

1898. *Sciurus douglasii albolimbatus* Allen, Bull. Amer. mus. nat. hist., X, p. 453. November 10, 1898.

Type locality. — Blue Cañyon, Placer County, California.

Sciurus douglasii mearnsi (Townsend).

1897. *Sciurus hudsonius mearnsi* Townsend, Proc. biol. soc. Washington, XI, p. 146. June 9, 1897.

1899. *Sciurus douglasi mearnsi* Nelson, Proc. Washington acad. sci., I, p. 87. May 9, 1899.

Type locality. — San Pedro Martir Mountains, Lower California, Mexico. Altitude, about 7000 feet.

* **Sciurus fremonti** Audubon and Bachman.

1853. *Sciurus fremonti* Audubon and Bachman, Quad. N. Amer., III, p. 237.

1885. *Sciurus hudsonius fremonti* True, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

1890. *Sciurus fremonti* Merriam, North Amer. fauna, no. 3, p. 48. September 11, 1890.

Type locality. — 'Rocky Mountains,' probably in the Park region of central Colorado.

Sciurus fremonti neomexicanus Allen.

1898. *Sciurus fremonti neomexicanus* Allen, Bull. Amer. mus. nat. hist., X, p. 291. July 22, 1898.

Type locality. Rayado Canyon, Colfax County, New Mexico.

Sciurus fremonti mogollonensis (Mearns).

1890. *Sciurus hudsonius mogollonensis* Mearns, Bull. Amer. mus. nat. hist., II, p. 277. February 21, 1890.

1890. *Sciurus fremonti mogollonensis* MERRIAM, N. Amer. fauna, no. 3, p. 48. September 11, 1890.

TYPE LOCALITY.—Quaking Asp settlement, summit of Mogollon Mountains, Arizona.

Sciurus fremonti grahamensis (Allen).

1894. *Sciurus hudsonicus grahamensis* ALLEN, Bull. Amer. mus. nat. hist., VI, p. 350. December 7, 1894.

1898. *Sciurus fremonti grahamensis* ALLEN, Bull. Amer. mus. nat. hist., X, p. 292. July 22, 1898.

TYPE LOCALITY.—Graham Mountains, Graham County, Arizona.

Subgenus ARAEOSCIURUS Nelson.[1]

1899. *Araeosciurus* NELSON, Proc. Washington acad. sci., I, p. 29. May 9, 1899. Type.—*Sciurus oculatus* PETERS.

Sciurus oculatus Peters.

1863. *Sciurus oculatus* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 653.

TYPE LOCALITY.—Mexico, probably near Las Vigas, State of Vera Cruz.

Sciurus oculatus tolucae Nelson.

1898. *Sciurus oculatus tolucae* NELSON, Proc. biol. soc. Washington, XII, p. 148. June 3, 1898.

TYPE LOCALITY.—North slope of the Volcano of Toluca, State of Mexico, Mexico.

Sciurus alleni Nelson.

1898. *Sciurus alleni* NELSON, Proc. biol. soc. Washington, XII, p. 147. June 3, 1898.

TYPE LOCALITY.—Monterey, State of Nuevo Leon, Mexico.

Sciurus nayaritensis Allen.

1890. *Sciurus nayaritensis* ALLEN, Bull. Amer. mus. nat. hist., II, p. VII, foot-note. February, 1890.

TYPE LOCALITY.—Sierra Valparaiso, State of Zacatecas, Mexico.

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[1] Revised by Nelson, Proc. Washington acad. sci., I, pp. 88-97. May 9, 1899.

Sciurus apache Allen.

1893. *Sciurus apache* Allen, Bull. Amer. mus. nat. hist., v, p. 29. March 16, 1893.

Type locality.—Mountains of northwestern Chihuahua (near Bavispe River?), Mexico.

* **Sciurus arizonensis** Coues.

1867. *Sciurus arizonensis* Coues, Amer. nat., i, p. 357.

1885. *Sciurus arizonensis* True, Proc. U. S. nat. mus., vii (1884), p. 595. 1885.

Type locality.—Fort Whipple, Yavapi County, Arizona.

Sciurus arizonensis huachuca Allen.

1894. *Sciurus arizonensis huachuca* Allen, Bull. Amer. mus. nat. hist., vi, p. 349. December 7, 1894.

Type locality.—Huachuca Mountains, southern Arizona.

Subgenus Parasciurus Trouessart.[1]

1880. *Parasciurus* Trouessart, Le naturaliste, ii, no. 37, p. 292. October, 1880. Type.— *Sciurus niger* Linnaeus.

* **Sciurus ludovicianus** Custis.

1806. *Sciurus ludovicianus* Custis, Barton's med. and phys. journal, ii, pt. ii, p. 47.

1885. *Sciurus niger ludovicianus* True, Proc. U. S. nat. mus., vii (1884), p. 595. 1885.

Type locality.—Red River, Louisiana.

Sciurus ludovicianus limitis (Baird).

1855. *Sciurus limitis* Baird, Proc. acad. nat. sci. Phila., vii, p. 331.

1896. *Sciurus ludovicianus limitis* Bangs, Proc. biol. soc. Washington, x, p. 149. December 28, 1896.

Type locality.— Devil's River, Valverde County, Texas.

* **Sciurus ludovicianus neglectus** (Gray).

1867. *Macroxus neglectus* Gray, Ann. and mag. nat. hist., 3d ser., xx, p. 425. December, 1867.

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[1] Revised by Bangs, Proc. biol. soc. Washington, X, pp. 147-153. December 29, 1896.

1885. *Sciurus niger cinereus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

1896. *Sciurus ludovicianus vicinus* BANGS, Proc. biol. soc. Washington, x, p. 150. December 28, 1896.

1900. *Sciurus ludovicianus neglectus* NELSON, Proc. biol. soc. Washington, XIII, p. 170. October 31, 1900.

TYPE LOCALITY.—Wilmington, Delaware (see Nelson, Proc. biol. soc. Washington, XIII, p. 170.)

* **Sciurus niger** Linnaeus.

1758. [*Sciurus*] *niger* LINNAEUS, Syst. nat., x ed., I, p. 64.

1885. *Sciurus niger niger* TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

TYPE LOCALITY.—Probably southern South Carolina (the name is based on Catesby's black fox squirrel).

Subgenus GUERLINGUETUS Gray.[1]

1821. *Guerlinguetus* GRAY, London med. repos., XV, p. 304. April, 1821. Type.—*Sciurus guerlinguetus* GRAY=*Sciurus aestuans* LINNAEUS.

* **Sciurus aestuans hoffmanni** Peters.

1863. *Sciurus aestuans* var. *hoffmanni* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 654.

1885. *Sciurus aestuans rufoniger*, TRUE, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

1899. *Sciurus aestuans hoffmanni* NELSON, Proc. Washington acad. sci., I, p. 98. May 9, 1899.

TYPE LOCALITY. — Costa Rica.

Sciurus richmondi Nelson.

1898. *Sciurus richmondi* NELSON, Proc. biol. soc. Washington, XII, p. 146. June 3, 1898.

TYPE LOCALITY. — Escondido River, fifty miles above Bluefields, Nicaragua.

* **Sciurus variabilis morulus** Bangs.

1885. *Sciurus variabilis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 596. 1885.

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[1] Revised by Nelson, Proc. Washington acad. sci., I, pp. 98–101. May 9, 1899.

1900. *Sciurus variabilis morulus* BANGS, Proc. New England zool. club, II, p. 43. September 20, 1900.
TYPE LOCALITY. — Loma del Leon, Panama.

Subgenus BAIOSCIURUS Nelson.[1]

1899. *Baiosciurus* NELSON, Proc. Washington acad. sci., I, p. 31. May 9, 1899. Type. — *Sciurus deppei* PETERS.

* **Sciurus deppei** Peters.
1863. *Sciurus deppei* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 654.
1885. *Sciurus deppei* TRUE, Proc. U. S. nat. mus., VII. (1884), p. 595. 1885.
TYPE LOCALITY. — Papantla, State of Vera Cruz, Mexico.

Sciurus negligens Nelson.
1898. *Sciurus negligens* NELSON, Proc. biol. soc. Washington, XII, p. 147. June 3, 1898.
TYPE LOCALITY. — Alta Mira, State of Tamaulipas, Mexico.

Subgenus MICROSCIURUS Allen.

1895. *Microsciurus* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 332. November 8, 1895. Type. — *Sciurus alfari* ALLEN.

Sciurus alfari Allen.
1895. *Sciurus* (*Microsciurus*) *alfari* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 333. November 8, 1895.
TYPE LOCALITY. — Jiménez, Costa Rica.

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[1] Revised by Nelson, Proc. Washington acad. sci., I, pp. 101–105. May 9, 1899.

Genus **TAMIAS** Illiger.

1811. *Tamias* Illiger, Prodr. syst. mam. et avium, p. 83. Type. — *Sciurus striatus* Linnaeus.

* **Tamias striatus** (Linnaeus).

1758. [*Sciurus*] *striatus* Linnaeus, Syst. nat., x ed., i, p. 64.

1857. *Tamias striatus* Baird, 11th Smithsonian report, p. 55.

1885. *Tamias striatus* True, Proc. U. S. nat. mus., vii (1884), p. 593. 1885.

Type locality. — Southeastern United States.

Tamias striatus griseus Mearns.

1891. *Tamias striatus griseus* Mearns, Bull. Amer. mus. nat. hist., iii, p. 231. June 5, 1891.

Type locality.— Fort Snelling, Hennepin County, Minnesota.

Tamias striatus lysteri (Richardson).

1829. *Sciurus* (*Tamias*) *lysteri* Richardson, Fauna Boreali-Americana, i, p. 181.

1886. *Tamias striatus lysteri* Merriam, Amer. nat., xx, p. 242. March, 1886.

Type locality. —Penetanguishene, Georgian Bay, Ontario, Canada.

Tamias striatus venustus Bangs.

1896. *Tamias striatus venustus* Bangs, Proc. biol. soc. Washington, x, p. 137. December 28, 1896.

Type locality. — Stilwell, Boston Mts., Indian Territory.

Genus **EUTAMIAS** Trouessart.[1]

1880. *Eutamias* Trouessart, Catal. mam. viv. et foss., rongeurs, p. 86. Type. — *Sciurus striatus asiaticus* Gmelin.

See Allen, Abstract proc. Linn. soc. New York, 1893–1894, p. 42, July 20, 1894.

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[1] A review of the American species of this genus was published by Allen in 1890 (Bull. Amer. mus. nat. hist., iii, pp. 45–116, June, 1890), but so many new forms have been described since then that the paper is no longer a fair presentation of the subject.

Eutamias alpinus (Merriam).

1893. *Tamias alpinus* Merriam, Proc. biol. soc. Washington, viii, p. 137. December 28, 1893.

1897. *Eutamias alpinus* Merriam, Proc. biol. soc. Washington, xi, p. 191. July 1, 1897.

Type locality. — Big Cottonwood Meadows, just south of Mt. Whitney, Tulare County, California. Altitude, 10,000 feet.

Eutamias amoenus (Allen).

1890. *Tamias amoenus* Allen, Bull. Amer. mus. nat. hist., iii, p. 90. June, 1890.

1897. *E*[*utamias*] *amoenus* Merriam, Proc. biol. soc. Washington, xi, p. 191. July 1, 1897.

Type locality. — Fort Klamath, Klamath County, Oregon.

Eutamias bulleri (Allen).

1889. *Tamias asiaticus bulleri* Allen, Bull. Amer. mus. nat. hist., ii, p. 173. October 21, 1889.

Type locality. — Sierra de Valparaiso, State of Zacatecas, Mexico.

Eutamias callipeplus (Merriam).

1893. *Tamias callipeplus* Merriam, Proc. biol. soc. Washington, viii, p. 136. December 28, 1893.

1897. *E*[*utamias*] *callipeplus* Merriam, Proc. biol. soc. Washington, xi, p. 191. July 1, 1897.

Type locality.— Mount Piños, Ventura County, California.

Eutamias caniceps Osgood.

1900. *Eutamias caniceps* Osgood, North Amer. fauna, no. 19, p. 28. October 6, 1900.

Type locality.— Lake Lebarge, Yukon, Canada.

Eutamias caurinus Merriam.

1898. *Eutamias caurinus* Merriam, Proc. acad. nat. sci. Phila., p. 352. October 4, 1898.

Type locality. — Timber-line, near head of Soleduc River, Olympic Mountains, Clallam County, Washington.

Eutamias cinereicollis (Allen).

1890. *Tamias cinereicollis* Allen, Bull. Amer. mus. nat. hist., iii, p. 94. June, 1890.

Type locality. — San Francisco Mountain, Coconino County, Arizona.

* **Eutamias dorsalis** (Baird).

1855. *Tamias dorsalis* Baird, Proc. acad. nat. sci. Phila., vii, p. 332. April, 1855.

1885. *Tamias asiaticus dorsalis* True, Proc. U. S. nat. mus., vii (1884), p. 593. 1885.

1897. *E[utamias] dorsalis* Merriam, Proc. biol. soc. Washington, xi, p. 210. July 1, 1897.

Type locality. — Fort Webster, lat. 32° 47′, long. 108° 4′, Grant County, New Mexico.

Eutamias dorsalis utahensis Merriam.

1897. *Eutamias dorsalis utahensis* Merriam, Proc. biol. soc. Washington, xi, p. 210. July 1, 1897.

Type locality. — Ogden, Weber County, Utah.

Eutamias frater (Allen).

1890. *Tamias frater* Allen, Bull. Amer. mus. nat. hist., iii, p. 88. June, 1890.

1897. *E[utamias] frater* Merriam, Proc. biol. soc. Washington, xi, p. 192. July 1, 1897.

Type locality. — Donner, Placer County, California.

Eutamias hindsi (Gray).

1842. *Tamias hindei* (typ. err. for *hindsi*) Gray, Ann. and mag. nat. hist., x, p. 264. December, 1842.

1897. *E[utamias] hindsi* Merriam, Proc. biol. soc. Washington, xi, p. 194. July 1, 1897.

Type locality. — Near San Francisco, California.

Eutamias macrorhabdotes (Merriam).

1886. *Tamias macrorhabdotes* Merriam, Proc. biol. soc. Washington, iii, p. 25. January 27, 1886.

Type locality. — Nicasio, Marin County, California.

Recognized as distinct by Allen (Bull. Amer. mus. nat. hist., iii, p. 78, June, 1900), but regarded as identical with *E. quadrimaculatus* by Merriam (Proc. biol. soc. Washington, xi, p. 203, July 1, 1897).

Eutamias merriami (Allen).

1889. *Tamias asiaticus merriami* Allen, Bull. Amer. mus. nat. hist., ii, p. 176. October 21, 1889.

1897. *E[utamias] merriami* MERRIAM, Proc. biol. soc. Washington, XI, p. 191. July 1, 1897.

TYPE LOCALITY. — San Bernardino Mountains, California.

* **Eutamias minimus** (Bachman).

1839. *Tamias minimus* BACHMAN, Journ. acad. nat. sci. Phila., VIII, pt. I, p. 71.

1885. *Tamias asiaticus pallidus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 593. 1885.

1890. *Tamias minimus* ALLEN, Bull. Amer. mus. nat. hist., III, p. 110. June, 1890.

TYPE LOCALITY. — Near Green River City, Wyoming (see Allen, Bull. Amer. mus. nat. hist., III, p. 112, June, 1890).

Eutamias minimus consobrinus (Allen).

1890. *Tamias minimus consobrinus* ALLEN, Bull. Amer. mus. nat. hist., III, p. 112. June, 1890.

TYPE LOCALITY. — Wahsatch foot-hills, near Salt Lake City, Utah.

Eutamias minimus melanurus (Merriam).

1890. *Tamias minimus melanurus* MERRIAM, North Amer. fauna, no. 4, p. 22. October 8, 1890.

TYPE LOCALITY. — West side of Snake River, near Blackfoot, Bingham County, Idaho.

Regarded by Merriam (N. Amer. fauna, no. 5, p. 46, July 30, 1891) as a moulting phase of *E. minimus pictus*.

Eutamias minimus pictus (Allen).

1890. *Tamias minimus pictus* ALLEN, Bull. Amer. mus. nat. hist., III, p. 115. June, 1890.

TYPE LOCALITY. — Kelton, Boxelder County, Utah.

Regarded by Merriam (Proc. biol. soc. Washington, XI, pp. 190, 191, 194, July 1, 1897) as a distinct species.

Eutamias obscurus (Allen).

1890. *Tamias obscurus* ALLEN, Bull. Amer. mus. nat. hist., III, p. 70. June, 1890.

TYPE LOCALITY. — San Pedro Martir Mountains, Lower California, Mexico.

Eutamias oreocetes Merriam.

1897. *Eutamias oreocetes* MERRIAM, Proc. biol. soc. Washington, XI, p. 207. July 1, 1897.

TYPE LOCALITY. — Near Summit, Teton Mountains, Teton County, Montana.

Eutamias palmeri Merriam.

1897. *Eutamias palmeri* MERRIAM, Proc. biol. soc. Washington, XI, p. 208. July 1, 1897.

TYPE LOCALITY.— Charleston Peak, Lincoln County, Nevada. Altitude, 8000 feet.

Eutamias panamintinus (Merriam).

1893. *Tamias panamintinus* MERRIAM, Proc. biol. soc. Washington, VIII, p. 134. December 28, 1893.

1897. *E*[*utamias*] *panamintinus* MERRIAM, Proc. biol. soc. Washington, XI, p. 191. July 1, 1897.

TYPE LOCALITY. — Johnson Canyon, Panamint Mountains, Inyo County, California.

Eutamias pricei (Allen).

1895. *Tamias pricei* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 333. November 8, 1895.

TYPE LOCALITY. — Portola, San Mateo County, California.

Regarded by Merriam (Proc. biol. soc. Washington, XI, p. 197, July 1, 1897) as a form of *E. merriami* too slightly differentiated to require a name.

Eutamias quadrimaculatus (Gray).

1867. *Tamias quadrimaculatus* GRAY, Ann. and mag. nat. hist. 3d ser., XX, p. 435.

1897. *E*[*utamias*] *quadrimaculatus* Merriam, Proc. biol. soc. Washington, XI, p. 191. July 1, 1897.

TYPE LOCALITY. — Michigan Bluff, Placer County, California.

* **Eutamias quadrivittatus** (Say).

1823. *Sciurus quadrivittatus* SAY, Long's exped. to Rocky Mts., II, p. 45.

1885. *Tamias asiaticus quadrivittatus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 593. 1885.

TYPE LOCALITY. — "In Colorado, on the Arkansas River, near where it breaks through the foot-hills" (see Allen, Bull. Amer. mus. nat. hist., III, p. 98, June, 1890).

Eutamias quadrivittatus affinis (Allen).

1890. *Tamias quadrivittatus affinis* Allen, Bull. Amer. mus. nat. hist., III, p. 103. June, 1890.

Type locality. — Ashcroft, British Columbia, Canada.

Regarded by Merriam (Proc. biol. soc. Washington, XI, p. 208, July 1, 1897) as a distinct species.

* **Eutamias quadrivittatus borealis** (Allen).

1877. *Tamias asiaticus borealis* Allen, Monogr. N. Amer. rodentia, p. 793. August, 1877.

1885. *Tamias asiaticus borealis* True, Proc. U. S. nat. mus., VII (1884), p. 593. 1885.

Type locality. — Fort Liard, Mackenzie, Canada (see Allen, Bull. Amer. mus. nat. hist., III, p. 109, June, 1890).

Eutamias quadrivittatus felix (Rhoads).

1895. *Tamias quadrivittatus felix* Rhoads, Amer. nat., XXIX, p. 941. October, 1895.

Type locality. — Mount Baker Range, British Columbia, Canada. Altitude, 7000 feet.

Eutamias quadrivittatus gracilis (Allen).

1890. *Tamias quadrivittatus gracilis* Allen, Bull. Amer. mus. nat. hist., III, p. 99. June, 1890.

Type locality. — San Pedro, Socorro County, New Mexico.

Eutamias quadrivittatus luteiventris (Allen).

1890. *Tamias quadrivittatus luteiventris* Allen, Bull. Amer. mus. nat. hist., III, p. 101. June, 1890.

Type locality. — Chief Mountain Lake, northwestern Montana.

Eutamias quadrivittatus neglectus (Allen).

1890. *Tamias quadrivittatus neglectus* Allen, Bull. Amer. mus. nat. hist., III, p. 106. June, 1890.

Type locality. — Eastern shore of Lake Superior, Ontario, Canada.

Eutamias senex (Allen).

1890. *Tamias senex* Allen, Bull. Amer. mus. nat. hist., III, p. 83. June, 1890.

1897. *E*[*utamias*] *senex* Merriam, Proc. biol. soc. Washington, XI, p. 191. July 1, 1897.

TYPE LOCALITY. — Summit of Donner Pass, Placer County, California.

Eutamias speciosus (Merriam).

1890. *Tamias speciosus* MERRIAM, Bull. Amer. mus. nat. hist., III, p. 86. June, 1890.

1897. *E*[*utamias*] *speciosus* MERRIAM, Proc. biol. soc. Washington, XI, p. 191. July 1, 1897.

TYPE LOCALITY. — San Bernardino Mountains, San Bernardino County, California.

Eutamias speciosus inyoensis Merriam.

1897. *Eutamias speciosus inyoensis* MERRIAM, Proc. biol. soc. Washington, XI, p. 208. July 1, 1897.

TYPE LOCALITY. — White Mountains, Inyo County, California.

* **Eutamias townsendii** (Bachman).

1839. *Tamias townsendii* BACHMAN, Journ. acad. nat. sci. Phila., VIII, pt. I, p. 68.

1885. *Tamias asiaticus townsendi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 593. 1885.

1897. *E*[*utamias*] *townsendii* MERRIAM, Proc. biol. soc. Washington, XI, p. 192. July 1, 1897.

TYPE LOCALITY. — Lower Columbia River, Oregon.

Eutamias townsendii ochrogenys Merriam.

1897. *Eutamias townsendii ochrogenys* MERRIAM, Proc. biol. soc. Washington, XI, pp. 195, 206. July 1, 1897.

TYPE LOCALITY. — Mendocino, Mendocino County, California.

Eutamias umbrinus (Allen).

1890. *Tamias umbrinus* ALLEN, Bull. Amer. mus. nat. hist., III, p. 96. June, 1890.

TYPE LOCALITY. — Uinta Mountains, south of Ft. Bridger, Sweetwater County, Wyoming.

Genus **SPERMOPHILUS** Cuvier.[1]

1825. *Spermophilus* Cuvier, Dents des mamm., p. 160. Type. — *Mus citellus* Linnaeus.

* **Spermophilus annulatus** Audubon and Bachman.

1842. *Spermophilus annulatus* Audubon and Bachman, Journ. acad. nat. sci. Phila., VIII, pt. II, p. 319.

1885. *Spermophilus annulatus* True, Proc. U. S. nat. mus., VII (1884), p. 595. 1885.

Type locality.—Unknown; probably in western Mexico.

Spermophilus armatus Kennicott.

1863. *Spermophilus armatus* Kennicott, Proc. acad. nat. sci. Phila., p. 158.

1891. *Spermophilus armatus* Merriam, North Amer. fauna, no. 5, p. 38. July 30, 1891.

Type locality.—Foot-hills of the Uinta Mountains, near Fort Bridger, Sweetwater County, Wyoming.

Spermophilus barrowensis Merriam.

1900. *Spermophilus barrowensis* Merriam, Proc. Washington acad. sci., II, p. 19. March 14, 1900.

Type locality.—Point Barrow, Alaska.

Spermophilus beldingi Merriam.

1888. *Spermophilus beldingi* Merriam, Ann. New York acad. sci., IV, p. 317. December 28, 1888.

Type locality.—Donner, Placer County, California.

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[1] In this genus the following subgenera have been recently used: *Otospermophilus* Brandt (Bull. class. phys.-math. de l'acad. imp. des sci. de St. Petersbourg, II, p. 379 1849), for *S. grammurus* and its allies; *Ammospermophilus* Merriam (Proc. biol. soc. Washington, VII, p. 27, April 13, 1893), for *S. leucurus* (type) and related species; *Xerospermophilus* Merriam (Proc. biol. soc. Washington, VII, p. 27, April 13, 1893), for *S. mohavensis* (type) and the allied species of the *spilosoma* group; *Callospermophilus* Merriam (Proc. biol. soc. Washington, XI, p. 189, July 1, 1877), for *S. lateralis*; and *Ictidomys* Allen (Monogr. N. Amer. rodentia, p. 821, August, 1877), for *S. tridecemlineatus* (see Merriam, Science, n. s., II, p. 418, September 27, 1885). As but one attempt (Trouessart, Cat. mamm., pt. II, pp. 433-441, 1897), has been made to assign the various North American forms to their respective subgenera, and that probably without a study of the group, it seems best to arrange the species alphabetically.

Spermophilus beringensis Merriam.

1900. *Spermophilus beringensis* Merriam, Proc. Washington acad. sci., ii, p. 20. March 14, 1900.

Type locality.—Cape Lisbourne (Coal Veins), Alaska.

Spermophilus bernardinus Merriam.

1893. *Spermophilus chrysodeirus brevicaudus* Merriam, Proc. biol. soc. Washington, viii, p. 134. December 28, 1893 (not of Brandt, 1844).

1898. *Spermophilus* (*Callospermophilus*) *bernardinus* Merriam, Science, n. s., viii, p. 782. December 2, 1898.

Type locality.— San Bernardino Peak, San Bernardino County, California.

Spermophilus canescens Merriam.

1890. *Spermophilus canescens* Merriam, N. Amer. fauna, no. 4, p. 38. October 8, 1890.

Type locality.—Wilcox, Cochise County, Arizona.

Spermophilus castanurus (Merriam).

1890. *Tamias castanurus* Merriam, N. Amer. fauna, no. 4, p. 19. October 8, 1890.

1892. [*Spermophilus*] *castanurus* Merriam Proc. biol. soc. Washington vii, p. 25. April 13, 1892.

Type locality. — Park City, Wahsatch Mountains, Summit County, Utah. Altitude, 7000 feet.

Spermophilus chrysodeirus (Merriam).

1890. *Tamias chrysodeirus* Merriam, N. Amer. fauna, no. 4, p. 19. October 8, 1890.

1893. *S*[*permophilus*] *chrysodeirus* Merriam, Proc. biol. soc. Washington, viii, p. 134. December 28, 1893.

Type locality.—Fort Klamath, Klamath County, Oregon.

Spermophilus cinerascens (Merriam).

1890. *Tamias cinerascens* Merriam, N. Amer. fauna, no. 4, p. 20. October 8, 1890.

1892. *Spermophilus cinerascens* Merriam, Proc. biol. soc., Washington, vii, p. 25. April 13, 1892.

Type locality.— Helena, Lewis and Clarke County, Montana. Altitude, 4500 feet.

* **Spermophilus columbianus** (Ord).

1815. *Arctomys columbianus* Ord, Guthrie's geography, 2d Am. ed., II, p. 292. Described on page 303.

1885. *Spermophilus empetra erythroglutaeus* True, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

1891. *Spermophilus columbianus* Merriam, North Amer. fauna, no. 5, p. 39. July 30, 1891.

Type locality. — Camas prairie between the forks of the Clearwater and Kooskooskie, about forty miles from Moscow, Lincoln County, Washington (see Merriam, North Amer. fauna, no. 5, p. 41, July 30, 1891).

Spermophilus cryptospilotus Merriam.

1890. *Spermophilus cryptospilotus* Merriam, N. Amer. fauna, no. 3, p. 57. September 11, 1890.

Type locality. — Tenebito Wash, Painted Desert, Coconino County, Arizona.

* **Spermophilus elegans** Kennicott.

1863. *Spermophilus elegans* Kennicott, Proc. acad. nat. sci. Phila., p. 158.

1885. *Spermophilus richardsoni townsendi* True, Proc. U. S. nat. mus., VII (1884), p. 594. 1885. (Not *S. townsendi* Bachman, 1839.)

1891. *Spermophilus elegans* Merriam, North Amer. fauna, no. 5, p. 39. July 30, 1891.

Type locality.—Fort Bridger, Sweetwater County, Wyoming.

* **Spermophilus empetra** (Pallas).

1778. *Mus empetra* Pallas, Nov. sp. quadr. glir. ord., p. 74.

1877. *Spermophilus empetra* Allen, Monogr. N. Amer. rodentia, p. 839. August, 1877.

1885. *Spermophilus empetra empetra* True, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

Type locality.— Banks of the Mackenzie River, Canada.

* **Spermophilus empetra kodiacensis** Allen.

1874. *Spermophilus parryi* var. *kodiacensis* Allen, Proc Boston soc. nat. hist., XVI, p. 292.

1877. *Spermophilus empetra* var. *kodiacensis* Allen, Monogr. N. Amer. rodentia, p. 839. August, 1877.

1885. *Spermophilus empetra kodiacensis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — Kadiak Island, Alaska.

Spermophilus empetra phaeognathus (Richardson).

1829. *Arctomys parryi* var. *phaeognatha* RICHARDSON, Fauna Boreali-Americana, I, p. 161.

1898. *Spermophilus empetra phaeognathus* ALLEN, Bull. Amer. mus. nat. hist., X, p. 454. November 10, 1898.

TYPE LOCALITY. — Hudson Bay.

Spermophilus empetra plesius Osgood.

1900. *Spermophilus empetra plesius* OSGOOD, North Amer. fauna, no. 19, p. 29. October 6, 1900.

TYPE LOCALITY. — Bennett City, head of Lake Bennett, British Columbia, Canada.

* **Spermophilus franklinii** (Sabine).

1822. *Arctomys franklinii* SABINE, Trans. Linn. soc., XIII, p. 587.

1827. *Spermophilus franklini* LESSON, Man. de mammalogie, p. 244.

1885. *Spermophilus franklini* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — Vicinity of Cumberland House, Saskatchewan, Canada.

* **Spermophilus grammurus** (Say).

1823. *S*[*ciurus*] *grammurus* SAY, Long's exped. Rocky Mountains, II, p. 72.

1844. *Spermophilus grammurus* BRANDT, Bull. acad. imp. sci., St. Petersbourg, II, p. 380.

1885. *Spermophilus grammurus grammurus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — In Colorado, on the Arkansas River, at its exit from the Rocky Mountains.

Spermophilus grammurus atricapillus Bryant.

1889. *Spermophilus grammurus atricapillus* BRYANT, Proc. California acad. sci., 2d ser., II, p. 26. June 20, 1889.

TYPE LOCALITY. — Comondu, Lower California, Mexico.

***Spermophilus grammurus beecheyi** (Richardson).

1829. *Arctomys* (*Spermophilus*) *beecheyi* RICHARDSON, Fauna Boreali-Americana, I, p. 170.

1874. *Spermophilus grammurus* var. *beecheyi* ALLEN, Proc. Boston soc. nat. hist., XVI, p. 293.

1885. *Spermophilus grammurus beecheyi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — "Neighborhood of San Francisco and Monterey, California."

Regarded by Merriam (Proc. biol. soc. Washington, VIII, p. 133, December 28, 1893) as a distinct species.

Spermophilus grammurus buckleyi (Slack).

1861. *Spermophilus buckleyi* SLACK, Proc. acad. nat. sci. Phila., p. 314.

1896. *Spermophilus grammurus buckleyi* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 67. April 22, 1896.

TYPE LOCALITY. — Packsaddle Mountain, Llano County, Texas.

Spermophilus grammurus couchii (Baird).

1855. *Spermophilus couchii* BAIRD, Proc. acad. nat. sci. Phila., p. 332.

1896. *S*[*permophilus*] *grammurus couchii* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 68. April 22, 1896.

TYPE LOCALITY.— Santa Catarina, State of Nueva Leon, Mexico.

* **Spermophilus grammurus douglasii** (Richardson).

1829. *Arctomys* (*Spermophilus*) *douglasii* RICHARDSON, Fauna Boreali-Americana, I, p. 172.

1874. *Spermophilus grammurus* var. *douglassi* Allen, Proc. Boston soc. nat. hist., XVI, p. 293.

1885. *Spermophilus grammurus douglassi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — Banks of the Columbia River, Oregon.

Spermophilus grammurus fisheri (Merriam).

1893. *Spermophilus beecheyi fisheri* MERRIAM, Proc. biol. soc. Washington, VIII, p. 133. December 28, 1893.

1894. *Spermophilus grammurus fisheri* ALLEN, Abstract proc. Linn. soc. New York, 1893–1894, p. 41. July 20, 1894.

TYPE LOCALITY. — Kern Valley, twenty-five miles above Kernville, Tulare County, California.

* **Spermophilus harrisii** Audubon and Bachman.

1854. *Spermophilus harrisii* AUDUBON and BACHMAN, Quadr. N. Amer., III, p. 267.

1885. *Tamias harrisi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — Unknown (see Merriam, North Amer. fauna, no. 2, pp. 19–20, October 30, 1889).

Spermophilus harrisii saxicola Mearns.

1896. *Spermophilus harrisii saxicolus* MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 2. March 25, 1896. (Reprint: Proc. U. S. nat. mus., XVIII, p. 444. May 23, 1896.)

TYPE LOCALITY.— Tinajas Altas, Gila Mountains, Yuma County, Arizona.

Spermophilus interpres (Merriam).

1890. *Tamias interpres* MERRIAM, North Amer. fauna, no. 4, p. 21. October 8, 1890.

1892. *Spermophilus interpres* BRYANT, Zoe, III, p. 208. October, 1892.

TYPE LOCALITY. — El Paso, El Paso County, Texas.

* **Spermophilus lateralis** (Say).

1823. *S[ciurus] lateralis* SAY, Long's exped. Rocky Mountains, II, p. 46.

1843. *Sp[ermophilus] lateralis* WAGNER, Schreber's Säugthiere, Suppl., III, p. 252.

1885. *Tamias lateralis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 593. 1885.

TYPE LOCALITY. — Near the source of the Arkansas River, Colorado.

Spermophilus lateralis saturatus (Rhoads).

1895. *Tamias lateralis saturatus* RHOADS, Proc. acad. nat. sci. Phila., p. 43. April 9, 1895.

TYPE LOCALITY.— Lake Kichelos, Kittitas County, Washington.

Spermophilus leucurus (Merriam).

1889. *Tamias leucurus* MERRIAM, North Amer. fauna, no. 2, p. 20. October 30, 1889.

1892. *Spermophilus leucurus* MERRIAM, Proc. biol. soc. Washington, VII, p. 27. April 13, 1892.

Type locality. — San Gorgonio Pass, Riverside County, California.

Spermophilus leucurus cinnamomeus (Merriam).

1890. *Tamias leucurus cinnamomeus* Merriam, North Amer. fauna, no. 3, p. 52. September 11, 1890.

1892. *Spermophilus leucurus cinnamomeus* Bryant, Zoe, III, p. 208. October, 1892.

Type locality. — Echo Cliffs, Painted Desert, Coconino County, Arizona.

Spermophilus leucurus peninsulae (Allen).

1893. *Tamias leucurus peninsulae* Allen, Bull. Amer. mus. nat. hist., V, p. 197. August 18, 1893.

1897. [*Spermophilus*] *leucurus peninsulae* Trouessart, Catal. mamm., pt. II, p. 434.

Type locality. — San Telmo, Lower California, Mexico.

* **Spermophilus mexicanus** (Erxleben).

1777. [*Sciurus*] *mexicanus* Erxleben, Syst. regni anim., I, p. 428.

1843. *Spermophilus mexicanus* Wagner, Schreber's Säugthiere, Suppl., III, p. 250.

1885. *S*[*permophilus*] *mexicanus* True, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

Type locality. — South-central Mexico.[1]

Spermophilus mexicanus parvidens Mearns.

1896. *Spermophilus mexicanus parvidens* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 1. March 25, 1896. (Reprint: Proc. U. S. nat. mus., XVIII, p. 443. May 23, 1896.)

Type locality. — Fort Clark, Kinney County, Texas.

Spermophilus mohavensis Merriam.

1889. *Spermophilus mohavensis* Merriam, North Amer. fauna, no. 2, p. 15. October 30, 1889.

Type locality. — Mohave River, San Bernardino County, California.

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[1] The name *Sciurus mexicanus* was restricted by Lichtenstein (Darstellung neuer oder wenig bekannter Säugethiere, text accompanying pl. XXXI, 1827–1834) to the animal occurring at Toluca, Mexico. See Mearns, Proc. U. S. nat. mus., XVIII, p. 443, May 23, 1896.

Spermophilus mollis Kennicott.

1863. *Spermophilus mollis* KENNICOTT, Proc. acad. nat. sci. Phila., p. 158.

1885. *Spermophilus mollis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — Camp Floyd, near Fairfield, Wasatch County, Utah.

Sphermophilus mollis canus Merriam.

1898. *Spermophilus mollis canus* MERRIAM, Proc. biol. soc. Washington, XII, p. 70. March 24, 1898.

TYPE LOCALITY. — Antelope, Wasco County, Oregon.

Spermophilus mollis stephensi Merriam.

1898. *Spermophilus mollis stephensi* MERRIAM, Proc. biol. soc. Washington, XII, p. 69. March 24, 1898.

TYPE LOCALITY. — Queen Station, near head of Owen's Valley, Esmeralda County, Nevada.

Spermophilus mollis yakimensis Merriam.

1898. *Spermophilus mollis yakimensis* MERRIAM, Proc. biol. soc. Washington, XII, p. 70. March 24, 1898.

TYPE LOCALITY. — Mabton, Yakima County, Washington.

Spermophilus neglectus Merriam.

1889. *Spermophilus neglectus* MERRIAM, North Amer. fauna, no. 2, p. 17. October 30, 1889.

TYPE LOCALITY. — Dolan's Spring, Mohave County, Arizona.

Spermophilus nelsoni Merriam.

1893. *Spermophilus nelsoni*, MERRIAM, Proc. biol. soc. Washington, VIII, p. 129. December 28, 1893.

TYPE LOCALITY. — Tipton, San Joaquin Valley, Tulare County, California.

* **Spermophilus obsoletus** Kennicott.

1863. *Spermophilus obsoletus* KENNICOTT, Proc. acad. nat. sci. Phila., p. 157.

1885. *Spermophilus obsoletus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — Extreme western Nebraska.

Spermophilus oregonus Merriam.

1898. *Spermophilus oregonus* MERRIAM, Proc. biol. soc. Washington, XII, p. 69. March 24, 1898.

TYPE LOCALITY.— Swan Lake Valley, Klamath Basin, Oregon.

Spermophilus osgoodi Merriam.

1900. *Spermophilus osgoodi* MERRIAM, Proc. Washington acad. sci., II, p. 18. March 14, 1900.

TYPE LOCALITY. — Fort Yukon, Alaska.

Spermophilus perotensis Merriam.

1893. *Spermophilus perotensis* MERRIAM, Proc. biol. soc. Washington, VIII, p. 131. December 28, 1893.

TYPE LOCALITY. — Perote, State of Vera Cruz, Mexico.

* **Spermophilus richardsonii** (Sabine).

1822. *Arctomys richardsônii* SABINE, Trans. Linn. soc., XIII, p. 589.

1845. *Spermophilus richardsonii* AUDUBON and BACHMAN, Quadr. N. Amer., I, p. 377.

1885. *Spermophilus richardsoni richardsoni* TRUE, Proc., U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — Carlton House, Saskatchewan, Canada.

Spermophilus sonoriensis Ward.

1891. *Spermophilus sonoriensis* WARD, Amer. nat., XXV, p. 158. February, 1891.

TYPE LOCALITY. — Hermosillo, State of Sonora, Mexico.

Regarded by Merriam (Science, n. s., VII, p. 32, January 7, 1898) as a race of *S. tereticaudus*.

* **Spermophilus spilosoma** Bennett.

1833. *Spermophilus spilosoma* BENNETT, Proc. zool. soc. London, p. 40.

1885. *Spermophilus spilosoma* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — "That part of California that adjoins Mexico." Name restricted by Merriam (North Amer. fauna, no. 4, p. 37, October 8, 1890) to the animal occurring in northern Mexico and extreme western Texas.

Spermophilus spilosoma annectens Merriam.

1893. *Spermophilus spilosoma annectens* MERRIAM, Proc. biol. soc. Washington, VIII, p. 132. December 28, 1893.

TYPE LOCALITY. — Padre Island, Cameron County, Texas.

Spermophilus spilosoma macrospilotus Merriam.

1890. *Spermophilus spilosoma macrospilotus* MERRIAM, North Amer. fauna, no. 4, p. 38. October 8, 1890.

TYPE LOCALITY. —Oracle, Pinal County, Arizona.

Spermophilus spilosoma major Merriam.

1890. *Spermophilus spilosoma major* MERRIAM, North Amer. fauna, no. 4, p. 39. October 8, 1890.

TYPE LOCALITY.—Albuquerque, Bernalillo County, New Mexico.

Spermophilus spilosoma obsidianus Merriam.

1890. *Spermophilus spilosoma obsidianus* MERRIAM, North Amer. fauna, no. 3, p. 56. September 11, 1890.

TYPE LOCALITY. — Cedar belt, northeast of San Francisco Mountain, Coconino County, Arizona.

Spermophilus spilosoma pratensis Merriam.

1890. *Spermophilus spilosoma pratensis* MERRIAM, North Amer. fauna, no. 3, p. 55. September 11, 1890.

TYPE LOCALITY.—Pine plateau at north foot of San Francisco Mountain, Coconino County, Arizona.

* **Spermophilus tereticaudus** Baird.

1857. *Spermophilus tereticaudus* BAIRD, Mam. N. Amer., p. 315.

1885. *Spermophilus tereticaudus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

TYPE LOCALITY. — Old Fort Yuma, San Diego County, California.

Spermophilus townsendii Bachman.

1839. *Spermophilus townsendii* BACHMAN, Journ. acad. nat. sci. Phila., VIII, p. 61.

1891. *Spermophilus townsendi* MERRIAM, North Amer. fauna, no. 5, p. 36. July 30, 1891.

TYPE LOCALITY.—Walla Walla, Walla Walla County, Washington.

* **Spermophilus tridecemlineatus** (Mitchill).

1821. *Sciurus tridecem-lineatus* MITCHILL, Med. repos., n. s., VI, (XXI), p. 248.

1849. *Spermophilus tridecemlineatus* AUDUBON and BACHMAN, Quadr. N. Amer., I, p. 294.

1885. *Spermophilus tridecimlineatus tridecimlineatus* True, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

Type locality. — Central Minnesota (see Allen, Bull. Amer. mus. nat. hist., VII, p. 338, November 8, 1895).

Spermophilus tridecemlineatus alleni Merriam.

1898. *Spermophilus tridecemlineatus alleni* Merriam, Proc. biol. soc. Washington, XII, p. 71. March 24, 1898.

Type locality. — Bighorn Mountains, Wyoming.

Spermophilus tridecemlineatus badius Bangs.

1899. *Spermophilus tridecemlineatus badius* Bangs, Proc. New England zool. club, I, p. 1. February 8, 1899.

Type locality. — Stotesbury, Vernon County, Missouri.

Spermophilus tridecemlineatus olivaceus Allen.

1895. *Spermophilus tridecemlineatus olivaceus* Allen, Bull. Amer. mus. nat. hist., VII, p. 337. November 8, 1895.

Type locality. — Custer, Black Hills, South Dakota.

* **Spermophilus tridecemlineatus pallidus** Allen.

1877. [*Spermophilus tridecemlineatus*] var. *pallidus* Allen, Monogr. N. Amer. rodentia, p. 872. August, 1877.

1885. *Spermophilus tridecimlineatus pallidus* True, Proc. U. S. nat. mus., VII (1884), p. 594. 1885.

Type locality. — Plains of the Lower Yellowstone River (see Allen, Bull. Amer. mus. nat. hist., VII, p. 338, November 8, 1895).

Spermophilus tridecemlineatus parvus Allen.

1895. *Spermophilus tridecemlineatus parvus* Allen, Bull. Amer. mus. nat. hist., VII, p. 337. November 8, 1895.

Type locality. — Uncompahgre Indian Reservation, northeastern Utah.

Spermophilus tridecemlineatus texensis Merriam.

1898. *Spermophilus tridecemlineatus texensis* Merriam, Proc. biol. soc. Washington, XII, p. 71. March 24, 1898.

Type locality. — Gainesville, Cooke County, Texas.

Spermophilus variegatus (Erxleben).

1777. [*Sciurus*] *variegatus* Erxleben, Syst. regni anim., I, p. 421.

1898. *Spermophilus variegatus* NELSON, Science, n. s., VIII, p. 898. December 23, 1898.

TYPE LOCALITY.— South-central Mexico.

Spermophilus wortmani (Allen).

1895. *Tamias wortmani* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 335. November 8, 1895.

TYPE LOCALITY.— Kinney Ranch, Bitter Creek, Sweetwater County, Wyoming.

Genus **CYNOMYS** Rafinesque.

1817. *Cynomys* RAFINESQUE, Amer. monthly magazine, II, p. 45. November, 1817. Type. — The Barking Squirrel of Lewis and Clark = *Arctomys ludovicianus* ORD.

Cynomys arizonensis Mearns.

1890. *Cynomys arizonensis* MEARNS, Bull. Amer. mus. nat. hist., II, p. 305. February 21, 1890.

TYPE LOCALITY.— Point of Mountain, near Wilcox, Cochise County, Arizona.

* **Cynomys gunnisoni** Baird.

1855. *Spermophilus gunnisoni* BAIRD, Proc. acad. nat. sci. Phila., VII, p. 334. April, 1855.

1857. *Cynomys gunnisoni* BAIRD, Mamm. N. Amer., p. 335.

1885. *Cynomys columbianus* TRUE, Proc. U. S. nat. mus., VII (1884) p. 593. 1885.

1890. *Cynomys gunnisoni* MERRIAM, North Amer. fauna, no. 3, p. 58. September 11, 1890.

1891. *Cynomys gunnisoni* MERRIAM, North Amer. fauna, no. 5, p. 40. July 30, 1891.

TYPE LOCALITY. — Cochetopa Pass, Saguache County, Colorado.

Cynomys leucurus Merriam.

1890. *Cynomys leucurus* MERRIAM, North Amer. fauna, no. 4, p. 33. October 8, 1890.

TYPE LOCALITY. —Fort Bridger, Sweetwater County, Wyoming.

According to Allen (Bull. Amer. mus. nat. hist., x, pp. 455–456, November 10, 1898) this should stand as *Cynomys lewisii* (*Arctomys lewisii* Audubon and Bachman, Quadr. N. Amer., iii, p. 32, 1853, type locality, 'Oregon').

* **Cynomys ludovicianus** (Ord).

1815. *Arctomys ludovicianus* Ord, Guthrie's geography, 2d Amer. ed., ii, p. 292. Description on page 302.
1857. *Cynomys ludovicianus* Baird, Mamm. N. Amer., p. 331.
1885. *Cynomys ludovicianus* True, Proc. U. S. nat. mus., vii (1884), p. 593. 1885.
Type locality. — "Missouri and throughout Louisiana."

Cynomys mexicanus Merriam.

1892. *Cynomys mexicanus* Merriam, Proc. biol. soc. Washington, vii, p. 157. July 27, 1892.
Type locality. — La Ventura, State of Coahuila, Mexico.

Genus **ARCTOMYS** Schreber.[1]

1780. *Arctomys*, Schreber, Säugthiere, iv, pls. ccvii–ccxi. Included the species *marmota*, *monax*, *bobac*, *empetra* and *citillus*.

Arctomys dacota Merriam.

1889. *Arctomys dacota* Merriam, North Amer. fauna, no. 2, p. 8. October 30, 1889.
Type locality. — Custer, Black Hills, South Dakota.

* **Arctomys flaviventer** Audubon and Bachman.

1841. *Arctomys flaviventer* Audubon and Bachman, Proc. acad. nat. sci. Phila., p. 99.
1885. *Arctomys flaviventer* True, Proc. U. S. nat. mus., vii (1884), p. 593. 1885.
Type locality. — "Mountains between Texas and California."

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[1] Palmer has suggested (Science, n. s., vi, p. 105, July 16, 1897) that this name may eventually be displaced by *Marmota* Blumenbach, 1779 (Handb. d. Naturgeschichte).

Arctomys flaviventer avarus Bangs.

1899. *Arctomys flaviventer avarus* Bangs, Proc. New England zool. club, I, p. 68. July 31, 1899.

Type locality. — Okanagan, British Columbia, Canada.

Arctomys ignavus Bangs.

1899. *Arctomys ignavus* Bangs, Proc. New England zool. club, I, p. 13. February 28, 1899.

Type locality. — Black Bay, Straits of Belle Isle, Labrador.

* **Arctomys monax** (Linnaeus).

1758. [*Mus*] *monax* Linnaeus, Syst. nat., x ed., I, p. 60.

1780. *Arctomys monax* Schreber, Säugthiere, IV, pl. CCVIII.

1885. *Arctomys monax* True, Proc. U. S. nat. mus., VII (1884), p. 593. 1885.

Type locality. — Maryland.

Arctomys monax canadensis (Erxleben).

1777. [*Glis*] *canadensis* Erxleben, Syst. regni anim., I, p. 363.

1898. *Arctomys monax canadensis* Allen, Bull. Amer. mus. nat. hist., x, p. 456. November 10, 1898.

Type locality. — Hudson Bay.

Arctomys olympus Merriam.

1898. *Arctomys olympus* Merriam, Proc. acad. nat. sci. Phila., p. 352. October 4, 1898.

Type locality. — Timber-line at head of Soleduc River, Olympic Mountains, Clallam County, Washington.

* **Arctomys pruinosus** Gmelin.

1788. [*Arctomys*] *pruinosa* Gmelin, Syst. nat., I, p. 144.

1885. *Arctomys pruinosus* True, Proc. U. S. nat. mus., VII (1884), p. 593. 1885.

Type locality. — Northern North America.

Genus **SCIUROPTERUS** F. Cuvier.[1]

1825. *Sciuropterus* F. Cuvier, Dents du mammifères, p. 255 (description, pp. 161–162). Type. — *Sciurus volans* Linnaeus.

***Sciuropterus alpinus** (Richardson).

1828. *Pteromys alpinus* Richardson, Zool. journ., iii, p. 519.

1885. *Sciuropterus volucella hudsonius* True, Proc. U. S. nat. mus., vii (1884), p. 596. 1885. (Part.)

1897. *Sciuropterus alpinus* Rhoads, Proc. acad. nat. sci. Phila., p. 319. June, 1897.

Type locality. — Rocky Mountains, at the sources of the Athabaska and Peace Rivers, Alberta, Canada.

Sciuropterus alpinus fuliginosus Rhoads.

1897. *Sciuropterus alpinus fuliginosus* Rhoads, Proc. acad. nat. sci. Phila., p. 321. June, 1897.

Type locality. — Cascade Mountains, near Martin Station, Kittitass County, Washington.

Sciuropterus alpinus lascivus Bangs.

1899. *Sciuropterus alpinus lascivus* Bangs, Proc. New England zool. club., i, p. 69. July 31, 1900.

Type locality. — Tallac, El Dorado County, California.

Sciuropterus alpinus olympicus Elliot.

1899. *Sciuropterus alpinus olympicus* Elliot, Field Columbian mus. publ., i, p. 225. February 1, 1899.

Type locality. — Happy Lake, Clallam County, Washington.

Sciuropterus alpinus klamathensis Merriam.

1897. *Sciuropterus alpinus klamathensis* Merriam, Proc. biol. soc. Washington, xi, p. 225. July 15, 1897.

Type locality. — Fort Klamath, Klamath County, Oregon. Altitude, 4200 feet.

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[1] Eastern forms revised by Bangs (Proc. biol. soc. Washington, x, pp. 162–166, December 28, 1896), Western by Rhoads (Proc. acad. nat. sci. Phila., 1897, pp. 314–327, June, 1897). The species are here necessarily arranged alphabetically.

Sciuropterus alpinus californicus Rhoads.

1897. *Sciuropterus alpinus californicus* Rhoads, Proc. acad. nat. sci. Phila., p. 323. June, 1897.

Type locality. — San Bernardino Mountains, California.

Sciuropterus alpinus oregonensis (Bachman).

1839. *Pteromys oregonensis* Bachman, Journ. acad. nat. sci. Phila., viii, p. 101.

1897. *Sciuropterus alpinus oregonensis* Rhoads, Proc. acad. nat. sci. Phila., p. 324. June, 1897.

Type locality. — Pine woods of the Columbia, near the sea. Probably near St. Helen, Columbia County, Oregon (see Rhoads, Proc. acad. nat. sci. Phila., 1897, p. 324).

Regarded by Merriam (Proc. biol. soc. Washington, xiii, p. 151, June 13, 1900) as a distinct species.

Sciuropterus alpinus stephensi (Merriam).

1900. *Sciuropterus oregonensis stephensi* Merriam, Proc. biol. soc. Washington, xiii, p. 151. June 13, 1900.

Type locality. — Sherwood, Mendocino County, California. Altitude, 2500 feet.

Sciuropterus alpinus bangsi Rhoads.

1897. *Sciuropterus alpinus bangsi*, Rhoads, Proc. acad. nat. sci. Phila., p. 321. June, 1897.

Type locality. — Idaho County, Idaho.

Sciuropterus sabrinus (Shaw).

1801. *Sciurus sabrinus* Shaw, Gen. zool., ii, p. 157.

1896. *Sciuropterus sabrinus* Bangs, Proc. biol. soc. Washington, x, p. 162. December 28, 1896.

Type locality. — Severn River, Keewatin, Canada.

Sciuropterus sabrinus macrotis Mearns.

1898. *Sciuropterus sabrinus macrotis* Mearns, Proc. U. S. nat. mus., xxi, p. 353. November 4, 1898.

Type locality. — Hunter Mountain, Catskill Mountains, Greene County, New York.

Sciuropterus sabrinus makkovikensis Sornborger.

1900. *Sciuropterus sabrinus makkovikensis* Sornborger, Ottawa naturalist, xiv, p. 48. June 6, 1900.

Type locality. — Makkovik, Labrador.

Sciuropterus silus Bangs.

1896. *Sciuropterus silus* Bangs, Proc. biol. soc. Washington, x, p. 163. December 28, 1896.

Type locality. — Top of Katis Mountain, near White Sulphur Springs, Greenbrier County, West Virginia.

Sciuropterus yukonensis Osgood.

1900. *Sciuropterus yukonensis* Osgood, North Amer. fauna, no. 19, p. 25. October 6, 1900.

Type locality. — Camp Davidson, Yukon River, near Alaska-Canada boundary, Yukon, Canada.

* **Sciuropterus volans** (Linnaeus).

1758. [*Mus*] *volans* Linnaeus, Syst. nat., x ed., i, p. 63.

1885. *Sciuropterus volucella volucella* True, Proc. U. S. nat. mus., vii (1884), p. 596. 1885. (Part.)

1890. *S*[*ciuropterus*] *volans* Jordan, Manual of the vertebrate animals of the northern United States, 5th ed., p. 321.

Type locality. — Virginia (see Bangs, Proc. biol. soc. Washington, x, p. 165, December 28, 1896).

Sciuropterus volans querceti Bangs.

1896. *Sciuropterus volans querceti* Bangs, Proc. biol. soc. Washington, x, p. 166. December 28, 1896.

Type locality. — Citronelle, Citrus County, Florida.

Family CASTORIDAE.

Genus CASTOR Linnaeus.

1758. *Castor* Linnaeus, Syst. nat., x ed., i, p. 58. Type. — *Castor fiber* Linnaeus.

* **Castor canadensis** Kuhl.[1]

1820. *Castor canadensis* Kuhl, Beiträge z. Zoologie, p. 64.

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[1] Reviewed by Rhoads in Trans. Amer. philos. soc., n. s., xix, pp. 417-439, September, 1898.

1885. *Castor fiber* True, Proc. U. S. nat. mus., vii (1884), p. 596. 1885.

Type locality. — Hudson Bay.

Castor canadensis carolinensis Rhoads.

1898. *Castor canadensis carolinensis* Rhoads, Trans. Amer. philos. soc., n. s., xix, p. 420. September, 1898.

Type locality. — Dan River, near Danbury, Stokes County, North Carolina.

Castor canadensis frondator Mearns.

1897. *Castor canadensis frondator* Mearns, Preliminary diagnoses of new mammals of the genera Sciurus, Castor, Neotoma and Sigmodon, from the Mexican border of the United States, p. 2. March 5, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 503. January 19, 1898.)

Type locality. — San Pedro River, State of Sonora, Mexico, near monument no. 98 of the Mexican boundary line.

Castor canadensis pacificus Rhoads.

1898. *Castor canadensis pacificus* Rhoads, Trans. Amer. philos. soc., n. s., xix, p. 422. September, 1898.

Type locality. — Lake Kichelos, Cascade Mountains, Kittitass County, Washington.

Family **APLODONTIIDAE**.

Genus **APLODONTIA** Richardson.

1829. *Aplodontia* Richardson, Zool. journ., iv, p. 334. January, 1829. Type. — *Aplodontia leporina* Richardson = *Anisonyx rufa* Rafinesque.

Aplodontia major Merriam.

1886. *Aplodontia major* Merriam, Ann. New York acad. sci., iii, p. 316. May, 1886.

Type locality. — Sierra Nevada Mountains, Placer County, California.

Aplodontia major rainieri Merriam.

1899. *Aplodontia major rainieri* Merriam, Proc. biol. soc. Washington, xiii, p. 21. January 31, 1899.

Type locality.— Paradise Creek, south side of Mt. Rainier, Lewis County, Washington. Altitude, 5200 feet.

Aplodontia olympica Merriam.

1899. *Aplodontia olympica* Merriam, Proc. biol. soc. Washington, xiii, p. 20. January 31, 1899.

Type locality. — Queniult Lake, Chehalis County, Washington.

Aplodontia pacifica Merriam.

1899. *Aplodontia pacifica* Merriam, Proc. biol. soc. Washington, xiii, p. 19. January 31, 1899.

Type locality. — Newport, mouth of Yaquina Bay, Lincoln County, Oregon.

Aplodontia phaea Merriam.

1899. *Aplodontia phaea* Merriam, Proc. biol. soc. Washington, xiii, p. 20. January 31, 1899.

Type locality. — Point Reyes, Marin County, California.

* **Aplodontia rufa** (Rafinesque).

1817. *Anisonyx? rufa* Rafinesque, Amer. monthly magazine, ii, p. 45. November, 1817.

1885. *Haplodon rufus* True, Proc. U. S. nat. mus., vii (1884), p. 596. 1885.

1886. *Aplodontia rufa* Merriam, Ann. New York acad. sci., iii, p. 316. May, 1886.

Type locality. — Neighborhood of the Columbia River, Oregon.

Family **MURIDAE.**

Subfamily Murinae.

Genus **MUS** Linnaeus.

1758. *Mus* Linnaeus, Syst. nat., x ed., i, p. 59. Name at present restricted to genus including the species *musculus* and *rattus*.

Mus alexandrinus Geoffroy.

1818. *Mus alexandrinus* Geoffroy, Description de l'Egypte, mammifères, p. 733.

Regarded by Yerbury and Thomas (Proc. zool. soc. London, 1895, p. 553) as a form of *Mus rattus*.

Type locality. — Alexandria, Egypt.

Mus musculus Linnaeus.

1758. [*Mus*] *musculus* Linnaeus, Syst. nat., x ed., i, p. 62.

Type locality. — Sweden.

Mus musculus jalapae Allen and Chapman.

1897. *Mus musculus jalapae* Allen and Chapman, Bull. Amer. mus. nat. hist., ix, p. 198. June 16, 1897.

Type locality. — Jalapa, State of Vera Cruz, Mexico.

Mus norvegicus Erxleben.

1777. [*Mus*] *norvegicus* Erxleben, Syst. regni anim., i, p. 381.

Type locality. — Norway.

Usually known as *Mus decumanus* (Pallas, nov. sp. quadr. glir. ord., p. 91, 1778). For change see Rehn, Proc. biol. soc. Washington, xiii, p. 167, October 31, 1900.

Mus rattus Linnaeus.

1758. [*Mus*] *rattus* Linnaeus, Syst. nat., x ed., i, p. 61.

Type locality. — Sweden.

Subfamily **CRICETINAE.**

Genus **ONYCHOMYS** Baird.

1857. *Onychomys* Baird, Mamm. N. Amer., p. 458. Type.—*Hypudaeus leucogaster* Wied.

Onychomys arcticeps Rhoads.

1898. *Onychomys arcticeps* Rhoads, Proc. acad. nat. sci. Phila., p. 194. May 3, 1898.

Type locality. — Clapham, Union County, New Mexico.

Onychomys fuliginosus Merriam.

1890. *Onychomys fuliginosus* Merriam, North Amer. fauna, no. 3, p. 60. September 11, 1890.

Type locality. — Black Tank lava beds, northeast of San Francisco Mountain, Coconino County, Arizona.

* **Onychomys leucogaster** (Wied).

1841. *Hypudaeus leucogaster* Wied, Reise in das innere Nord Amerika, ii, p. 99.

1857. *Onychomys leucogaster* Baird, Mamm. N. Amer., p. 459.

1885. *Hesperomys leucogaster* True, Proc. U. S. nat. mus., vii (1884), p. 597. 1885.

Type locality. — Clark, Clark County, South Dakota.

Onychomys leucogaster brevicaudus Merriam.

1891. *Onychomys leucogaster brevicaudus* Merriam, North Amer. fauna no. 5, p. 52. July 30, 1891.

Type locality. — Blackfoot, Bingham County, Idaho.

Onychomys longicaudus Merriam.

1889. *Onychomys longicaudus* Merriam, North Amer. fauna, no. 2, p. 2. October 30, 1889.

Type locality. — St. George, Washington County, Utah.

Onychomys longipes Merriam.

1889. *Onychomys longipes* Merriam, North Amer. fauna, no. 2, p. 1. October 30, 1889.

Type locality. — Concho County, Texas.

Onychomys melanophrys (Merriam).

1889. *Onychomys leucogaster melanophrys* MERRIAM, North Amer. fauna, no. 2, p. 2. October 30, 1889.

1890. *O[nychomys] melanophrys* MERRIAM, North Amer. fauna, no. 3, p. 61. September 11, 1890.

TYPE LOCALITY. — Kanab, Kane County, Utah.

Onychomys melanophrys pallescens Merriam.

1890. *Onychomys melanophrys pallescens* MERRIAM, North Amer. fauna, no. 3, p. 61. September 11, 1890.

TYPE LOCALITY. — Moki Pueblos, Apache County, Arizona.

Onychomys ramona Rhoads.

1893. *Onychomys ramona* RHOADS, Amer. nat., XXVII, p. 833. September, 1893.

TYPE LOCALITY. — San Bernardino Valley, California.

* **Onychomys torridus** (Coues).

1874. *Hesperomys* (*Onychomys*) *torridus* COUES, Proc. acad. nat. sci. Phila., p. 183. December 15, 1874.

1885. *Hesperomys torridus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 597. 1885.

1889. *Onychomys torridus* MERRIAM, North Amer. fauna, no. 2, p. 3. October 30, 1889.

TYPE LOCALITY. — Camp Grant, Graham County, Arizona.

Onychomys torridus arenicola Mearns.

1896. *Onychomys torridus arenicola* MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 3. May 25, 1896. (Reprint: Proc. U. S. nat. mus., XIX, p. 139. December 21, 1896.)

TYPE LOCALITY. — Rio Grande, about six miles above El Paso, El Paso County, Texas.

Onychomys torridus perpallidus Mearns.

1896. *Onychomys torridus perpallidus* MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 4. May 25, 1896. (Reprint: Proc. U. S. nat. mus., XIX, p. 140. December 21, 1896.)

TYPE LOCALITY. — Left bank of the Colorado River at monument no. 204, Mexican boundary line, Yuma County, Arizona.

Genus **PEROMYSCUS** Gloger.

1841. *Peromyscus* GLOGER, Gemeinn. Hand.- u. Hilfsbuch d. Naturgesch., I, p. 95. Type. — *Peromyscus arboreus* GLOGER = *Mus sylvaticus noveboracensis* FISCHER.

Peromyscus affinis (Allen).

1891. *Hesperomys* (*Vesperimus*) *affinis* ALLEN, Proc. U. S. nat. mus., XIV, p. 195. July 24, 1891.

1897. *Peromyscus affinis* ALLEN and CHAPMAN, Bull. Amer. mus. nat. hist., IX, p. 7. February 23, 1897.

TYPE LOCALITY. — Barrio, State of Oaxaca, Mexico (see Allen and Chapman, Bull. Amer. mus. nat. hist., IX, p. 7, February 23, 1897).

Peromyscus akeleyi Elliot.

1899. *Peromyscus akeleyi* ELLIOT, Field Columb. mus. publication 30, zool. ser., I, p. 226. February 1, 1899.

TYPE LOCALITY. — Johnson's Ranch, Elwah River, Olympic Mountains, Clallam County, Washington.

Peromyscus anastasae Bangs.

1898. *Peromyscus anastasae* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 195. March, 1898.

TYPE LOCALITY. — Point Romo, Anastasia Island, St. John County, Florida.

Peromyscus anthonyi (Merriam).

1887. *Hesperomys* (*Vesperimus*) *anthonyi* MERRIAM, Proc. biol. soc. Washington, IV, p. 2. April 15, 1887.

1897. [*Peromyscus*] *anthonyi* TROUESSART, Catal. mamm., pt. III, p. 517.

TYPE LOCALITY. — Camp Apache, Grant County, New Mexico.

Peromyscus attwateri Allen.

1895. *Peromyscus attwateri* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 330. November 8, 1895.

TYPE LOCALITY. — Turtle Creek, Kerr County, Texas.

Peromyscus auripectus (Allen).

1893. *Sitomys auripectus* ALLEN, Bull. Amer. mus. nat. hist., V, p. 75. April 28, 1893.

1895. *Peromyscus auripectus* Allen, Bull. Amer. mus. nat. hist., vii, p. 226. June 29, 1895.

Type locality. — Bluff City, San Juan County, Utah.

Peromyscus auritus Merriam.

1898. *Peromyscus auritus* Merriam, Proc. biol. soc. Washington, xii, p. 119. April 30, 1898.

Type locality.— Mountains fifteen miles west of Oaxaca, State of Oaxaca, Mexico.

Peromyscus austerus (Baird).

1855. *Hesperomys austerus* Baird, Proc. acad. nat. sci. Phila., vii, p. 336. April, 1855.

1897. *P[eromyscus] austerus* Bangs, Amer. nat., xxxi, p. 75. January, 1897.

Type locality.—Spokane Plain, Spokane County, Washington.

Peromyscus aztecus (Saussure).

1860. *Hesperomys aztecus* Saussure, Revue et mag. de zoologie, 2d ser., xii, p. 105.

1897. *Peromyscus aztecus* Allen and Chapman, Bull. Amer. mus. nat. hist., ix, p. 8. February 23, 1897.

Type locality. — Southern Mexico.

Peromyscus banderanus Allen.

1897. *Peromyscus banderanus* Allen, Bull. Amer. mus. nat. hist., ix, p. 51. March 15, 1897.

Type locality. — Terro Tepic, Valle de Banderas, State of Jalisco, Mexico.

Peromyscus bellus Bangs.

1896. *Peromyscus bellus* Bangs, Proc. biol. soc. Washington, x, p. 137. December 28, 1896.

Type locality. — Stillwell, Boston Mts., Indian Territory.

Peromyscus boylii (Baird).

1855. *Hesperomys boylii* Baird, Proc. acad. nat. sci. Phila., vii, p. 335. April, 1855.

1896. *Peromyscus boylii* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 3. May 25, 1896. (Reprint: Proc. U. S. nat. mus., xix, p. 139. December 21, 1896.)

Type locality. —Middle Fork of American River, California.

Peromyscus boylii penicillatus Mearns.

1896. *Peromyscus boylii penicillatus* MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 2. May 25, 1896. (Reprint: Proc. U. S. nat. mus., XIX, p. 139. December 21, 1896.)

TYPE LOCALITY. — Foot-hills of the Franklin Mountains, near El Paso, El Paso County, Texas.

Peromyscus boylii pinalis (MILLER).

1893. *Sitomys rowleyi pinalis* MILLER, Bull. Amer. mus. nat. hist., V, p. 331. December 16, 1893.

1896. *P*[*eromyscus*] *b*[*oylii*] *pinalis*, MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 3. May 25, 1896. (Reprint: Proc. U. S. nat. mus., XIX, p. 139. December 21, 1896.)

TYPE LOCALITY. — Granite Gap, Grant County, New Mexico.

Peromyscus boylii rowleyi (Allen).

1893. *Sitomys rowleyi* ALLEN. Bull. Amer. mus. nat. hist., V, p. 76. April 28, 1893.

1896. *P*[*eromyscus*] *b*[*oylii*] *rowleyi* MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 3. May 25, 1896. (Reprint: Proc. U. S. nat. mus., XIX, p. 139. December 21, 1896.)

TYPE LOCALITY. — Nolan's Ranch, San Juan County, Utah.

* **Peromyscus californicus** (Gambel).

1848. *Mus californicus* GAMBEL, Proc. acad. nat. sci. Phila., IV, p. 78. August, 1848.

1885. *Hesperomys californicus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 597. 1885.

1895. *Peromyscus californicus* RHOADS, Proc. acad. nat. sci. Phila., p. 34. February 21, 1895.

TYPE LOCALITY. — Monterey, Monterey County, California.

Peromyscus canadensis (Miller).

1893. *Sitomys americanus canadensis* MILLER, Proc. biol. soc. Washington, VIII, p. 55. June 20, 1893.

1896. *Peromyscus canadensis* BANGS, Proc. biol. soc. Washington, X, p. 49. March 9, 1896.

TYPE LOCALITY. — Peterboro, Madison County, New York.

Peromyscus canadensis abietorum Bangs.

1896. *Peromyscus canadensis abietorum* Bangs, Proc. biol. soc. Washington, x, p. 49. March 9, 1896.

Type locality. — James River, Nova Scotia.

Peromyscus canadensis nubiterrae Rhoads.

1896. *Peromyscus leucopus nubiterrae* Rhoads, Proc. acad. nat. sci. Phila., p. 187. April, 1896.

1897. *Peromyscus canadensis nubiterrae* Rhoads, Proc. acad. nat. sci. Phila., p. 213. May, 1897.

Type locality. — Summit of Roan Mountain, Mitchell County, North Carolina. Altitude, 6370 feet.

Peromyscus canadensis umbrinus Miller.

1897. *Peromyscus canadensis umbrinus* Miller, Proc. Boston soc. nat. hist., xxviii, p. 23. April, 1897.

Type locality. — Peninsula Harbor, north shore of Lake Superior, Ontario, Canada.

Peromyscus canus Mearns.

1896. *Peromyscus canus* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 3. March 25, 1896. (Reprint: U. S. nat. mus., xviii, p. 445. May 23, 1896.)

Type locality. — Fort Clark, Kinney County, Texas.

Peromyscus cedrosensis Allen.

1898. *Peromyscus cedrosensis* Allen, Bull. Amer. mus. nat. hist., x, p. 154. April 12, 1898.

Type locality. — Cerros Island, Lower California, Mexico.

Peromyscus cherriei (Allen.)

1891. *Hesperomys* (*Vesperimus*) *cherriei* Allen, Bull. Amer. mus. nat. hist., iii, p. 211. April 17, 1891.

1897. *Peromyscus cherriei* Allen, Bull. Amer. mus. nat. hist., ix, p. 35. March 11, 1897.

Type locality. — La Carpintera, Costa Rica.

Peromyscus cineritius Allen.

1898. *Peromyscus cineritius* Allen, Bull. Amer. mus. nat. hist., x, p. 155. April 12, 1898.

Type locality. —San Roque Island, Lower California, Mexico.

Peromyscus comptus Merriam.

1898. *Peromyscus comptus* MERRIAM, Proc. biol. soc. Washington, XII, p. 120. April 30, 1898.

TYPE LOCALITY. — Mountains, near Chilpancingo, State of Guerrero, Mexico.

Peromyscus crinitus (Merriam).

1891. *Hesperomys crinitus* MERRIAM, North Amer. fauna, no. 5, p. 53. July 30, 1891.

TYPE LOCALITY. — Shoshone Falls, Snake River, Lincoln County, Idaho.

Peromyscus crinitus scitulus Bangs.

1899. *Peromyscus crinitus scitulus* BANGS, Proc. New England zool. club, I, p. 67. July 31, 1899.

TYPE LOCALITY. — Gardnerville, Douglas County, Nevada.

Peromyscus difficilis (Allen).

1891. *Vesperimus difficilis* ALLEN, Bull. Amer. mus. nat. hist., III, p. 298. June 30, 1891.

1897. [*Peromyscus*] *difficilis* TROUESSART, Catal. mamm., pt. III, p. 518.

TYPE LOCALITY. — Sierra de Valparaiso, State of Zacatecas Mexico.

Peromyscus dubius Allen.

1898. *Peromyscus dubius* ALLEN, Bull. Amer. mus. nat. hist., X, p. 157. April 12, 1898.

TYPE LOCALITY. — Todos Santos Island, Lower California, Mexico.

Peromyscus dyselius Elliot.

1898. *Peromyscus dyselius* ELLIOT, Field Columb. mus. publication 27, zool. ser., I, p. 207. March, 1898.

TYPE LOCALITY. — Portola, San Mateo County, California.

* **Peromyscus eremicus** (Baird).

1857. *Hesperomys eremicus* BAIRD, Mamm. N. Amer., p. 479.

1885. *Hesperomys leucopus eremicus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 597. 1885.

1895. *Peromyscus eremicus* ALLEN. Bull. Amer. mus. nat. hist., VII, p. 226. June 29, 1895.

TYPE LOCALITY. — Old Fort Yuma, San Diego County, California.

Peromyscus eremicus arenarius Mearns.

1896. *Peromyscus eremicus arenarius* MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 2. May 25, 1896. (Reprint: Proc. U. S. nat. mus., XIX, p. 138. December 21, 1896.)

TYPE LOCALITY. — Banks of the Rio Grande, about six miles from El Paso, El Paso County, Texas.

Peromyscus eremicus propinquus ALLEN.

1898. *Peromyscus eremicus propinquus* ALLEN, Bull. Amer. mus. nat. hist., X, p. 154. April 12, 1898.

TYPE LOCALITY. — San Pablo Point, San Pablo Bay, Lower California, Mexico.

Peromyscus eva THOMAS.

1898. *Peromyscus eva* THOMAS, Ann. and mag. nat. hist., 7th ser., I, p. 44. January, 1898.

TYPE LOCALITY.— San José del Cabo, Lower California, Mexico.

Peromyscus exiguus ALLEN.

1898. *Peromyscus exiguus* ALLEN, Bull. Amer. mus. nat. hist., X, p. 157. April 12, 1898.

TYPE LOCALITY. — San Martin Island, Lower California, Mexico.

Peromyscus felipensis MERRIAM.

1898. *Peromyscus felipensis* MERRIAM, Proc. biol. soc. Washington, XII, p. 122. April 30, 1898.

TYPE LOCALITY. — Cerro San Felipe, State of Oaxaca, Mexico. Altitude, 10,200 feet.

Peromyscus floridanus (Chapman).

1889. *Hesperomys floridanus* CHAPMAN, Bull. Amer. mus. nat. hist., II, p. 117. June 7, 1889.

1896. *Peromyscus floridanus* BANGS, Proc. biol. soc. Washington, X, p. 122. November 5, 1896.

TYPE LOCALITY. — Gainesville, Alachua County, Florida.

Peromyscus fraterculus (Miller).

1892. *Vesperimus fraterculus* MILLER, Amer. nat., XXVI, p. 261. March, 1892.

1897. [*Peromyscus*] *fraterculus* TROUESSART, Catal. mamm., pt. III, p. 515.

TYPE LOCALITY. — Dulzura, San Diego County, California.

Peromyscus furvus Allen and Chapman.

1897. *Peromyscus furvus* ALLEN and CHAPMAN, Bull. Amer. mus. nat. hist., IX, p. 201. June 16, 1897.

TYPE LOCALITY. —Jalapa, State of Vera Cruz, Mexico.

Peromyscus geronimensis ALLEN.

1898. *Peromyscus geronimensis* ALLEN, Bull: Amer. mus. nat. hist., V, p. 156. April 12, 1898.

TYPE LOCALITY. — San Geronimo Island, Lower California, Mexico.

Peromyscus gilberti (ALLEN).

1893. *Sitomys gilberti* ALLEN, Bull. Amer. mus. nat. hist., V, p. 188. August 18, 1893.

1896. *Peromyscus gilberti* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 267. December 4, 1896.

TYPE LOCALITY.— Bear Valley, San Benito County, California.

* **Peromyscus gossypinus** (Le Conte).[1]

1853. *Hesperomys gossypinus* LE CONTE, Proc. acad. nat. sci. Phila., VI, p. 411.

1885. *Hesperomys leucopus gossypinus* TRUE, Proc. U. S. nat. mus., VII (1894), p. 597. 1895.

1896. *Peromyscus gossypinus* RHOADS, Proc. acad. nat. sci. Phila., p. 189. April 21, 1896.

TYPE LOCALITY. — Georgia; probably the Le Conte Plantation, near Riceboro, Liberty County (see Bangs, Proc. biol. soc. Washington, X, p. 123, November 5, 1896).

Peromyscus gossypinus mississippiensis RHOADS.

1896. *Peromyscus gossypinus mississippiensis* RHOADS, Proc. acad. nat. sci. Phila., p. 189. April 21, 1896.

TYPE LOCALITY. — Samburg, Reelfoot Lake, Tennessee.

Peromyscus gossypinus nigriculus BANGS.

1896. *Peromyscus gossypinus nigriculus* BANGS, Proc. biol. soc. Washington, X, p. 124. November 5, 1896.

TYPE LOCALITY. — Burbridge, Plaquemines Parish, Louisiana.

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[1] The subspecies of *Peromyscus gossypinus* have been revised by Bangs (Proc. biol. soc. Washington, X, pp. 119-125, November 5, 1896).

Peromyscus gossypinus palmarius Bangs.

1896. *Peromyscus gossypinus palmarius* Bangs, Proc. biol. soc. Washington, x, p. 124. November 5, 1896.

Type locality. — Oak Lodge, on the east peninsula opposite Micco, Brevard County, Florida.

Peromyscus gratus Merriam.

1898. *Peromyscus gratus* Merriam, Proc. biol. soc. Washington, x, p. 123. April 30, 1898.

Type locality. — Tlalpam, near City of Mexico, Mexico.

Peromyscus guatemalensis Merriam.

1898. *Peromyscus guatemalensis* Merriam, Proc. biol. soc. Washington, xii, p. 118. April 30, 1898.

Type locality.— Todos Santos, Guatemala. Altitude, 10,000 feet.

Peromyscus gymnotis Thomas.

1894. *Peromyscus gymnotis* Thomas, Ann. and mag. nat., hist., 6th ser., xiv, p. 365. November, 1894.

Type locality. — Guatemala.

Peromyscus herronii (Rhoads).

1893. *Sitomys herronii* Rhoads, Amer. nat., xxvii, p. 832. September, 1893.

1897. [*Peromyscus*] *herroni* Trouessart, Catal. mamm., pt. iii, p. 516.

Type locality. — San Bernardino Valley, California.

Peromyscus herroni nigellus (Rhoads).

1894. *Sitomys herroni nigellus* Rhoads, Proc. acad. nat. sci. Phila., p. 257. October, 1894.

1897. [*Peromyscus*] *herroni nigellus* Trouessart, Catal. mamm., pt. iii, p. 516.

Type locality. — West Cajon Pass, San Bernardino Mountains, San Bernardino County, California.

Peromyscus hylocetes Merriam.

1898. *Peromyscus hylocetes* Merriam, Proc. biol. soc. Washington, xii, p. 124. April 30, 1898.

Type locality. — Patzcuaro, State of Michoacan, Mexico. Altitude, 8000 feet.

Peromyscus insignis Rhoads.

1895. *Peromyscus insignis* Rhoads, Proc. acad. nat. sci. Phila., p. 33. February 21, 1895.

Type locality. — Dulzura, San Diego County, California.

Peromyscus insolatus (Rhoads).[1]

1894. *Sitomys insolatus* Rhoads, Proc. acad. nat. sci. Phila., p. 256. October, 1894.

1897. [*Peromyscus*] *insolatus* Trouessart, Catal. mamm., pt. III, p. 515.

Type locality. — Oro Grande, Mohave Desert, Kern County, California.

Peromyscus insulanus Bangs.

1898. *Peromyscus insulanus* Bangs, Proc. Boston soc. nat. hist., XXVIII, p. 196. March, 1898.

Type locality. — North end of Cumberland Island, Camden County, Georgia.

Peromyscus keeni (Rhoads).

1894. *Sitomys keeni* Rhoads, Proc. acad. nat. sci. Phila., p. 258. October, 1894.

1897. *P*[*eromyscus*] *keeni* Bangs, Amer. nat., XXXI, p. 75. January, 1897.

Type locality. — Masset, Graham Island, Queen Charlotte Islands, British Columbia, Canada.

Peromyscus lepturus Merriam.

1898. *Peromyscus lepturus* Merriam, Proc. biol. soc. Washington, XII, p. 118. April 30, 1898.

Type locality. — Mt. Zempoaltepec, State of Oaxaca, Mexico. Altitude, 8200 feet.

* **Peromyscus leucopus** (Rafinesque).

1818. *Musculus leucopus* Rafinesque, American monthly magazine, III, p. 446. October, 1818.

1885. *Hesperomys leucopus leucopus* True, Proc. U. S. nat. mus., VII (1884), p. 597. 1885.

1891. *Vesperimus americanus* Allen, Bull. Amer. mus. nat. hist., III, p. 297. June 30, 1891.

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[1] Type of the subgenus *Trinodontomys* (Rhoads, Proc. acad. nat. sci. Phila., 1894, p. 257. October, 1894).

1895. *Peromyscus leucopus* THOMAS, Ann. and Mag. nat. hist., 6th ser., XVI, p. 192. February, 1895.

TYPE LOCALITY. — Pine barrens of Kentucky.

Peromyscus leucopus noveboracensis (Fischer).

1829. [*Mus sylvaticus*] *noveboracensis*, FISCHER, Synopsis mammalium, p. 318.

1897. *Peromyscus leucopus noveboracensis* MILLER, Proc. Boston soc. nat. hist., XXVIII, p. 22. April 30, 1897.

TYPE LOCALITY. — New York.

Peromyscus leucurus Thomas.

1894. *Peromyscus leucurus* THOMAS, Ann. and mag. nat. hist., 6th ser., XIV, p. 364. November, 1894.

TYPE LOCALITY. — Tehuantepec, Mexico.

Peromyscus levipes Merriam.

1898. *Peromyscus levipes* MERRIAM, Proc. biol. soc. Washington, XII, p. 123. April 30, 1898.

TYPE LOCALITY. — Mt. Malinche, State of Tlaxcala, Mexico. Altitude, 8400 feet.

Peromyscus macropus (Merriam).

1890. *Hesperomys macropus* MERRIAM, North Amer. fauna, no. 4, p. 53. October 8, 1890.

TYPE LOCALITY. — Lake Worth, Dade County, Florida.

Regarded by Chapman (Bull. Amer. mus. nat. hist., VI, p. 336, November 30, 1894) as identical with *P. floridanus*.

Peromyscus macrorhinus (Rhoads)

1894. *Sitomys macrorhinus* RHOADS, Proc. acad. nat. sci. Phila., p. 259. October, 1894.

1897. *P*[*eromyscus*] *macrorhinus* BANGS, Amer. nat. XXXI, p. 75. January, 1897.

TYPE LOCALITY. — Skeena River, British Columbia, Canada.

Peromyscus madrensis Merriam.

1898. *Peromyscus madrensis* MERRIAM, Proc. biol. soc. Washington, XII, p. 16. January 27, 1898.

TYPE LOCALITY. — Maria Madre Island, Tres Marias Islands, State of Jalisco, Mexico.

Peromyscus major (Rhoads).

1893. *Sitomys major* Rhoads, Amer. nat. xxix, p. 831. September, 1893.

1897. [*Peromyscus*] *major* Trouessart, Catal. mamm., pt. iii, p. 516.

Type locality. — Squirrel Inn, San Bernardino County, California.

Peromyscus maniculatus (Wagner).

1845. *Hesperomys maniculatus* Wagner, Wiegmann's Arch. f. Naturg., xi, Bd. i, p. 148.

1898. *Peromyscus maniculatus* Bangs, Amer. nat., xxxii, p. 496. July. 1898.

Type locality. — The Moravian Settlements in Labrador.

Peromyscus martirensis (Allen).

1893. *Sitomys martirensis* Allen, Bull. Amer. mus. nat. hist., v, p. 187. August 18, 1893.

1897. [*Peromyscus*] *martirensis* Trouessart, Catal. mamm., pt. iii, p. 516.

Type locality. — San Pedro Martir Mountains, Lower California, Mexico. Altitude, 7000 feet.

Peromyscus mearnsii (Allen).

1891. *Vesperimus mearnsii* Allen, Bull. Amer. mus. nat. hist., iii, p. 299. June 30, 1891.

1895. *P*[*eromyscus*] *mearnsii* Attwater, Bull. Amer. mus. nat. hist., v, p. 331. November 8, 1895.

Type locality. — Brownsville, Cameron County, Texas.

Peromyscus megacephalus (Rhoads).

1894. *Sitomys megacephalus* Rhoads, Proc. acad. nat. sci. Phila., p. 254. October, 1894.

1896. *Peromyscus megacephalus* Rhoads, Proc. acad. nat. sci. Phila., p. 191. April, 1896.

Type locality. — Woodville, Jackson County, Alabama.

Regarded by Bangs (Proc. biol. soc. Washington, x, p. 120, November 5, 1896) as identical with the typical form of *P. gossypinus*.

Peromyscus megalops Merriam.

1898. *Peromyscus megalops* Merriam, Proc. biol. soc. Washington, xii, p. 119. April 30, 1898.

Type locality. — Mountains near Ozolotepec, State of Oaxaca, Mexico.

Peromyscus megalotis (Merriam).

1890. *Hesperomys megalotis* Merriam, North Amer. fauna, no. 3, p 64. September 11, 1890.

1895. *Peromyscus megalotis* Allen, Bull. Amer. mus. nat. hist., vii, p. 229. June 29, 1895.

Type locality. — Black Tank, Desert of the Little Colorado, Coconino County, Arizona.

Peromyscus mekisturus Merriam.

1898. *Peromyscus mekisturus* Merriam, Proc. biol. soc. Washington, xii, p. 124. April 30, 1898.

Type locality. — Chalchicomula, State of Puebla, Mexico. Altitude, 8400 feet.

* **Peromyscus melanophrys** (Coues).

1874. *Hesperomys* (*Vesperimus*) *melanophrys* Coues, Proc. acad. nat. sci. Phila., p. 181. December 15, 1874.

1885. *Hesperomys melanophrys* True, Proc. U. S. nat. mus., vii (1884), p. 598. 1885.

1897. *P*[*eromyscus*] *melanophrys* Allen, Bull. Amer. mus. nat. hist., ix, p. 51. March 15, 1897.

Type locality. — Santa Efigenia, Tehuantepec, Mexico.

Peromyscus melanotis Allen and Chapman.

1897. *Peromyscus melanotis* Allen and Chapman, Bull. Amer. mus. nat. hist., ix, p. 203. June 16, 1897.

Type locality. — Las Vigas, State of Vera Cruz, Mexico.

Peromyscus merriami Mearns.

1896. *Peromyscus merriami* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 2. May 25, 1896. (Reprint: Proc. U. S. nat. mus., xix, p. 138. December 21, 1896.)

Type locality. — Village of Sonoyta, on the Sonoyta River, State of Sonora, Mexico.

* **Peromyscus mexicanus** (Saussure).

1860. *Hesperomys mexicanus* Saussure, Revue et magasin de zoologie, 2d ser., xii, p. 103.

1885. *Hesperomys mexicanus* True, Proc. U. S. nat mus., vii (1884), p. 597. 1885.

1897. *Peromyscus mexicanus* ALLEN, Bull. Amer. mus. nat. hist., IX, p. 51. March 15, 1897.

TYPE LOCALITY. — State of Vera Cruz, Mexico (see Allen, Bull. Amer. mus. nat. hist., IX, p. 51. March 15, 1897).

Peromyscus mexicanus orizabae Merriam.

1898. *Peromyscus mexicanus orizabae* MERRIAM, Proc. biol. soc. Washington, XII, p. 121. April 30, 1898.

TYPE LOCALITY. — Orizaba, State of Vera Cruz, Mexico. Altitude, 4200 feet.

Peromyscus mexicanus saxatilis Merriam.

1898. *Peromyscus mexicanus saxatilis* MERRIAM, Proc. biol. soc. Washington, XII, p. 121. April 30, 1898.

TYPE LOCALITY. — Jacaltenango, Huehuetenango, Guatemala.

Peromyscus mexicanus totontepecus Merriam.

1898. *Peromyscus mexicanus totontepecus* MERRIAM, Proc. biol. soc. Washington, XII, p. 120. April 30, 1898.

TYPE LOCALITY. — Totontepec, State of Oaxaca, Mexico. Altitude, 6500 feet.

* **Peromyscus michiganensis** (Audubon and Bachman).

1842. *Mus michiganensis* AUDUBON and BACHMAN, Journ. acad. nat. sci. Phila., VIII, pt. II, p. 304.

1885. *Hesperomys michiganensis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 597. 1885.

1896. *Peromyscus michiganensis* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 238. November 21, 1896.

TYPE LOCALITY.— Erie County, Ohio.

Peromyscus michiganensis pallescens Allen.

1896. *Peromyscus michiganensis pallescens* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 238. November 21, 1896.

TYPE LOCALITY.— San Antonio, Bexar County, Texas.

Peromyscus musculoides Merriam.

1898. *Peromyscus musculoides* MERRIAM, Proc. biol. soc. Washington, XII, p. 124. April 30, 1898.

TYPE LOCALITY. — Cuicatlan, State of Oaxaca, Mexico.

Peromyscus musculus (Merriam).

1892. *Sitomys musculus* MERRIAM, Proc. biol. soc. Washington, VIII, p. 170. December 29, 1892.

1897. *Peromyscus musculus* Allen and Chapman, Bull. Amer. mus. nat. hist., IX, p. 203. June 16, 1897.

Type locality. — Near City of Colima, State of Colima, Mexico.

Peromyscus musculus brunneus Allen and Chapman.

1897. *Peromyscus musculus brunneus* Allen and Chapman, Bull. Amer. mus. nat. hist., IX, p. 203. June 16, 1897.

Type locality. — Jalapa, State of Vera Cruz, Mexico.

Peromyscus nasutus (Allen).

1891. *Vesperimus nasutus* Allen, Bull. Amer. mus. nat. hist., III, p. 299. June 30, 1891.

Type locality. — Estes Park, Larimer County, Colorado.

Peromyscus nelsoni Merriam.[1]

1898. *Peromyscus* (*Megadontomys*) *nelsoni* Merriam, Proc. biol. soc. Washington, XII, p. 116. April 30, 1898.

Type locality. — Jico, State of Vera Cruz, Mexico. Altitude, 6000 feet.

Peromyscus niveiventris (Chapman).

1889. *Hesperomys niveiventris* Chapman, Bull. Amer. mus. nat. hist., II, p. 117. June 7, 1889.

1896. *Peromyscus niveiventris* Bangs, Proc. biol. soc. Washington, X, p. 121. November 5, 1896.

Type locality. — On the east peninsula, opposite Micco, Brevard County, Florida.

Peromyscus nudipes (Allen).

1891. *Hesperomys* (*Vesperimus*?) *nudipes* Allen, Bull. Amer. mus. nat. hist., III, p. 213. April 17, 1891.

1897. *Peromyscus nudipes* Alfaro, Mammiferos de Costa Rica, p. 35.

Type locality. — La Carpintera, Costa Rica.

* **Peromyscus nuttalli** (Harlan).

1832. *Arvicola nuttalli* Harlan, Monthly Amer. journ. geol. and nat. sci. Phila., p. 446. April, 1832.

1885. *Hesperomys aureolus* True, Proc. U. S. nat. mus., VII (1884), p. 598. 1885.

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[1] Placed by Merriam in the subgenus *Megadontomys*.

1898. *Peromyscus nuttalii* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 197. March, 1898.

TYPE LOCALITY. — Norfolk, Norfolk County, Virginia.

Peromyscus oaxacensis Merriam.

1898. *Peromyscus oaxacensis* MERRIAM, Proc. biol. soc. Washington, XII, p. 122. April 30, 1898.

TYPE LOCALITY. Cerro San Felipe, State of Oaxaca, Mexico. Altitude, 10,000 feet.

Peromyscus oreas Bangs.

1898. *Peromyscus oreas* BANGS, Proc. biol. soc. Washington, XII, p. 84. March 24, 1898.

TYPE LOCALITY. — Mt. Baker Range, British Columbia, near boundary of Whatcom County, Washington. Altitude, 6500 feet.

Peromyscus phasma Bangs.

1898. *Peromyscus phasma* BANGS, Proc. Boston soc.. nat. hist., XXVIII, p. 199. March, 1898.

TYPE LOCALITY. — Point Romo, Anastasia Island, St. John County, Florida.

Peromyscus robustus (Allen).

1893. *Sitomys robustus* ALLEN, Bull. Amer. mus. nat. hist., V, p. 335. December 16, 1893.

1897. [*Peromyscus*] *robustus* TROUESSART, Catal. mamm., pt. III, p. 516.

TYPE LOCALITY. — Lakeport, Lake County, California.

Peromyscus rufinus (Merriam).

1890. *Hesperomys leucopus rufinus* MERRIAM, North Amer fauna, no. 3, p. 65. September 11, 1890.

1896. *Peromyscus rufinus* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 252. November 25, 1896.

TYPE LOCALITY. — San Francisco Mountain, Coconino County, Arizona. Altitude, 9000 feet.

Peromyscus sitkensis Merriam.

1897. *Peromyscus sitkensis* MERRIAM, Proc. biol. soc. Washington, XI, p. 223. July 15. 1897.

TYPE LOCALITY. — Sitka, Alaska.

Peromyscus spicilegus Allen.

1897. *Peromyscus spicilegus* ALLEN, Bull. Amer. mus. nat. hist., IX, p. 50. March 15, 1897.

TYPE LOCALITY. — Mineral San Sebastian, Mascota, State of Jalisco, Mexico.

Peromyscus stephensi Mearns.

1897. *Peromyscus stephensi* MEARNS, Proc. U. S. nat. mus., XIX, p. 721. July 30, 1897.

TYPE LOCALITY. — The lowest water on the wagon road, in a canyon at the east base of the Coast Range Mountains, San Diego County, California.

Peromyscus subgriseus (Chapman).

1893. *Sitomys niveiventris subgriseus* CHAPMAN, Bull. Amer. mus. nat. hist., V, p. 340. December 22, 1893.

1898. *Peromyscus subgriseus* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 200. March, 1898.

TYPE LOCALITY. — Gainesville, Alachua County, Florida.

Peromyscus subgriseus baliolus Bangs.

1898. *Peromyscus subgriseus arenarius* Bangs, Proc. Boston soc. nat. hist., XXVIII, p. 202. March, 1898. (Not *P. eremicus arenarius* Mearns, 1896.)

1898. *Peromyscus subgriseus baliolus* BANGS, Science, n. s., VIII, p. 215. August 19, 1898.

TYPE LOCALITY. — Hursman's Lake, Savannah River, near Bascom, Scriven Co., Georgia.

Peromyscus subgriseus rhoadsi Bangs.

1898. *Peromyscus subgriseus rhoadsi* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 201. March, 1898.

TYPE LOCALITY. — Anclote River, Hillsboro County, Florida.

Peromyscus taylori (Thomas).[1]

1887. *Hesperomys* (*Vesperimus*) *taylori* THOMAS, Ann. and mag. nat. hist., 5 ser., XIX, p. 66. January, 1887.

1896. *Peromyscus* (*Baiomys*) *taylori* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 65. April 22, 1896.

TYPE LOCALITY. — San Diego, Duval Co., Texas.

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[1] This species has been made type of the subgenus *Baiomys* (True, Proc. U. S. nat mus., XVI, p. 758, February 7, 1893).

Peromyscus tehuantepecus Merriam.

1898. *Peromyscus tehuantepecus* Merriam, Proc. biol. soc. Washington, xii, p. 122. April 30, 1898.

Type locality. — Tehuantepec, State of Oaxaca, Mexico.

Peromyscus texanus (Woodhouse).

1853. *Hesperomys texanus* Woodhouse, Proc. acad. nat. sci. Phila., vi, p. 242. February, 1853.

1896. *Peromyscus texanus* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 4. March 25, 1896. (Reprint: Proc. U. S. nat. mus., xviii, p. 446. May 23, 1896.)

Type locality. — Western Texas.

Peromyscus texanus arcticus (Mearns).

1890. *Hesperomys leucopus arcticus* Mearns, Bull. Amer. mus. nat. hist., ii, p. 285. February 21, 1890.

1896. *Peromyscus texanus arcticus* Allen, Bull. Amer. mus. nat. hist., viii, p. 252. November 25, 1896.

Type locality. — Fort Simpson, Mackenzie, Canada.

Peromyscus texanus arizonae (Allen).

1894. *Sitomys americanus arizonae* Allen, Bull. Amer. mus. nat. hist., vi, p. 321. November 7, 1894.

Type locality. — Fairbank, Cochise County, Arizona.

Afterward regarded by Allen (Bull. Amer. mus. nat. hist., vii, p. 229, June 29, 1895) as a synonym of *Hesperomys sonoriensis* Le Conte.

Peromyscus texanus artemisiae (Rhoads).

1894. *Sitomys americanus artemisiae* Rhoads, Proc. acad. nat. sci. Phila., p. 260. October, 1894.

Type locality.— Ashcroft, British Columbia, Canada.

Peromyscus texanus clementis (Mearns).

1896. *Peromyscus texanus clementis* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 4. March 25, 1896. (Reprint: Proc. U. S. nat. mus., xviii, p. 446. May 23, 1896).

Type locality. — San Clemente Island, Los Angeles County, California.

Peromyscus texanus coolidgei (Thomas).

1898. *Peromyscus leucopus coolidgei* Thomas, Ann. and mag. nat. hist., 7th ser., i, p. 45. January, 1898.

Type locality. — Santa Anita, Cape Region of Lower California, Mexico.

Peromyscus texanus deserticola (Mearns).

1890. *Hesperomys leucopus deserticolus* Mearns, Bull. Amer. mus. nat. hist., ii, p. 285. Described on page 287. February 21, 1890.

1896. *P*[*eromyscus*] *t*[*exanus*] *deserticolus* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 4. March 25, 1896. (Reprint: Proc. U. S. nat. mus., xviii, p. 446. May 23, 1896.)

Type locality. — Mohave Desert, San Bernardino County, California.

Peromyscus texanus gambelii (Baird).

1857. *Hesperomys gambelii* Baird, Mamm. N. Amer., p. 464.

1896. *P*[*eromyscus*] *t*[*exanus*] *gambelii* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 4. March 25, 1896. (Reprint: Proc. U. S. nat. mus., xviii, p. 446. May 23, 1896).

Type locality. — Monterey, Monterey County, California (see Allen, Bull. Amer. mus. nat. hist., v, p. 191, August 18, 1893).

Peromyscus texanus medius Mearns.

1896. *Peromyscus texanus medius* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 4. March 25, 1896. (Reprint: Proc. U. S. nat. mus., xviii, p. 446. May 23, 1896).

Type locality.—Nachoguero Valley, Lower California, Mexico.

Peromyscus texanus nebrascensis (Mearns).

1890. *Hesperomys leucopus nebrascensis* Mearns, Bull. Amer. mus. nat. hist., ii, p. 285. Described on page 287. February 21, 1890.

1896. *Peromyscus texanus nebrascensis* Allen, Bull. Amer. mus. nat. hist., viii, p. 251. November 25, 1896.

Type locality. — Calf Creek, central Montana.

Peromyscus texanus saturatus Bangs.

1897. *Peromyscus texanus saturatus* BANGS, Amer. nat., XXXI, p. 75. January, 1897.

TYPE LOCALITY. — Saturna Island, in the Gulf of Georgia, half way between Victoria and Vancouver City, British Columbia, Canada.

* **Peromyscus texanus sonoriensis** (Le Conte).

1853. *Hesperomys sonoriensis* LE CONTE, Proc. acad. nat. sci. Phila., p. 413.

1885. *Hesperomys leucopus sonoriensis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 597. 1885. (Part.)

1896. [*Peromyscus texanus*] *sonoriensis* MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 3. March 25, 1896. (Reprint: Proc. U. S. nat. mus., XVIII, p. 446. May 23, 1896).

TYPE LOCALITY. — Santa Cruz, State of Sonora, Mexico.

Peromyscus texanus subarcticus Allen.

1899. *Peromyscus texanus subarcticus* ALLEN, Bull. Amer. mus. nat. hist., XII, p. 15. March 4, 1899.

TYPE LOCALITY. — Deerlodge County, Montana.

Peromyscus texanus thurberi (Allen).

1893. *Sitomys americanus thurberi* ALLEN, Bull. Amer. mus. nat. hist., V, p. 185. August 18, 1893.

1896. *P*[*eromyscus*] *t*[*exanus*] *thurberi* MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 4. March 25, 1896. (Reprint: Proc. U. S. nat. mus., XVIII, p. 446. May 23, 1896.)

TYPE LOCALITY. — San Pedro Martir Mountains, Lower California, Mexico. Altitude, 8200 feet.

Peromyscus thomasi Merriam.[1]

1898. *Peromyscus* (*Megadontomys*) *thomasi* MERRIAM, Proc. biol. soc. Washington, XII, p. 116. April 30, 1898.

TYPE LOCALITY. — Mountains near Chilpancingo, State of Guerrero, Mexico. Altitude 9700 feet.

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[1] This species has been made type of the subgenus *Megadontomys* (Merriam, Proc. biol. soc. Washington, XII, p. 115, April 30, 1898). *P. nelsoni* is the only other known member of the group.

Peromyscus tiburonensis Mearns.

1897. *Peromyscus tiburonensis* MEARNS, Proc. U. S. nat. mus., XIX, p. 720. June 30, 1897.

TYPE LOCALITY. — Tiburon Island, Gulf of California, Mexico.

Peromyscus tornillo Mearns.

1896. *Peromyscus tornillo* MEARNS, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 3. March 25, 1896. (Reprint: Proc. U. S. nat. mus., XVIII, p. 445. May 23, 1896.)

TYPE LOCALITY. — Rio Grande, about six miles above El Paso, El Paso County, Texas.

Peromyscus truei (Shufeldt).

1886. *Hesperomys truei* SHUFELDT, Proc. U. S. nat. mus., VIII, p. 407. September 14, 1885.

1895. *P[eromyscus] truei* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 229. June 29, 1895.

TYPE LOCALITY. — Fort Wingate, Valencia County, New Mexico.

Peromyscus yucatanicus Allen and Chapman.

1897. *Peromyscus yucatanicus* ALLEN and CHAPMAN, Bull. Amer. mus. nat. hist., IX, p. 8. February 23, 1897.

TYPE LOCALITY. — Chichen-Itza, Yucatan.

Peromyscus zarhynchus Merriam.

1898. *Peromyscus zarhynchus* MERRIAM, Proc. biol. soc. Washington, XII, p. 117. April 30, 1898.

TYPE LOCALITY. — Tumbala, State of Chiapas, Mexico.

Peromyscus zarhynchus cristobalensis Merriam.

1898. *Peromyscus zarhynchus cristobalensis* MERRIAM, Proc. biol. soc., Washington, XII, p. 117. April 30, 1898.

TYPE LOCALITY. — San Cristobal, State of Chiapas, Mexico.

Genus **RHIPIDOMYS** Tschudi.

1845. *Rhipidomys* TSCHUDI, Fauna peruana, p. 183. Type. — *Hesperomys leucodactylus* TSCHUDI.

* **Rhipidomys sumichrasti** (Saussure).

1861. *Hesperomys sumichrasti* SAUSSURE, Revue et magasin de zoologie, 2d ser., XII, p. 107.

1885. *Hesperomys sumichrasti* TRUE, Proc. U. S. nat. mus., VII (1884), p. 598. 1885.

1897. [*Rhipidomys*] *sumichrasti* TROUESSART, Catal. mamm., pt. III, p. 519.

TYPE LOCALITY. — Eastern slope of mountains in State of Vera Cruz, Mexico.

Rhipidomys decolorus True.

1894. *Sitomys* (*Rhipidomys*) *decolorus* TRUE, Proc. U. S. nat. mus., XVI, p. 689. February 5, 1894.

1897. [*Rhipidomys*] *decolorus* TROUESSART, Catal. mamm., pt. III, p. 519.

TYPE LOCALITY. — Rio de las Piedras, Honduras.

Genus **TYLOMYS** Peters.

1866. *Tylomys* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 404. Type. — *Hesperomys* (*Tylomys*) *nudicaudus* PETERS.

* **Tylomys nudicaudus** (Peters).

1866. *Hesperomys* (*Tylomys*) *nudicaudus* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 404, pl. 1, figs. 1–4.

1885. *Hesperomys nudicaudus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 598. 1885.

1897. [*Tylomys*] *nudicaudus* TROUESSART, Catal. mamm., pt. III, p. 520.

TYPE LOCALITY. — Guatemala.

* **Tylomys panamensis** (Gray).

1873. *Neomys panamensis* GRAY, Ann. and mag. nat. hist., 4th ser., XII, p. 417.

1885. *Hesperomys panamensis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 598. 1885.

1897. [*Tylomys*] *panamensis* Trouessart, Catal. mamm., pt. iii, p. 520.

Type locality. — Panama.

Tylomys watsoni Thomas.

1899. *Tylomys watsoni* Thomas, Ann. and mag. nat. hist., 7th ser., iv, p. 278. October, 1899.

Type locality. — Bogava, Chiriqui, N. W. Panama. Altitude, 800 feet.

Genus **HOLOCHILUS** Brandt.

1835. *Holochilus* Brandt, Mem. de l'acad. imper. sci. St. Petersbourg, 6th ser., i, p. 428. Type. — *Mus* (*Holochilus*) *leucogaster* Brandt.

* **Holochilus pilorides** (Pallas).

1778. *Mus pilorides* Pallas, Nov. spec. quadr. glir. ord., p. 91.

1885. *Hesperomys pilorides* True, Proc. U. S. nat. mus., vii (1884), p. 598. 1885.

1897. [*Holochilus*] *pilorides* Trouessart, Catal. mamm., pt. iii, p. 520.

Type locality. — Island of Martinique, Lesser Antilles.

Genus **SIGMODON** Say and Ord.

1825. *Sigmodon* Say and Ord, Journ. acad. nat. sci. Phila., iv, pt. ii, p. 352. Type. — *Sigmodon hispidus* Say and Ord.

Sigmodon borucae Allen.

1897. *Sigmodon borucae* Allen, Bull. Amer. mus. nat. hist., ix, p. 40. March 11, 1897.

Type locality. — Boruca, Costa Rica.

Sigmodon colimae Allen.

1897. *Sigmodon colimae* ALLEN, Bull. Amer. mus. nat. hist., IX, p. 55. March 15, 1897.

TYPE LOCALITY. — Plains of Colima, State of Colima, Mexico.

Sigmodon fulviventer Allen.

1889. *Sigmodon fulviventer* ALLEN, Bull. Amer. mus. nat. hist., II, p. 180. October 21, 1889.

TYPE LOCALITY. — Zacatecas, State of Zacatecas, Mexico.

* **Sigmodon hispidus** Say and Ord.

1825. *Sigmodon hispidus* SAY and ORD, Journ. acad. nat. sci. Phila., IV, pt. II, p. 354.

1885. *Sigmodon hispidus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 598. 1885.

TYPE LOCALITY.— St. John's River, Florida.

Sigmodon hispidus arizonae Mearns.

1890. *Sigmodon hispidus arizonae* MEARNS, Bull. Amer. mus. nat. hist., II, p. 285. February 21, 1890.

TYPE LOCALITY. — Fort Verde, Yavapai County, Arizona.

Sigmodon hispidus eremicus Mearns.

1897. *Sigmodon hispidus eremicus* MEARNS. Preliminary diagnoses of new mammals of the genera Sciurus, Castor, Neotoma and Sigmodon, from the Mexican border of the United States, p. 4. March 15, 1897. (Reprint: Proc. U. S. nat. mus., XX, p. 504. January 19, 1898).

TYPE LOCALITY. —Cienega Well, thirty miles south of monument no. 204, Mexican boundary line, on the left bank of the Colorado River, State of Sonora, Mexico.

Sigmodon hispidus littoralis Chapman.

1889. *Sigmodon hispidus littoralis* CHAPMAN, Bull. Amer. mus. nat. hist., II, p. 118. June 7, 1889.

TYPE LOCALITY.— East Peninsula, opposite Micco, Brevard County, Florida.

Sigmodon hispidus pallidus Mearns.

1897. *Sigmodon hispidus pallidus* MEARNS, Preliminary diagnoses of new mammals of the genera Sciurus, Castor, Neotoma and Sigmodon, from the Mexican border of the United States, p. 4. March 15, 1897. (Reprint: Proc. U. S. nat. mus., XX, p. 504. January 19, 1898).

TYPE LOCALITY. — Left bank of the Rio Grande, about six miles above El Paso, El Paso County, Texas.

Sigmodon hispidus spadicipygus Bangs.

1898. *Sigmodon hispidus spadicipygus* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 192. March, 1898.

TYPE LOCALITY. — Cape Sable, Monroe County, Florida.

Sigmodon hispidus texianus (Audubon and Bachman).

1853. *Arvicola texiana* AUDUBON and BACHMAN, Quad. N. Amer., III, p. 229.

1891. *Sigmodon hispidus texianus* ALLEN, Bull. Amer. mus. nat. hist., III, p. 287. June 30, 1891.

TYPE LOCALITY. — Brasos River, Texas.

Sigmodon mascotensis Allen.

1897. *Sigmodon mascotensis* ALLEN, Bull. Amer. mus. nat. hist., IX, p. 54. March 15, 1897.

TYPE LOCALITY. — Mineral San Sebastian, Mascota, State of Jalisco, Mexico.

Sigmodon minimus Mearns.

1894. *Sigmodon minima* MEARNS, Proc. U. S. nat. mus., XVII, p. 130. July 19, 1894.

TYPE LOCALITY.—Upper corner monument, Grant County, New Mexico, on the Mexican boundary line, 100 miles west of the initial monument on the west bank of the Rio Grande.

Sigmodon toltecus (Saussure).

1860. *Hesperomys toltecus* SAUSSURE, Revue et magasin de zoologie, 2d ser., XII, p. 98.

1897. *Sigmodon toltecus* ALLEN, Bull. Amer. mus. nat. hist., IX, p. 54. March 15, 1897.

TYPE LOCALITY. — Mountains of the State of Vera Cruz, Mexico.

Genus **ORYZOMYS** Baird.

1857. *Oryzomys* BAIRD, Mamm. N. Amer., p. 458. Type.— *Mus palustris* HARLAN.

Oryzomys alfaroi (Allen).

1891. *Hesperomys* (*Oryzomys*) *alfaroi* Allen, Bull. Amer. mus. nat. hist., III, p. 214. April 17, 1891.

1894. *Oryzomys alfaroi* Allen, Abstract proc. Linn. soc. New York, 1893–1894, p. 36. July 20, 1894.

Type locality. — San Carlos, Costa Rica.

Oryzomys antillarum Thomas.

1898. *Oryzomys antillarum* Thomas, Ann. and mag. nat. hist., 7th ser., I, p. 177. February, 1898.

Type locality. — Jamaica.

Oryzomys aquaticus Allen.

1891. *Oryzomys aquaticus* Allen, Bull. Amer. mus. nat. hist., III, p. 289. June 30, 1891.

Type locality. — Brownsville, Cameron County, Texas.

Oryzomys bulleri Allen.

1897. *Oryzomys bulleri* Allen, Bull. Amer. mus. nat. hist., IX, p. 53. March 15, 1897.

Type locality. — Valle de Banderas, Terro Tepic, State of Jalisco, Mexico.

Oryzomys chapmani Thomas.

1898. *Oryzomys chapmani* Thomas, Ann. and mag. nat. hist., 7th ser., I, p. 179. February, 1898.

Type locality. — Jalapa, State of Vera Cruz, Mexico.

Oryzomys chrysomelas Allen.

1897. *Oryzomys chrysomelas* Allen, Bull. Amer. mus. nat. hist., IX, p. 37. March 11, 1897.

Type locality. — Suerre, Costa Rica.

Oryzomys costaricensis Allen.

1893. *Oryzomys costaricensis* Allen, Bull. Amer. mus. nat. hist., V, p. 239. September 22, 1893.

Type locality.— El General, Costa Rica. Altitude, 2150 feet.

* **Oryzomys couesi** (Alston).

1876. *Hesperomys couesi* Alston, Proc. zool. soc. London, p. 756.

1885. *Hesperomys couesi* True, Proc. U. S. nat. mus., VII (1884), p. 597. 1885.

1893. *Oryzomys couesi* THOMAS, Ann. and mag. nat. hist., 6th ser., XI, p. 403. May, 1893.

TYPE LOCALITY. — Coban, Guatemala (see Thomas, Ann. and mag. nat. hist., 6th ser., XI, p. 403, May, 1893).

Oryzomys fulgens Thomas.

1893. *Oryzomys fulgens* THOMAS, Ann. and mag. nat. hist., 6th ser., XI, p. 403. May, 1893.

TYPE LOCALITY. — " Mexico."

Oryzomys fulvescens (Saussure).

1860. *Hesperomys fulvescens* SAUSSURE, Revue et magasin de zoologie, 2d ser., XII, p. 102. March, 1860.

1897. *Oryzomys fulvescens* ALLEN and CHAPMAN, Bull. Amer. mus. nat. hist., IX, p. 204. June 16, 1897.

TYPE LOCALITY. — State of Vera Cruz, Mexico.

Oryzomys gracilis Thomas.

1894. *Oryxomys gracilis* THOMAS, Ann. and mag. nat. hist., 6th ser., XIV, p. 358. November, 1894.

1895. *Oryzomys gracilis* THOMAS, Ann. and mag. nat. hist., 6th ser., XVI, p. 57. July, 1895.

TYPE LOCALITY. — Concordia, Medellin, Colombia.

Oryzomys jalapae Allen and Chapman.

1897. *Oryzomys jalapae* ALLEN and CHAPMAN, Bull. Amer. mus. nat. hist. IX, p. 206. June 16, 1897.

TYPE LOCALITY. —Jalapa, State of Vera Cruz, Mexico.

Oryzomys melanotis Thomas.

1893. *Oryzomys melanotis* THOMAS, Ann. and mag. nat. hist., 6th ser., XI, p. 404. May, 1893.

TYPE LOCALITY. — Mineral San Sebastian, State of Jalisco, Mexico.

Oryzomys mexicanus Allen.

1897. *Oryzomys mexicanus* ALLEN, Bull. Amer. mus. nat. hist., IX, p. 52. March 15, 1897.

TYPE LOCALITY. — Hacienda San Marcos, Tonila, State of Jalisco, Mexico.

Oryzomys nelsoni Merriam.

1898. *Oryzomys nelsoni* MERRIAM, Proc. biol. soc. Washington, XII, p. 15. January 27, 1898.

Type locality.— Maria Madre Island, Tres Marias Islands, State of Jalisco, Mexico.

* **Oryzomys palustris** (Harlan).

1837. *Mus palustris* Harlan, Silliman's Amer. journ. sci., xxxi, p. 386.

1857. *Oryzomys palustris* Baird, Mamm. N. Amer., p. 459.

1885. *Hesperomys palustris* True, Proc. U. S. nat. mus., vii (1884), p. 597. 1885. (Part.)

Type locality.— Fast Land, near Salem, Salem County, New Jersey.

Oryzomys palustris coloratus Bangs.

1898. *Oryzomys palustris coloratus* Bangs, Proc. Boston soc. nat. hist., xxviii, p. 189. March, 1898.

Type locality.— Cape Sable, Monroe County, Florida.

Oryzomys palustris natator Chapman.

1893. *Oryzomys palustris natator* Chapman, Bull. Amer. mus. nat. hist., v, p. 44. March 17, 1893.

Type locality.— Gainesville, Alachua County, Florida.

Oryzomys palustris texensis Allen.

1894. *Oryzomys palustris texensis* Allen, Bull. Amer. mus. nat. hist., vi, p. 177. May 31, 1894.

Type locality. — Rockport, Aransas County, Texas.

Oryzomys peninsulae Thomas.

1897. *Oryzomys peninsulae* Thomas, Ann. and mag. nat. hist., 6th ser., xx, p. 548. December, 1897.

Type locality. — Santa Anita, Lower California, Mexico.

Oryzomys talamancae Allen.

1891. *Oryzomys talamancae* Allen, Proc. U. S. nat. mus., xiv, p. 193. July 24, 1891.

Type locality. — Talamanca, Costa Rica.

Oryzomys victus Thomas.

1898. *Oryzomys victus* Thomas, Ann. and mag. nat. hist., 7th ser., i, p. 177. February, 1898.

Type locality. — St. Vincent, Lesser Antilles.

Genus **ZYGODONTOMYS** Allen.

1897. *Zygodontomys* Allen, Bull. Amer. mus. nat. hist., IX, p. 38. March 11, 1897. Type.— *Oryzomys cherriei* Allen.

Zygodontomys cherriei (Allen).
1895. *Oryzomys cherriei* Allen, Bull. Amer. mus. nat. hist., VII, p. 329. November 8, 1895.
1897. *Zygodontomys cherriei* Allen, Bull. Amer. mus. nat. hist., IX, p. 38. March 11, 1897.
Type locality.— Boruca, Costa Rica.

Genus **SIGMODONTOMYS** Allen.

1897. *Sigmodontomys* Allen, Bull. Amer. mus. nat. hist., IX, p. 38. March 11, 1897. Type.— *Sigmodontomys alfari* Allen.

Sigmodontomys alfari Allen.
1897. *Sigmodontomys alfari* Allen, Bull. Amer. mus. nat. hist., IX, p. 39. March 11, 1897.
Type locality. — Jiménez, Costa Rica. Altitude, 700 feet.

Genus **REITHRODONTOMYS** Giglioli.[1]

1873. *Reithrodontomys* Giglioli, Richerche intorno alla distrib. geog. gener., p. 60. Type.— *Reithrodon* from North America = *Mus lecontii* Audubon and Bachman.

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[1] A synopsis was published by Allen in 1895 (Bull. Amer. mus. nat. hist., VII, pp. 107–143, May 21, 1895), but the subsequent increase of nearly 100 per cent in the number of known forms makes it necessary to treat the genus as not revised.

Reithrodontomys arizonensis Allen.

1895. *Reithrodontomys arizonensis* Allen, Bull. Amer. mus. nat. hist., vii, p. 134. May 21, 1895.

Type locality.— Chiricahua Mountains, Cochise County, Arizona. Altitude, 8000 feet.

Reithrodontomys australis Allen.

1895. *Reithrodontomys australis* Allen, Bull. Amer. mus. nat. hist., vii, p. 328. November 8, 1895.

Type locality.— Volcano of Irazú, Costa Rica.

Reithrodontomys chrysopsis Merriam.

1900. *Reithrodontomys chrysopsis* Merriam, Proc. biol. soc. Washington, xiii, p. 152. June 13, 1900.

Type locality. — Mount Popocatapetl, Mexico.

Reithrodontomys chrysotis Elliot.

1899. *Reithrodontomys chrysotis* Elliot, Field Columbian mus., publication 37, zool. ser., i, p. 281. May 9, 1899.

Type locality.— Dougherty, Washita River, Indian Territory.

Reithrodontomys costaricensis Allen.

1895. *Reithrodontomys costaricensis* Allen, Bull. Amer. mus. nat. hist., vii, p. 139. May 21, 1895.

Type locality.— La Carpintera, Costa Rica. Altitude, 6000 feet.

Reithrodontomys dychei Allen.

1895. *Reithrodontomys dychei* Allen, Bull. Amer. mus. nat. hist., vii, p. 120. May 21, 1895.

Type locality. — Lawrence, Douglas County, Kansas.

Reithrodontomys dychei nebrascensis Allen.

1895. *Reithrodontomys dychei nebrascensis* Allen, Bull. Amer. mus. nat. hist., vii, p. 122. May 21, 1895.

Type locality. — Kennedy, Cherry County, Nebraska.

Reithrodontomys fulvescens (Allen).

1894. *Reithrodontomys mexicanus fulvescens* Allen, Bull. Amer. mus. nat. hist., vi, p. 319. November 7, 1894.

1895. *Reithrodontomys fulvescens* Allen, Bull. Amer. mus. nat. hist., vii, p. 138. May 21, 1895.

Type locality. — Oposura, State of Sonora, Mexico.

Reithrodontomys klamathensis Merriam.

1899. *Reithrodontomys klamathensis* MERRIAM, North Amer. fauna, no. 16, p. 93. October 28, 1899.

TYPE LOCALITY. — Big Spring (Mayten), Shasta Valley, Siskiyou County, California.

Reithrodontomys laceyi Allen.

1896. *Reithrodontomys laceyi* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 235. November 21, 1896.

TYPE LOCALITY. — Watson's Ranch, fifteen miles south of San Antonio, Bexar County, Texas.

* **Reithrodontomys lecontii** (Audubon and Bachman).

1842. *Mus lecontii* AUDUBON and BACHMAN, Journ. acad. nat. sci. Phila., VIII, pt. II, p. 307.

1885. *Ochetodon humilis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 598. 1885. (Part.)

1895. *Reithrodontomys lecontii* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 116. May 21, 1895.

TYPE LOCALITY. — Georgia; probably the Le Conte plantation, near Riceboro, Liberty County.

Reithrodontomys lecontii dickensoni (Rhoads).

1895. *Reithrodontomys humilis dickensoni* RHOADS, Amer. nat., XXIX, p. 590. June, 1895.

1898. *Reithrodontomys lecontii dickensoni* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 186. March, 1898.

TYPE LOCALITY. — Willow Oak, Pasco County, Florida.

Reithrodontomys lecontii impiger Bangs.

1898. *Reithrodontomys lecontii impiger* BANGS, Proc. biol. soc. Washington, XII, p. 167. August 10, 1898.

TYPE LOCALITY. — White Sulphur Springs, Greenbrier County, West Virginia.

* **Reithrodontomys longicauda** (Baird).

1857. *Reithrodon longicauda* BAIRD, Mamm. N. Amer., p. 451.

1885. *Ochetodon longicauda* TRUE, Proc. U. S. nat. mus., VII (1884), p. 598. 1885.

1895. *Reithrodontomys longicauda* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 129. May 21, 1895.

TYPE LOCALITY. — Petaluma, Sonoma County, California.

Reithrodontomys longicauda pallidus (Rhoads).

1893. *Reithrodontomys pallidus* Rhoads, Amer. nat., xxvii, p. 835. September, 1893.

1895. *Reithrodontomys longicauda pallidus* Allen, Bull. Amer. mus. nat. hist., vii, p. 131. May 21, 1895.

Type locality. — Santa Ysabel, San Jacinto Mountains, San Diego County, California.

Reithrodontomys megalotis (Baird).

1857. *Reithrodon megalotis* Baird, Mamm. N. Amer., p. 451.

1893. *Reithrodontomys megalotis* Allen, Bull. Amer. mus. nat. hist., v, p. 79. April 28, 1893.

Type locality. — Between Janos and San Luis Springs, State of Sonora, Mexico, near border of Grant County, New Mexico.

Reithrodontomys megalotis deserti Allen.

1895. *Reithrodontomys megalotis deserti* Allen, Bull. Amer. mus. nat. hist., vii, p. 127. May 21, 1895.

Type locality. — Oasis Valley, Nye County, Nevada.

Reithrodontomys merriami Allen.

1895. *Reithrodontomys merriami* Allen, Bull. Amer. mus. nat. hist., vii, p. 119. May 21, 1895.

Type locality. — Austin Bayou, near Alvin, Brazoria County, Texas.

* **Reithrodontomys mexicanus** (Saussure).

1860. *Reithrodon mexicanus* Saussure, Revue et magasin de zoologie, 2d ser., xii, p. 109.

1885. *Ochetodon mexicanus* True, Proc. U. S. nat. mus., vii (1884), p. 598. 1885.

1895. *Reithrodontomys mexicanus* Allen, Bull. Amer. mus. nat. hist., vii, p. 135. May 21, 1895.

Type locality. — Mountains of Vera Cruz, Mexico.

Reithrodontomys mexicanus aurantius Allen.

1895. *Reithrodontomys mexicanus aurantius* Allen, Bull. Amer. mus. nat. hist., vii, p. 137. May 21, 1895.

Type locality. — Lafayette, Lafayette Parish, Louisiana.

Reithrodontomys mexicanus gracilis Allen and Chapman.

1897. *Reithrodontomys mexicanus gracilis* Allen and Chap-

MAN, Bull. Amer. mus. nat. hist., IX, p. 9. February 23, 1897.
TYPE LOCALITY. — Chichen-Itza, Yucatan.

Reithrodontomys mexicanus intermedius Allen.
1895. *Reithrodontomys mexicanus intermedius* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 136. May 21, 1895.
TYPE LOCALITY. — Brownsville, Cameron County, Texas.

* **Reithrodontomys montanus** (Baird).
1855. *Reithrodon montanus* BAIRD, Proc. acad. nat. sci. Phila., p. 335.
1885. *Ochetodon montanus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 598. 1885.
1893. *Reithrodontomys montanus* ALLEN, Bull. Amer. mus. nat. hist., V, p. 80. April 28, 1893.
TYPE LOCALITY. — Probably near the upper end of the San Luis Valley, Saguache County, Colorado (see Allen, Bull. Amer. mus. nat. hist., VII, p. 124, May 21, 1895).

Reithrodontomys rufescens Allen and Chapman.
1897. *Reithrodontomys rufescens* ALLEN and CHAPMAN, Bull. Amer. mus. nat. hist., IX, p. 199. June 16, 1897.
TYPE LOCALITY. — Jalapa, State of Vera Cruz, Mexico.

Reithrodontomys saturatus Allen and Chapman.
1897. *Reithrodontomys saturatus* ALLEN and CHAPMAN, Bull. Amer. mus. nat. hist., IX, p. 201. June 16, 1897.
TYPE LOCALITY. — Las Vigas, State of Vera Cruz, Mexico.

Reithrodontomys sumichrasti (Saussure).
1861. *Reithrodon sumichrasti* SAUSSURE, Revue et magasin de zoologie, 2d ser., XIII, p. 3.
1895. *Reithrodontomys sumichrasti* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 110. May 21, 1895.
TYPE LOCALITY. — Mexico, probably in the State of Vera Cruz.

Regarded by Allen (Bull. Amer. mus. nat. hist., VII, p. 135, May 21, 1895) as identical with *R. mexicanus*.

Reithrodontomys tenuis Allen.
1899. *Reithrodontomys tenuis* ALLEN, Bull. Amer. mus. nat. hist., XII, p. 15. March 4, 1899.
TYPE LOCALITY. — Rosario, State of Sinaloa, Mexico.

Genus **AKODON** Meyen.

1833. *Akodon* MEYEN, Nova acta phys. med. acad. caes. Leop.-Card., XVI, pt. II, p. 599. Type.— *Akodon boliviense* MEYEN.

For the use of this name in place of *Abrothrix* Waterhouse (Proc. zool. soc. London, 1837, p. 21), see Thomas, Ann. and mag. nat. hist., 6th ser., XIV, p. 360, November, 1894.

* **Akodon teguina** (Alston).[1]

1876. *Hesperomys teguina* ALSTON, Proc. zool. soc. London, p. 755.

1885. *Hesperomys teguina* TRUE, Proc. U. S. nat. mus., VII (1884), p. 598. 1885.

1897. [*Akodon*] *teguina* TROUESSART, Catal. mamm., pt. III, p. 537.

TYPE LOCALITY.— Coban, Guatemala.

Subfamily NEOTOMINAE.[2]

Genus **NEOTOMA** Say and Ord.[3]

1825. *Neotoma* SAY and ORD, Journ. acad. nat. sci. Phila., IV, pt. II, p. 345. Type.— *Mus floridana* ORD.

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[1] *Oryzomys chrysomelas* Allen was originally recorded (Allen, Bull. Amer. mus. nat. hist., III, p. 210, April 17, 1891) as *Hesperomys* [= *Akodon*] *caliginosus* Tomes.

[2] In 1894 Merriam published a partial revision of this group (Proc. acad. nat. sci. Phila., 1894, pp. 225-252, September 24, 1894).

[3] The bushy-tailed species (*N. cinerea* and its allies) are regarded by Merriam (Proc. biol. soc. Washington, VIII, p. 112, July 31, 1893, and Proc. acad. nat. sci. Phila, 1894, p. 242, September 24, 1894) as forming the subgenus *Teonoma* Gray (List of the specimens of mammalia in the British museum, p. 117, 1843). As the boundaries between this group and typical *Neotoma* have not been clearly defined, no attempt is here made to maintain the distinction.

Neotoma anthonyi Allen.

1898. *Neotoma anthonyi* ALLEN, Bull. Amer. mus. nat. hist., x, p. 151. April 12, 1898.

TYPE LOCALITY. — Todos Santos Island, Lower California, Mexico.

Neotoma arenacea Allen.

1898. *Neotoma arenacea* ALLEN, Bull. Amer. mus. nat. hist., x, p. 150. April 12, 1898.

TYPE LOCALITY. — San José del Cabo, Lower California, Mexico.

Neotoma arizonae Merriam.

1893. *Neotoma arizonae* MERRIAM, Proc. biol. soc. Washington, VIII, p. 110. July 31, 1893.

TYPE LOCALITY. — Keams Canyon, Apache County, Arizona.

Neotoma attwateri Mearns.

1897. *Neotoma attwateri* MEARNS, Proc. U. S. nat. mus., XIX, p. 721. July 30, 1897.

TYPE LOCALITY. — Lacey's Ranch, Turtle Creek, Kerr County, Texas.

Neotoma baileyi Merriam.

1894. *Neotoma baileyi* MERRIAM, Proc. biol. soc. Washington, IX, p. 123. July 2, 1894.

TYPE LOCALITY. — Valentine, Cherry County, Nebraska.

Neotoma bella Bangs.

1899. *Neotoma bella* BANGS, Proc. New England zool. club, I, p. 66. July 31, 1899.

TYPE LOCALITY. — Palm Springs, Riverside County, California.

Neotoma bryanti Merriam.

1887. *Neotoma bryanti* MERRIAM, Amer. nat., XXI, p. 191. February, 1887.

TYPE LOCALITY. — Cerros Island, Lower California, Mexico.

Neotoma californica Price.

1894. *Neotoma californica* PRICE, Proc. Cal. acad. sci., 2d ser., IV, p. 154. May 9, 1894.

TYPE LOCALITY. — Bear Valley, San Benito County, California.

Regarded by Merriam (Proc. acad. nat. sci. Phila., 1894, p. 247, September 24, 1894) as identical with *N. intermedia*.

Neotoma campestris Allen.

1894. *Neotoma campestris* Allen, Bull. Amer. mus. nat. hist., vi, p. 322. November 7, 1894.

Type locality. — Pendennis, Lane County, Kansas.

* **Neotoma cinerea** (Ord).

1815. *Mus cinereus* Ord, Guthrie's geog., 2d Amer. ed., ii, p. 292.

1857. *Neotoma cinerea* Baird, Mamm. N. Amer., p. 499.

1885. *Neotoma cinerea* True, Proc. U. S. nat. mus., vii (1884), p. 598. 1885.

Type locality. — Near Great Falls, Cascade County, Montana.

Neotoma cinerea columbiana Elliot.

1899. *Neotoma c[inerea] columbiana* Elliot, Field Columbian mus., publication 32, zool. ser., i, p. 255. March, 1899.

Type locality.— Ducks, British Columbia, Canada.

Neotoma cinerea drummondi (Richardson).

1828. *Myoxus drummondi* Richardson, Zool. journ., iii, p. 517.

1892. *Neotoma cinerea drummondi* Merriam, Proc. biol. soc. Washington, vii, p. 25. April 13, 1892.

Type locality. — Rocky Mountains, British Columbia, Canada, at about lat. 57°.

Neotoma cinerea fusca (True).

1894. *Neotoma occidentalis fusca* True, Diagnoses of some undescribed wood rats (genus Neotoma) in the national museum, p. 2. June 27, 1894. (Reprint: Proc. U. S. nat. mus., xvii, p. 354. November 15, 1894.)

1897. *[Neotoma] cinerea fusca* Trouessart, Catal. mamm., pt. iii, p. 544.

Type locality. — Fort Umpqua, Douglas County, Oregon.

Neotoma cinerea occidentalis (Baird).

1855. *Neotoma occidentalis* Baird, Proc. acad. nat. sci. Phila., p. 335.

1891. *Neotoma cinerea occidentalis* Merriam, North Amer. fauna, no. 5, p. 58. July 30, 1891.

TYPE LOCALITY.— Shoalwater Bay, Pacific County, Washington.

Neotoma cinnamomea Allen.

1895. *Neotoma cinnamomea* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 331. November 8, 1895.

TYPE LOCALITY.—Kinney Ranch, Bitter Creek, Sweetwater County, Wyoming.

Neotoma cumulator Mearns.

1897. *Neotoma cumulator* MEARNS, Preliminary diagnoses of new mammals of the genera Sciurus, Castor, Neotoma, and Sigmodon, from the Mexican border of the United States, p. 3. March 5, 1897. (Reprint: Proc. U. S. nat. mus., XX, p. 503. January 19, 1898.)

TYPE LOCALITY.— Old Fort Yuma, San Diego County, California.

Neotoma desertorum Merriam.

1894. *Neotoma desertorum* MERRIAM, Proc. biol. soc. Washington, IX, p. 125. July 2, 1894.

TYPE LOCALITY.— Furnace Creek, Death Valley, Inyo County, California.

Neotoma desertorum sola Merriam.

1894. *Neotoma desertorum sola* MERRIAM, Proc. biol. soc. Washington, IX, p. 126. July 2, 1894.

TYPE LOCALITY.— San Emigdio, Kern County, California.

Neotoma fallax Merriam.

1894. *Neotoma fallax* MERRIAM, Proc. biol. soc. Washington, IX, p. 123. July 2, 1894.

TYPE LOCALITY.— Gold Hill, Boulder County, Colorado.

* **Neotoma ferruginea** Tomes.

1861. *Neotoma ferruginea* TOMES, Proc. zool. soc. London, p. 282.

1885. *Neotoma ferruginea* TRUE, Proc. U. S. nat. mus., VII (1884), p. 598. 1885.

TYPE LOCALITY.— Dueñas, Guatemala.

* **Neotoma floridana** (Ord).

1818. *Mus floridana* ORD, Bull. soc. philom. Paris, p. 181. December, 1818.

1825. *N[eotoma] floridana* Say and Ord, Journ. acad. nat. sci. Phila., iv, pt. ii, p. 346.

1885. *Neotoma floridana* True, Proc. U. S. nat. mus., vii (1884), p. 598. 1885.

Type locality.— St. John's River, Florida; probably near Jacksonville, Duval County (see Bangs, Proc. Boston soc. nat. hist., xxviii, p. 184, March, 1898).

Neotoma floridana rubida Bangs.

1898. *Neotoma floridana rubida* Bangs, Proc. Boston soc. nat. hist., xxviii, p. 185. March, 1898.

Type locality.— Gibson, Terrebonne Parish, Louisiana.

Neotoma fulviventer Merriam.

1894. *Neotoma fulviventer* Merriam, Proc. biol. soc. Washington, ix, p. 121. July 2, 1894.

Type locality.— Toluca Valley, State of Mexico, Mexico.

* **Neotoma fuscipes** Baird.

1857. *Neotoma fuscipes* Baird, Mamm. N. Amer., p. 495.

1885. *Neotoma fuscipes* True, Proc. U. S. nat. mus., vii (1884), p. 598. 1885.

Type locality.— Petaluma, Sonoma County, California.

Neotoma fuscipes affinis Elliot.

1898. *Neotoma fuscipes affinis* Elliot, Field Columbian mus., publication 30, zool. ser., i, p. 202. March, 1898.

Type locality.— Alum Rock Park, Santa Clara County, California.

Neotoma fuscipes annectens Elliot.

1898. *Neotoma fuscipes annectens* Elliot, Field Columbian mus., publication 30, zool. ser., i, p. 201. March, 1898.

Type locality.— Portola, San Mateo County, California.

Neotoma fuscipes dispar Merriam.

1894. *Neotoma fuscipes dispar* Merriam, Proc. biol. soc. Washington, ix, p. 124. July 2, 1894.

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

Neotoma fuscipes macrotis (Thomas).

1893. *Neotoma macrotis* Thomas, Ann. and mag. nat. hist., 6th ser., xii, p. 234. September, 1893.

1894. *Neotoma fuscipes macrotis* MERRIAM, Proc. acad. nat. sci. Phila., p. 246. September 25, 1894.

TYPE LOCALITY.— San Diego, San Diego County, California.

Neotoma fuscipes simplex (True).

1894. *Neotoma macrotis simplex* TRUE, Diagnoses of some undescribed wood rats (genus Neotoma) in the national museum, p. 2. June 27, 1894. (Reprint: Proc. U. S. nat. mus., XVII, p. 354. November 15, 1894.)

TYPE LOCALITY. — Old Fort Tejon, in mountains south of Kern Lake, Kern County, California.

Regarded by Merriam (Proc. acad. nat. sci. Phila., 1894, p. 246, September 24, 1894) as identical with *N. fuscipes macrotis*.

Neotoma fuscipes streatori Merriam.

1894. *Neotoma fuscipes streatori* MERRIAM, Proc. biol. soc. Washington, IX, p. 124. July 2, 1894.

TYPE LOCALITY.— Carbondale, Amador County, California.

Neotoma grangeri Allen.

1894. *Neotoma grangeri* ALLEN, Bull. Amer. mus. nat. hist., VI, p. 324. November 7, 1894.

TYPE LOCALITY.— Custer, Black Hills, Custer County, South Dakota.

Neotoma intermedia Rhoads.

1894. *Neotoma intermedia* RHOADS, Amer. nat., XXVIII, p. 69. January, 1894.

TYPE LOCALITY. — Dulzura, San Diego County, California.

Neotoma intermedia albigula (Hartley).

1894. *Neotoma albigula* HARTLEY, Proc. Cal. acad. sci., 2d ser., IV, p. 157. May 9, 1894.

1894. *Neotoma intermedia albigula* MERRIAM, Proc. acad. nat. sci. Phila., p. 248. September 24, 1894.

TYPE LOCALITY. — Vicinity of Fort Lowell, near Tucson, Pima County, Arizona.

Neotoma intermedia angusticeps Merriam.

1894. *Neotoma intermedia angusticeps* MERRIAM, Proc. biol. soc. Washington, IX, p. 127. July 2, 1894.

TYPE LOCALITY.— S. W. corner of Grant County, New Mexico.

Neotoma intermedia gilva Rhoads.

1894. *Neotoma intermedia gilva* Rhoads, Amer. nat., xxviii, p. 70. January, 1894.

Type locality.— Banning, San Bernardino County, California.

Regarded by Merriam (Proc. acad. nat. sci. Phila., 1894, p. 247, September 24, 1894) as identical with *N. intermedia.*

Neotoma intermedia melanura Merriam.

1894. *Neotoma intermedia melanura* Merriam, Proc. biol. soc. Washington, ix, p. 126. July 2, 1894.

Type locality. — Ortiz, State of Sonora, Mexico.

Neotoma latifrons Merriam.

1894. *Neotoma latifrons* Merriam, Proc. biol. soc. Washington, ix, p. 121. July 2, 1894.

Type locality. — Querendaro, State of Michoacan, Mexico.

Neotoma lepida Thomas.

1893. *Neotoma lepida* Thomas, Ann. and mag. nat. hist., 6th ser., xii, p. 235. September, 1893.

Type locality. — Williams Spring, about lat. 40°, long. 113°, just south of Champlin Mts., Juab County, Utah. Altitude, 4558 feet.

Regarded by Merriam (Proc. acad. nat. sci. Phila., 1894, p. 248, September 24, 1894) as identical with *N. arizonae,* and by Miller (Proc. New England zool. club, i, p. 66, July 31, 1899) as closely related to *N. desertorum.*

Neotoma leucodon Merriam.

1894. *Neotoma leucodon* Merriam, Proc. biol. soc. Washington, ix, p. 120. July 2, 1894.

Type locality. — San Luis Potosi, State of San Luis Potosi, Mexico.

Neotoma mexicana Baird.

1855. *Neotoma mexicana* Baird, Proc. acad. nat. sci. Phila., vii, p. 333. April, 1855.

1894. *Neotoma mexicana* Merriam, Proc. biol. soc. Washington, ix, p. 118. July 2, 1894.

Type locality. — Mountains near Chihuahua, State of Chihuahua, Mexico.

Neotoma mexicana bullata Merriam.

1894. *Neotoma mexicana bullata* Merriam, Proc. biol. soc. Washington, ix, p. 122. July 2, 1894.

Type locality.— Santa Catalina Mountains, Arizona.

Neotoma micropus Baird.

1855. *Neotoma micropus* Baird, Proc. acad. nat. sci. Phila., p. 333. April, 1855.

1891. *Neotoma micropus* Allen, Bull. Amer. mus. nat. hist., iii, p. 282. June 30, 1891.

Type locality.—Charco Escondido, State of Tamaulipas, Mexico.

Neotoma micropus canescens Allen.

1891. *Neotoma micropus canescens* Allen, Bull. Amer. mus. nat. hist., iii, p. 285. June 30, 1891.

Type locality. — North Beaver Creek, Pan Handle of Oklahoma.

Regarded by Merriam (Proc. acad. nat. sci. Phila., 1894, p. 244, September 24, 1894) as identical with *N. micropus.*

Neotoma micropus surberi Elliot.

1899. *Neotoma macropus* (*sic*) *surberi* Elliot, Field Columbian mus., publication 37, zool. ser., i, p. 279. May 9, 1899.

Type locality. — Canyon three miles west of Alva, Woods County, Oklahoma.

Neotoma monochroura Rhoads.

1894. *Neotoma monochroura* Rhoads, Amer. nat., xxviii, p. 67. January, 1894.

Type locality.— Grant's Pass, Josephine County, Oregon.

Regarded by Merriam (Proc. acad. nat. sci. Phila., 1894, p. 246, September 24, 1894) as identical with *N. fuscipes.*

Neotoma orizabae Merriam.

1894. *Neotoma orizabae* Merriam, Proc. biol. soc. Washington, ix, p. 122. July 2, 1894.

Type locality.— Mt. Orizaba, State of Puebla, Mexico.

Neotoma orolestes Merriam.

1894. *Neotoma orolestes* Merriam, Proc. biol. soc. Washington, ix, p. 128. July 2, 1894.

Type locality. — Saguache Valley, twenty miles west of Saguache, Saguache County, Colorado.

Neotoma pennsylvanica Stone.

1893. *Neotoma pennsylvanica* Stone, Proc. acad. nat. sci. Phila., p. 16. February, 1893.

Type locality.— South Mountain, Cumberland County, Pennsylvania.

Regarded by Rhoads (Proc. acad. nat. sci. Phila., 1894, pp. 213–231) as identical with the subfossil *N. magister* Baird (Mamm. N. Amer., p. 498, 1857) of the Pennsylvania cave deposits, and by Mearns (Bull. Amer. mus. nat. hist., x, pp. 334–335, September 9, 1898) as a distinct species.

Neotoma pinetorum Merriam.

1893. *Neotoma pinetorum* Merriam, Proc. biol. soc. Washington, viii, p. 111. July 31, 1893.

Type locality. — San Francisco Mountain, Coconino County, Arizona.

Neotoma rupicola Allen.

1894. *Neotoma rupicola* Allen, Bull. Amer. mus. nat. hist., vi, p. 323. November 7, 1894.

Type locality. — Corral Draw, Pine River Indian Reservation, southeastern base of Black Hills, South Dakota. Altitude, about 3700 feet.

Neotoma saxamans Osgood.

1900. *Neotoma saxamans* Osgood, North Amer. fauna, no. 19, p. 33. October 6, 1900.

Type locality. — Bennett City, head of Lake Bennett, British Columbia, Canada.

Neotoma sinaloae Allen.

1898. *Neotoma sinaloae* Allen, Bull. Amer. mus. nat. hist., x, p. 149. April 12, 1898.

Type locality.— Tatameles, State of Sinaloa, Mexico.

Neotoma splendens True.

1894. *Neotoma splendens* True, Diagnoses of some undescribed wood rats (genus Neotoma) in the national museum, p. 1. June 27, 1894. (Reprint: Proc. U. S. nat. mus., xvii, p. 353. November 15, 1894.)

Type locality. — Marin County, California.

Regarded by Merriam (Proc. acad. nat. sci. Phila., 1894, p. 246, September 24, 1894) as identical with *N. fuscipes*.

Neotoma tenuicauda Merriam.

1892. *Neotoma tenuicauda* MERRIAM, Proc. biol. soc. Washington, VII, p. 169. September 29, 1892.

TYPE LOCALITY.— North slope of the Sierra Nevada of Colima, State of Colima, Mexico. Altitude, 12,000 feet.

Neotoma torquata Ward.

1891. *Neotoma torquata* WARD, Amer. nat., XXV, p. 160. February, 1891.

TYPE LOCALITY.— An abandoned tunnel, between Tetela del Volcan and Zacualpan, State of Morelos, Mexico.

Neotoma venusta True.

1894. *Neotoma venusta* TRUE, Diagnoses of some undescribed wood rats (genus Neotoma) in the national museum, p. 2. June 27, 1894. (Reprint: Proc. U. S. nat. mus., XVII, p. 354. November 15, 1894.)

TYPE LOCALITY.— Carrizo Creek, San Diego County, California.

Regarded by Merriam (Proc. acad. nat. sci. Phila., 1894, p. 247, September 24, 1894) as identical with *N. intermedia*.

Genus **NELSONIA** Merriam.

1897. *Nelsonia* MERRIAM, Proc. biol. soc. Washington, XI, p. 277. December 17, 1897. Type.—*Nelsonia neotomodon* MERRIAM.

Nelsonia neotomodon Merriam.

1897. *Nelsonia neotomodon* MERRIAM, Proc. biol. soc. Washington, XI, p. 278. December 17, 1897.

TYPE LOCALITY.— Mountains near Plateado, State of Zacatecas, Mexico. Altitude, 8200 feet.

Genus **XENOMYS** Merriam.

1892. *Xenomys* Merriam, Proc. biol. soc. Washington, vii, p. 160. September 29, 1892. Type.—*Xenomys nelsoni* Merriam.

Xenomys nelsoni Merriam.

1892. *Xenomys nelsoni* Merriam, Proc. biol. soc. Washington, vii, p. 161. September 29, 1892.

Type locality.— Hacienda Magdalena, between the City of Colima and Manzanillo, State of Colima, Mexico.

Genus **NEOTOMODON** Merriam.

1898. *Neotomodon* Merriam, Proc. biol. soc. Washington, xii, p. 127. April 30, 1898. Type.— *Neotomodon alstoni* Merriam.

Neotomodon alstoni Merriam.

1898. *Neotomodon alstoni* Merriam, Proc. biol. soc. Washington, xii, p. 128. April 30, 1898.

Type locality. — Nahuatzin, State of Michoacan, Mexico. Altitude, 8500 feet.

Neotomodon orizabae Merriam.

1898. *Neotomodon orizabae* Merriam, Proc. biol. soc. Washington, xii, p. 129. April 30, 1898.

Type locality. — Mount Orizaba, State of Puebla, Mexico. Altitude, 9500 feet.

Neotomodon perotensis Merriam.

1898. *Neotomodon perotensis* Merriam, Proc. biol. soc. Washington, xii, p. 129. April 30, 1898.

Type locality. — Cofre de Perote, State of Vera Cruz, Mexico. Altitude, 9500 feet.

Genus **HODOMYS** Merriam.

1894. *Hodomys* Merriam, Proc. acad. nat. sci. Phila., p. 232. September 24, 1894. Type.— *Neotoma alleni* Merriam.

Hodomys alleni (Merriam).

1892. *Neotoma alleni* Merriam, Proc. biol. soc. Washington, VII, p. 168. September 29, 1892.

1894. *Hodomys alleni* Merriam, Proc. acad. nat. sci. Phila., p. 235. September 24, 1894.

Type locality.— Manzanillo, State of Colima, Mexico.

Hodomys vetulus Merriam.

1894. *Hodomys vetulus* Merriam, Proc. acad. nat. sci. Phila., p. 236. September 24, 1894.

Type locality.— Tehuacan, State of Puebla, Mexico.

Subfamily Microtinae.[1]

Genus **PHENACOMYS** Merriam.[2]

1889. *Phenacomys* Merriam, North Amer. fauna, no. 2, p. 28. October 30, 1889. Type.— *Phenacomys intermedius* Merriam.

Phenacomys intermedius Merriam.

1889. *Phenacomys intermedius* Merriam, North Amer. fauna, no. 2, p. 32. October 30, 1889.

Type locality.— Basaltic plateau about twenty miles N. N. W. of Kamloops, British Columbia, Canada. Altitude, 5500 feet.

Phenacomys orophilus Merriam.

1891. *Phenacomys orophilus* Merriam, North Amer. fauna, no. 5, p. 65. July 30, 1891.

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[1] Genera and subgenera revised by Miller, North Amer. fauna, no. 12. July 23, 1896.

[2] Revised by Miller, Proc. biol. soc. Washington, XI, pp. 77–87. April 21, 1897.

Type locality.— Salmon River Mountains, Idaho (near head of Timber Creek). Altitude, 10,500 feet.

Phenacomys olympicus Elliot.

1899. *Phenacomys olympicus* Elliot, Field Columbian mus., publication 30, zool. ser., I, p. 225. February 1, 1899.

Type locality.— Happy Lake, Olympic Mountains, Clallam County, Washington. Altitude, 5000 feet.

Phenacomys preblei Merriam.

1897. *Phenacomys preblei* Merriam, Proc. biol. soc. Washington, XI, p. 45. March 16, 1897.

Type locality. — Twin Peak, near Long's Peak, Boulder County, Colorado. Altitude, 9000 feet.

Phenacomys constablei Allen.

1899. *Phenacomys constablei* Allen, Bull. Amer. mus. nat. hist., XII, p. 4. March 4, 1899.

Type locality. — Telegraph Creek, Yukon, Canada.

Phenacomys latimanus Merriam.

1889. *Phenacomys latimanus* Merriam, North Amer. fauna, no. 2, p. 34. October 30, 1889.

Type locality. — Fort Chimo, Ungava, Labrador.

Phenacomys celatus Merriam.

1889. *Phenacomys celatus* Merriam, North Amer. fauna, no. 2, p. 33. October 30, 1889.

Type locality. — Godbout, Quebec, Canada.

The name *ungava* Merriam (North Amer. fauna, no. 2, p. 35, October 30, 1889; type locality, Fort Chimo, Ungava, Labrador) was adopted for this species by Miller (Proc. biol. soc. Washington, XI, p. 84, April 21, 1897).

Phenacomys celatus crassus Bangs.

1900. *Phenacomys celatus crassus* Bangs, Proc. New England zool. club, II, p. 39. September 20, 1900.

Type locality. — Rigoulette, Hamilton Inlet, Labrador.

Phenacomys longicaudus True.

1890. *Phenacomys longicaudus* True, Proc. U. S. nat. mus., XIII, p. 303. November 15, 1890.

Type locality. — Marshfield, Coos County, Oregon.

Genus **EVOTOMYS** Coues.[1]

1874. *Evotomys* COUES, Proc. acad. nat. sci. Phila., p. 186. December 15, 1874. Type.—*Mus rutilus* PALLAS.

Evotomys caurinus Bailey.

1898. *Evotomys caurinus* BAILEY, Proc. biol. soc. Washington, XII, p. 21. January 27, 1898.

TYPE LOCALITY.— Lund, east shore of Malaspina Inlet, British Columbia, Canada.

Evotomys wrangeli Bailey.

1897. *Evotomys wrangeli* BAILEY, Proc. biol. soc. Washington, XI, p. 120. May 13, 1897.

TYPE LOCALITY.— Wrangel, Wrangel Island, Alaska.

Evotomys dawsoni Merriam.

1888. *Evotomys dawsoni* MERRIAM, Amer. nat., XXII, p. 650. July, 1888.

TYPE LOCALITY. — Finlayson River, a northern source of the Liard River, lat. 61° 30′ N., long. 129° 30′ W., Yukon, Canada. Altitude, 3000 feet.

* **Evotomys alascensis** Miller.

1885. *Evotomys rutilus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 596. 1885.

1898. *Evotomys alascensis* MILLER, Proc. acad. nat. sci. Phila., p. 364. October 15, 1898.

TYPE LOCALITY.— St. Michaels, Norton Sound, Alaska.

Regarded by Osgood (North Amer. fauna, no. 19, p. 35, October 6, 1900) as a form of *E. dawsoni*.

Evotomys orca Merriam.

1900. *Evotomys orca* MERRIAM, Proc. Washington acad. sci., II, p. 24. March 14, 1900.

TYPE LOCALITY.— Orca, Prince William Sound, Alaska.

* **Evotomys gapperi** (Vigors).

1830. *Arvicola gapperi* VIGORS, Zool. journ., V, p. 204.

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[1] Revised by Bailey, Proc. biol. soc. Washington, XI, pp. 113–138. May 13, 1897.

1885. *Evotomys rutilus gapperi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 596. 1885.

1891. *E[votomys] gapperi* MERRIAM, North Amer. fauna, no. 5, p. 119. July 30, 1891.

TYPE LOCALITY. — Vicinity of Lake Simcoe, Ontario, Canada.

Evotomys gapperi ochraceus Miller.

1894. *Evotomys gapperi ochraceus* MILLER, Proc. Boston soc. nat. hist., XXVI, p. 193. March 24, 1894.

TYPE LOCALITY.— Mount Washington, Coos County, New Hampshire. Altitude, 5500 feet.

Evotomys gapperi rhoadsi Stone.

1893. *Evotomys gapperi rhoadsi* STONE, Amer. nat., XXVII, p. 55. January, 1893.

TYPE LOCALITY.— May's Landing, Atlantic County, New Jersey.

Regarded by Miller (Bull. N. Y. state mus., VIII, p. 111, November 21, 1900) as a distinct species.

Evotomys gapperi loringi Bailey.

1897. *Evotomys gapperi loringi* BAILEY, Proc. biol. soc. Washington, XI, p. 125. May 13, 1897.

TYPE LOCALITY. — Portland, Traill County, North Dakota.

Evotomys gapperi galei (Merriam).

1890. *Evotomys galei* MERRIAM, North Amer. fauna, no. 4, p. 23. October 8, 1890.

1897. *Evotomys gapperi galei* BAILEY, Proc. biol. soc. Washington, XI, p. 126. May 13, 1897.

TYPE LOCALITY. —Ward, Boulder County, Colorado. Altitude 9500 feet.

Evotomys gapperi saturatus Rhoads.

1894. *Evotomys gapperi saturatus* RHOADS, Proc. acad. nat. sci. Phila., p. 284. October 23, 1894.

TYPE LOCALITY. — Nelson, British Columbia, Canada, on the Kootenay River, thirty miles north of the northern boundary of Washington.

Evotomys brevicaudus (Merriam).

1891. *Evotomys gapperi brevicaudus* MERRIAM, North Amer. fauna, no. 5, p. 119. July 30, 1891.

1897. *Evotomys brevicaudus* Bailey, Proc. biol. soc. Washington, xi, p. 129. May 13, 1897.

Type locality.— Three miles north of Custer, Black Hills, Custer County, South Dakota. Altitude, about 6000 feet.

Evotomys carolinensis Merriam.

1888. *Evotomys carolinensis* Merriam, Amer. journ. sci., 3d. ser., xxxvi, p. 460. December, 1888.

Type locality.— Roan Mountain, Mitchell County, North Carolina. Altitude, 6000 feet.

Evotomys ungava Bailey.

1897. *Evotomys ungava* Bailey, Proc. biol. soc. Washington, xi, p. 130. May 13, 1897.

Type locality. — Fort Chimo, Ungava, Labrador.

Evotomys idahoensis Merriam.

1891. *Evotomys idahoensis* Merriam, North Amer. fauna, no. 5, p. 66. July 30, 1891.

Type locality. — Sawtooth (or Alturas) Lake, east base of Sawtooth Mountains, Idaho. Altitude, 7200 feet.

Evotomys mazama Merriam.

1897. *Evotomys mazama* Merriam, Proc. biol. soc. Washington, xi, p. 71. April 21, 1897.

Type locality.— Crater Lake, Mt. Mazama, Klamath County, Oregon. Altitude, 7000 feet.

Evotomys obscurus Merriam.

1897. *Evotomys obscurus* Merriam, Proc. biol. soc. Washington, xi, p. 72. April 21, 1897.

Type locality.— Prospect, Upper Rogue River Valley, Jackson County, Oregon. Altitude, about 2600 feet.

Evotomys californicus Merriam.

1890. *Evotomys californicus* Merriam, North Amer. fauna, no. 4, p. 26. October 8, 1890.

Type locality. — Eureka, Humboldt County, California.

Evotomys occidentalis Merriam.

1890. *Evotomys occidentalis* Merriam, North Amer. fauna, no. 4, p. 25. October 8, 1890.

Type locality.— Aberdeen, Chehalis County, Washington.

Evotomys nivarius Bailey.

1897. *Evotomys nivarius* Bailey, Proc. biol. soc. Washington, xi, p. 136. May 13, 1897.

Type locality.— Northwest slope of Mt. Ellinor, Olympic Mountains, Washington. Altitude, 4000 feet.

Evotomys proteus Bangs.

1897. *Evotomys proteus* Bangs, Proc. biol. soc. Washington, xi, p. 137. May 13, 1897.

Type locality.— Hamilton Inlet, Labrador.

Genus **MICROTUS**[1] Schrank.

1798. *Microtus* Schrank, Fauna Boica, i, 1ste Abth., p. 72. Type.— *Microtus terrestris* Schrank = *Mus arvalis* Pallas (by elimination).

Subgenus Microtus Schrank.

* **Microtus borealis** (Richardson).

1828. *Arvicola borealis* Richardson, Zool. journ., iii, p. 517.

1885. *Arvicola riparius borealis* True, Proc. U. S. nat. mus., vii (1884), p. 597. 1885. (Part.)

1897. [*Microtus*] *borealis* Trouessart, Catal. mamm., pt. iii, p. 563.

Type locality. — Great Bear Lake, Mackenzie, Canada.

Regarded as a distinct species by Rhoads (Proc. acad. nat. sci. Phila., 1894, p. 286, October 23, 1894), but not mentioned by Bailey.

* **Microtus pennsylvanicus** (Ord).

1815. *Mus pennsylvanica* Ord, Guthrie's geography, 2d Amer. ed., ii, p. 292.

1885. *Arvicola riparius riparius* True, Proc. U. S. nat. mus., vii (1884), p. 597. 1885. (Part.)

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[1] Revised by Bailey, North Amer. fauna, no. 17. June 6, 1900.

1895. *M[icrotus] pennsylvanicus* Rhoads, Amer. nat., xxix, p. 940. October, 1895.

Type locality.— Meadows below Philadelphia, Pennsylvania.

Microtus pennsylvanicus nigrans Rhoads.

1897. *Microtus pennsylvanicus nigrans* Rhoads, Proc. acad. nat. sci. Phila., p. 307. June 18, 1897.

Type locality.— Currituck, Currituck County, North Carolina.

Microtus pennsylvanicus acadicus Bangs.

1897. *Microtus pennsylvanicus acadicus* Bangs, Amer. nat., xxxi, p. 239. March, 1897.

Type locality. — Digby, Nova Scotia.

Microtus pennsylvanicus modestus (Baird).

1857. *Arvicola modesta* Baird. Mamm. N. Amer., p. 535.

1900. *Microtus pennsylvanicus modestus* Bailey, North Amer. fauna, no. 17. June 6, 1900.

Type locality. — Cochitopa ("Sawatch") Pass, Saguache County, Colorado.

Microtus pennsylvanicus fontigenus (Bangs).

1896. *Microtus fontigenus* Bangs, Proc. biol. soc. Washington, x, p. 48. March 9, 1896.

1897. *Microtus pennsylvanicus fontigenus* Miller, Proc. Boston soc. nat. hist., xxviii, p. 14. April 30, 1897.

Type locality.— Lake Edward, Quebec, Canada.

Microtus pennsylvanicus labradorius Bailey.

1898. *Microtus pennsylvanicus labradorius* Bailey, Proc. biol. soc. Washington, xii, p. 88. April 30, 1898.

Type locality. — Fort Chimo, Ungava, Labrador.

Microtus drummondii (Audubon and Bachman).

1854. *Arvicola drummondii* Audubon and Bachman, Quad. N. Amer., iii, p. 166.

1894. *Arvicola (Mynomes) drummondi* Rhoads, Proc. acad. nat. sci. Phila., p. 287. October 23, 1894.

1897. *[Microtus] drummondi* Trouessart, Catal. mamm., pt. iii, p. 563.

Type locality. — "Valleys of the Rocky Mountains"; probably in the vicinity of Jasper House, Alberta, Canada.

Microtus aztecus (Allen).

1893. *Arvicola (Mynomes) aztecus* ALLEN, Bull. Amer. mus. nat. hist., v, p. 73. April 28, 1893.

1897. [*Microtus*] *aztecus* TROUESSART, Catal. mamm., pt. III, p. 562.

TYPE LOCALITY.— Aztec, San Juan County, New Mexico. Altitude, 5900 feet.

Microtus enixus Bangs.

1896. *Microtus enixus* BANGS, Amer. nat., XXX, p. 1051. December 5, 1896.

TYPE LOCALITY.— Hamilton Inlet, Labrador.

Microtus terraenovae (Bangs).

1894. *Arvicola terraenovae* BANGS, Proc. biol. soc. Washington, IX, p. 129. July 27, 1894.

1896. *M*[*icrotus*] *terraenovae* MILLER, North Amer. fauna, no. 12, p. 66. July 23, 1896.

TYPE LOCALITY.— Codroy, Newfoundland.

Microtus breweri (Baird).

1857. *Arvicola breweri* BAIRD, Mamm. N. Amer., p. 525.

1896. *Microtus breweri* MILLER, Proc. Boston soc. nat. hist., XXVII, p. 83. June, 1896.

TYPE LOCALITY.— Muskeget Island, off Nantucket, Massachusetts.

Microtus nesophilus Bailey.

1898. *Microtus insularis* BAILEY, Proc. biol. soc. Washington, XII, p. 86. April 30, 1897 (not of Nilsson).

1898. *Microtus nesophilus* BAILEY, Science, n. s., VIII, p. 783. December 2, 1898.

TYPE LOCALITY.— Great Gull Island, off eastern extremity of Long Island, Suffolk County, New York.

Microtus montanus (Peale).

1848. *Arvicola montana* PEALE, U. S. explor. exp., VIII, mamm. and ornith., p. 44.

1897. [*Microtus*] *montanus* TROUESSART, Catal. mamm., pt. III, p. 563.

TYPE LOCALITY.— Headwaters of the Sacramento River, near Mount Shasta, Siskiyou County, California.

Microtus montanus arizonensis Bailey.

1898. *Microtus montanus arizonensis* BAILEY, Proc. biol. soc. Washington, XII, p. 88. April 30, 1898.

TYPE LOCALITY.— Springerville, Apache County, Arizona.

Microtus montanus rivularis (Bailey).

1898. *Microtus nevadensis rivularis* BAILEY, Proc. biol. soc. Washington, XII, p. 87. April 30, 1898.

1900. *Microtus montanus rivularis* BAILEY, North Amer. fauna, no. 17, p. 29. June 6, 1900.

TYPE LOCALITY.— St. George, Washington County, Utah.

Microtus nanus (Merriam).

1891. *Arvicola (Mynomes) nanus* MERRIAM, North Amer. fauna, no. 5, p. 63. July 30, 1891.

1897. *Microtus nanus* MILLER, Proc. biol. soc. Washington, XI, p. 67. April 21, 1897.

TYPE LOCALITY.— Pahsimeroi Mountains, Idaho. Altitude, 9350 feet.

Microtus nanus canescens Bailey.

1898. *Microtus nanus canescens* BAILEY, Proc. biol. soc. Washington, XII, p. 87. April 30, 1898.

TYPE LOCALITY.—Conconully, Okanogan County, Washington.

Microtus canicaudus Miller.

1897. *Microtus canicaudus* MILLER, Proc. biol. soc. Washington, XI, p. 67. April 21, 1897.

TYPE LOCALITY.— McCoy, Willamette Valley, Polk County, Oregon.

Microtus dutcheri Bailey.

1898. *Microtus dutcheri* BAILEY, Proc. biol. soc. Washington, XII, p. 85. April 30, 1898.

TYPE LOCALITY. — Big Cottonwood Meadows, near Mount Whitney, Tulare County, California. Altitude, 10,000 feet.

Microtus nevadensis Bailey.

1898. *Microtus nevadensis* BAILEY, Proc. biol. soc. Washington, XII, p. 86. April 30, 1898.

TYPE LOCALITY. — Ash Meadows, Nye County, Nevada.

Microtus californicus (Peale).

1848. *Arvicola californica* Peale, U. S. explor. exp., viii, mamm. and ornith., p. 46.

1897. [*Microtus*] *californicus* Trouessart, Catal. mamm., pt. iii, p. 563.

Type locality. — Vicinity of San Francisco Bay, California.

Microtus californicus vallicola Bailey.

1898. *Microtus californicus vallicola* Bailey, Proc. biol. soc. Washington, xii, p. 89. April 30, 1898.

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

Microtus californicus constrictus Bailey.

1900. *Microtus californicus constrictus* Bailey, North Amer. fauna, no. 17, p. 36. June 6, 1900.

Type locality. — Cape Mendocino, Humboldt County, California.

Microtus edax (Le Conte).

1853. *Arvicola edax* Le Conte, Proc. acad. nat. sci. Phila., vi, p. 405.

1896. *Microtus edax* Allen, Bull. Amer. mus. nat. hist., viii, p. 268. December 4, 1896.

Type locality.— California, south of San Francisco.

Microtus scirpensis Bailey.

1900. *Microtus scirpensis* Bailey, North Amer. fauna, no. 17, p. 38. June 6, 1900.

Type locality. — Amargosa River, near Nevada line, Inyo County, California.

Microtus operarius (Nelson).

1893. *Arvicola operarius* Nelson, Proc. biol. soc. Washington, viii, p. 139. December 28, 1893.

1897. [*Microtus*] *operarius* Trouessart, Catal. mamm., pt. iii, p. 564.

Type locality. — St. Michaels, Norton Sound, Alaska.

Microtus macfarlani Merriam.

1900. *Microtus macfarlani* Merriam, Proc. Washington acad. sci., ii, p. 24. March 14, 1900.

Type locality.— Fort Anderson, Anderson River, Mackenzie, Canada.

Microtus yakutatensis Merriam.
1900. *Microtus yakutatensis* Merriam, Proc. Washington acad. sci., II, p. 22. March 14, 1900.
Type locality.— North shore of Yakutat Bay, Alaska.

Microtus kadiacensis Merriam.
1897. *Microtus kadiacensis* Merriam, Proc. biol. soc. Washington, XI, p. 222. July 15, 1897.
Type locality.— Kadiak Island, Alaska.

Microtus unalascensis Merriam.
1897. *Microtus unalascensis* Merriam, Proc. biol. soc. Washington, XI, p. 222. July 15, 1897.
Type locality.— Unalaska, Alaska.

Microtus unalascensis popofensis Merriam.
1900. *Microtus unalascensis popofensis* Merriam, Proc. Washington acad. sci., II, p. 22. March 14, 1900.
Type locality.— Popof Island, Shumagin Islands, Alaska.

Microtus sitkensis Merriam.
1897. *Microtus sitkensis* Merriam, Proc. biol. soc. Washington, XI, p. 221. July 15, 1897.
Type locality.— Sitka, Alaska.

Microtus innuitus Merriam.
1900. *Microtus innuitus* Merriam, Proc. Washington acad. sci., II, p. 21. March 14, 1900.
Type locality.— St. Lawrence Island, Bering Sea, Alaska.

Microtus abbreviatus Miller.
1899. *Microtus abbreviatus* Miller, Proc. biol. soc. Washington, XIII, p. 13. January 31, 1899.
Type locality.— Hall Island, Bering Sea, Alaska.

Microtus abbreviatus fisheri Merriam.
1900. *Microtus abbreviatus fisheri* Merriam, Proc. Washington acad. sci., II, p. 23. March 14, 1900.
Type locality.— St. Matthew Island, Bering Sea, Alaska.

* **Microtus townsendii** (Bachman).
1839. *Arvicola townsendii* Bachman, Journ. acad. nat. sci. Phila., VIII, pt. I, p. 60.

1885. *Arvicola townsendi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 597. 1885. (Part.)

1896. *M[icrotus] townsendi* MILLER, North Amer. fauna, no. 12, p. 66. July 22, 1896.

TYPE LOCALITY. — Columbia River; according to Bailey (North Amer. fauna, no. 17, p. 46, June 6, 1900), near mouth of Willamette, on or near Wappatoo (or Sauvie) Island.

Microtus tetramerus (Rhoads).

1894. *Arvicola (Tetramerodon) tetramerus* RHOADS, Proc. acad. nat. sci. Phila., p. 283. October 23, 1894.

1900. *Microtus tetramerus* BAILEY, North Amer. fauna, no. 17, p. 47. June 6, 1900.

TYPE LOCALITY. — Beacon Hill Park, Victoria, Vancouver Island, British Columbia, Canada.

Microtus longicaudus (Merriam).

1888. *Arvicola (Mynomes) longicaudus* MERRIAM, Amer. nat., XXII, p. 934. October, 1888.

1895. *Microtus (Mynomes) longicaudus* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 266. August 21, 1895.

TYPE LOCALITY. — Custer, Black Hills, Custer County, South Dakota. Altitude, 5500 feet.

Microtus mordax (Merriam).

1891. *Arvicola (Mynomes) mordax* MERRIAM, North Amer. fauna, no. 5, p. 61. July 30, 1891.

1897. *[Microtus] mordax* TROUESSART, Catal. mamm., pt. III, p. 564.

TYPE LOCALITY. — Sawtooth (or Alturas) Lake, east base of Sawtooth Mountains, Idaho. Altitude, 7200 feet.

Microtus macrurus Merriam.

1898. *Microtus macrurus* MERRIAM, Proc. acad. nat. sci. Phila., p. 353. October 4, 1898.

TYPE LOCALITY. — Lake Cushman, Olympic Mountains, Washington.

Microtus angusticeps Bailey.

1898. *Microtus angusticeps* BAILEY, Proc. biol. soc. Washington, XII, p. 86. April 30, 1898.

TYPE LOCALITY. — Crescent City, Del Norte County, California.

Microtus alticola (Merriam).

1890. *Arvicola (Mynomes) alticolus* MERRIAM, North Amer. fauna, no. 3, p. 67. September 11, 1890.

1895. *Microtus alticolus* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 219. June 29, 1895.

TYPE LOCALITY.— Little Spring, San Francisco Mountain, Coconino County, Arizona. Altitude, 8200 feet.

Microtus alticola leucophaeus (Allen).

1894. *Arvicola leucophaeus* ALLEN, Bull. Amer. mus. nat. hist., VI, p. 320. November 7, 1894.

1900. *Microtus alticolus leucophaeus* BAILEY, North Amer. fauna, no. 17, p. 53. June 6, 1900.

TYPE LOCALITY. — Graham Mountains, Graham County, Arizona.

* **Microtus mexicanus** (Saussure).

1861. *Arvicola (Hemiotomys) mexicanus* SAUSSURE, Revue et magasin de zoologie, 2d ser., XIII, p. 3. January, 1861.

1885. *Arvicola mexicanus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 597. 1885.

1897. [*Microtus*] *mexicanus* TROUESSART, Catal. mamm., pt. III, p. 564.

TYPE LOCALITY. — Mount Orizaba, State of Puebla, Mexico.

Microtus mexicanus phaeus (Merriam).

1892. *Arvicola phaeus* MERRIAM, Proc. biol. soc. Washington, VII, p. 171. September 29, 1892.

1900. *Microtus mexicanus phaeus* BAILEY, North Amer. fauna, no. 17, p. 54. June 6, 1900.

TYPE LOCALITY. — North slope of Sierra Nevada de Colima, State of Jalisco, Mexico. Altitude, 10,000 feet.

Microtus fulviventer Merriam.

1898. *Microtus fulviventer* MERRIAM, Proc. biol. soc. Washington, XII, p. 106. April 30, 1898.

TYPE LOCALITY. — Cerro San Felipe, State of Oaxaca, Mexico. Altitude, 10,200 feet.

Microtus mogollonensis (Mearns).

1890. *Arvicola mogollonensis* MEARNS, Bull. Amer. mus. nat. hist., II, p. 283. February 21, 1890.

1896. *M[icrotus] mogollonensis* Miller, Proc. biol. soc. Washington, xi, p. 68. April 21, 1896.

Type locality. — Bakers Butte, Mogollon Mountains, Yavapai County, Arizona.

* **Microtus xanthognathus** (Leach).

1815. *Arvicola xanthognatha* Leach, Zool. miscell., i, p. 60.

1885. *Arvicola xanthognathus* True, Proc. U. S. nat. mus., vii (1884), p. 597. 1885.

1896. *M[icrotus] xanthognathus* Miller, North Amer. fauna, no. 12, p. 66. July 23, 1896.

Type locality.— Hudson Bay.

Microtus chrotorrhinus (Miller).

1894. *Arvicola chrotorrhinus* Miller, Proc. Boston soc. nat. hist., xxvi, p. 190. March 24, 1894.

1896. *Microtus chrotorrhinus* Bangs, Proc. biol. soc. Washington, x, p. 49. March 9, 1896.

Type locality.— Head of Tuckerman's Ravine, Mount Washington, Coos County, New Hampshire. Altitude, 5300 feet.

Microtus chrotorrhinus ravus Bangs.

1898. *Microtus chrotorrhinus ravus* Bangs, Proc. biol. soc. Washington, xii, p. 188. November 16, 1898.

Type locality.— Black Bay, Strait of Belle Isle, Labrador.

Subgenus Arvicola Lacépède.

1799. *Arvicola* Lacépède, Tableau des divisions, sous-divisions, ordres et genres des mammifères, p. 10 (Published as supplement to Discours d'ouverture et de clôture du cours d'histoire naturelle, et tableaux méthodiques des mammifères et des oiseaux). Type. — *Arvicola amphibius* Lacépède = *Mus terrestris* Linnaeus.

Microtus richardsoni (DeKay).

1842. *Arvicola richardsoni* DeKay, Zool. New York, mamm., p. 91.

1894. *Aulacomys richardsoni* Rhoads, Proc. acad. nat. sci. Phila., p. 288. October 23, 1894.

1897. [*Microtus*] *richardsoni* Trouessart, Catal. mamm., pt. iii, p. 565.

TYPE LOCALITY. — "Near the foot of the Rocky Mountains." According to Bailey (North Amer. fauna, no. 17, p. 60, June 6, 1900) the type was collected by Drummond in the vicinity of Jasper House, Alberta, Canada.

Microtus richardsoni macropus (Merriam).

1891. *Arvicola* (*Mynomes*) *macropus* MERRIAM, North Amer. fauna, no. 5, p. 59. July 30, 1891.

1900. *Microtus richardsoni macropus* BAILEY, North Amer. fauna, no. 17, p. 61. June 6, 1900.

TYPE LOCALITY.— Pahsimeroi Mountains, Idaho. Altitude, about 9700 feet.

Microtus richardsoni arvicoloides (Rhoads).

1894. *Aulacomys arvicoloides* RHOADS, Amer. nat., XXVIII, p. 182. February 11, 1894.

1900. *Microtus richardsoni arvicoloides* BAILEY, North Amer. fauna, no. 17, p. 62. June 6, 1900.

TYPE LOCALITY. — Lake Kichelos, Kittitas County, Washington. Altitude, 8000 feet.

Subgenus PITYMYS McMurtrie.

1831. *Pitymys* McMURTRIE, Cuvier's anim. kingdom, Amer. ed., I, p. 434. Type.— *Psammomys pinetorum* LE CONTE.

* **Microtus pinetorum** (Le Conte).

1830. *Psammomys pinetorum* LE CONTE, Ann. lyc. nat. hist. New York, III, p. 133.

1885. *Arvicola pinetorum* TRUE, Proc. U. S. nat. mus., VII (1884), p. 596. 1885. (Part.)

1896. *Microtus pinetorum* MILLER, North Amer. fauna, no. 12, p. 9. July 23, 1896.

TYPE LOCALITY.— Pine forests of Georgia, probably on the Le Conte plantation, near Riceboro, Liberty County.

Microtus pinetorum scalopsoides (Audubon and Bachman).

1841. *Arvicola scalopsoides* AUDUBON and BACHMAN, Proc. acad. nat. sci. Phila., I, p. 97. October, 1841.

1896. *Microtus pinetorum scalopsoides* Batchelder, Proc. Boston soc. nat. hist., xxvii, p. 187. October, 1896.

Type locality. — Long Island, New York.

Microtus pinetorum auricularis Bailey.

1898. *Microtus pinetorum auricularis* Bailey, Proc. biol. soc. Washington, xii, p. 90. April 30, 1898.

Type locality. — Washington, Adams County, Mississippi.

Microtus nemoralis (Bailey).

1898. *Microtus pinetorum nemoralis* Bailey, Proc. biol. soc. Washington, xii, p. 89. April 30, 1898.

1900. *Microtus nemoralis* Bailey, North Amer. fauna, no. 17, p. 65. June 6, 1900.

Type locality.— Stilwell, Boston Mts., Indian Territory.

* **Microtus quasiater** (Coues).

1874. *Arvicola (Pitymys) pinetorum* var. *quasiater* Coues, Proc. acad. nat. sci. Phila., p. 191. December 15, 1874.

1885. *Arvicola quasiater* True, Proc. U. S. nat. mus., vii (1884), p. 596. 1885.

1896. *M[icrotus] quasiater* Miller, North Amer. fauna, no. 12, p. 60. July 23, 1896.

Type locality. — Jalapa, State of Vera Cruz, Mexico.

Subgenus Lagurus Gloger.

1841. *Lagurus* Gloger, Gemeinn. Hand- u. Hilfsbuch d. Naturgesch., i, p. 97. Type.— *Lagurus migratorius* Gloger=*Mus lagurus* Pallas.

* **Microtus curtatus** (Cope).

1868. *Arvicola curtata* Cope, Proc. acad. nat. sci. Phila., p. 2.

1885. *Arvicola austerus curtatus* True, Proc. U. S. nat mus., vii (1884), p. 597. 1885.

1896. *M[icrotus] curtatus* Miller, North Amer. fauna, no. 12, p. 51. July 23, 1896.

TYPE LOCALITY. — Pigeon Spring, Mount Magruder, Nevada, near boundary between Inyo County, California, and Esmeralda County, Nevada.

Microtus pallidus (Merriam).

1888. *Arvicola* (*Chilotus*) *pallidus* MERRIAM, Amer. nat., XXII, p. 704. August, 1888.

1896. *Microtus pallidus* MILLER, North Amer. fauna, no. 12, p. 50. July 23, 1896.

TYPE LOCALITY. — Fort Buford, Howard County, North Dakota.

Microtus pauperrimus (Cooper).

1868. *Arvicola pauperrima* COOPER, Amer. nat., II, p. 535. December, 1868.

1896. *M*[*icrotus*] *pauperrimus* MILLER, North Amer. fauna, no. 12, p. 51. July 23, 1896.

TYPE LOCALITY. — Plains of the Columbia, near the Snake River, southwestern Washington.

Subgenus CHILOTUS Baird.

1857. *Chilotus* BAIRD, Mamm. N. Amer., p. 516. Type.—*Arvicola oregoni* BACHMAN.

* **Microtus oregoni** (Bachman).

1839. *Arvicola oregoni* BACHMAN, Journ. acad. nat. sci. Phila., VIII, pt. I, p. 60.

1885. *Arvicola oregonus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 597. 1885.

1896. *Microtus oregoni* MILLER, North Amer. fauna, no. 12, p. 9. July 23, 1896.

TYPE LOCALITY. — Astoria, Clatsop County, Oregon.

Microtus serpens Merriam.

1897. *Microtus serpens* MERRIAM, Proc. biol. soc. Washington, XI, p. 75. April 21, 1897.

TYPE LOCALITY. — Agassiz, British Columbia, Canada.

Microtus bairdi Merriam.

1897. *Microtus bairdi* Merriam, Proc. biol. soc. Washington, xi, p. 74. April 21, 1897.

Type locality.— Glacier Peak, Crater Lake, Klamath County, Oregon. Altitude, 7800 feet.

Subgenus Pedomys Baird.

1857. *Pedomys* Baird, Mamm. N. Amer., p. 517. Type.— *Arvicola austerus* Le Conte.

* **Microtus austerus** (Le Conte).

1853. *Arvicola austerus* Le Conte, Proc. acad. nat. sci. Phila., vi, p. 405.

1885. *Arvicola austerus* True, Proc. U. S. nat. mus., vii (1884), p. 597. 1885.

1896. *Microtus austerus* Miller, North Amer. fauna, no. 12, p. 9. July 23, 1896.

Type locality. — Racine, Racine County, Wisconsin.

Allen (Bull. Amer. mus. nat. hist., x, p. 458, November 10, 1898) calls attention to the fact that the description of Wagner's *Hypudaeus ochrogaster* (Schreber's Säugthiere, Suppl., iii, p. 592, 1843) "admirably fits" this species, which he therefore proposes shall stand as *Microtus ochrogaster* (p. 459). The name *ochrogaster* is not mentioned by Bailey.

Microtus ludovicianus Bailey.

1900. *Microtus ludovicianus* Bailey, North Amer. fauna, no. 17, p. 74. June 6, 1900.

Type locality. — Iowa, Calcasieu Parish, Louisiana.

Microtus haydenii (Baird).

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

1894. *Arvicola* (*Pedomys*) *haydenii* Allen, Bull. Amer. mus. nat. hist., vi, p. 328. November 7, 1894.

1895. *Microtus* (*Pedomys*) *haydenii* Allen, Bull. Amer. mus. nat. hist., vii, p. 267. August 21, 1895.

Type locality. — Fort Pierre, Stanley County, South Dakota.

Microtus minor (Merriam).

1888. *Arvicola austerus minor* Merriam, Amer. nat., xxii, p. 600. July, 1888.

1900. *Microtus minor* Bailey, North Amer. fauna, no. 17, p. 75. June 6, 1900.

Type locality.— Bottineau, at base of Turtle Mountains, Bottineau County, North Dakota.

Subgenus Orthriomys Merriam.

1898. *Orthriomys* Merriam, Proc. biol. soc. Washington, xii, p. 106. April 30, 1898. Type.— *Microtus umbrosus* Merriam.

Microtus umbrosus Merriam.

1898. *Microtus umbrosus* Merriam, Proc. biol. soc. Washington, xii, p. 107. April 30, 1898.

Type locality. — Mount Zempoaltepec, State of Oaxaca, Mexico. Altitude, 8200 feet.

Subgenus Herpetomys Merriam.

1898. *Herpetomys* Merriam, Proc. biol. soc. Washington, xii, p. 107. April 30, 1898. Type.— *Microtus guatemalensis* Merriam.

Microtus guatemalensis Merriam.

1898. *Microtus guatemalensis* Merriam, Proc. biol. soc. Washington, xii, p. 108. April 30, 1898.

Type locality. — Todos Santos, State of Huehuetenango, Guatemala. Altitude, 10,000 feet.

Subgenus Neofiber True.

1884. *Neofiber* True, Science, iv, p. 34. July 11, 1884. Type.— *Neofiber alleni* True.

* **Microtus alleni** (True).

1884. *Neofiber alleni* True, Science, iv, p. 34. July 11, 1884.

1885. *Neofiber alleni* True, Proc. U. S. nat. mus., vii (1884), p. 596. 1885.

1896. *Microtus alleni* Miller, North Amer. fauna, no. 12, p. 9. July 23, 1896.

Type locality.— Georgiana, Brevard County, Florida.

Genus FIBER Cuvier.

1800. *Fiber* Cuvier, Leçons d'anat. comp., i, tabl. i (described but not named in 1798, Tabl. élém. de l'hist. nat. des anim., p. 141). Type.— *Castor zibethicus* Linnaeus.

Fiber macrodon Merriam.

1897. *Fiber macrodon* Merriam, Proc. biol. soc. Washington, xi, p. 143. May 13, 1897.

Type locality. — Lake Drummond, Dismal Swamp, Norfolk County, Virginia.

Fiber obscurus Bangs.

1894. *Fiber obscurus* Bangs, Proc. biol. soc. Washington, ix, p. 133. September 15, 1894.

Type locality. — Codroy, Newfoundland.

Fiber osoyoosensis Lord.

1863. *Fiber osoyoosensis* Lord, Proc. zool. soc. London, p. 97.

1900. *Fiber osoyoosensis* Osgood, North Amer. fauna, no. 19, p. 37. October 6, 1900.

Type locality.— Lake Osoyoos, British Columbia, Canada.

Fiber spatulatus Osgood.

1900. *Fiber spatulatus* Osgood, North Amer. fauna, no. 19, p. 36. October 6, 1900.

Type locality. — Lake Marsh, Yukon, Canada.

* **Fiber zibethicus** (Linnaeus).

1766. [*Castor*] *zibethicus* Linnaeus, Syst. nat., xii ed., i, p. 79.

1817. [*Fiber*] *zibeticus* Cuvier, Règne anim., i, p. 192.

1885. *Fiber zibethicus* True, Proc. U. S. nat. mus., vii (1884), p. 596. 1885.

Type locality. — Eastern Canada.

Fiber zibethicus aquilonius Bangs.

1899. *Fiber zibethicus aquilonius* Bangs, Proc. New England zool. club, i, p. 11. February 28, 1899.

Type locality. — Rigoulette, Hamilton Inlet, Labrador.

Fiber zibethicus pallidus Mearns.

1890. *Fiber zibethicus pallidus* Mearns, Bull. Amer. mus. nat. hist., ii, p. 280. February 21, 1890.

Type locality. — Fort Verde, Yavapai County, Arizona.

Fiber zibethicus rivalicius Bangs.

1895. *Fiber zibethicus rivalicius* Bangs, Proc. Boston soc. nat. hist., xxvi, p. 541. July 31, 1895.

Type locality. — Burbridge, Plaquemines Parish, Louisiana.

Genus **SYNAPTOMYS** Baird.[1]

1857. *Synaptomys* Baird, Mamm. N. Amer., p. 558. Type.— *Synaptomys cooperi* Baird.

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[1] Revised by Merriam, Proc. biol. soc. Washington, x, pp. 55–64. March 19, 1896.

Subgenus SYNAPTOMYS Baird.

*** Synaptomys cooperi** Baird.

1857. *S[ynaptomys] cooperi* BAIRD, Mamm. N. Amer., p. 558.

1885. *Synaptomys cooperi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 596. 1885.

TYPE LOCALITY.— Unknown, probably northern New Jersey.

Synaptomys fatuus Bangs.

1896. *Synaptomys fatuus* BANGS, Proc. biol. soc. Washington, x, p. 47. March 9, 1896.

TYPE LOCALITY. — Lake Edward, Quebec, Canada.

Regarded by Rhoads (Proc. acad. nat. sci. Phila., 1897, p. 306, June, 1897) as a form of *S. cooperi*.

Synaptomys helaletes Merriam.

1896. *Synaptomys helaletes* MERRIAM, Proc. biol. soc. Washington, x, p. 59. March 19, 1896.

TYPE LOCALITY.— Dismal Swamp, Norfolk County, Virginia.

According to Rhoads (Proc. acad. nat. sci. Phila., 1897, p. 305, June, 1897), this should stand as *Synaptomys cooperi stonei* (RHOADS) (*Synaptomys stonei* Rhoads, Amer. nat., XXVII, p. 53, January 11, 1893; type locality, Mays Landing, Atlantic County, New Jersey).

Synaptomys helaletes gossii Merriam.

1896. *Synaptomys helaletes gossii* MERRIAM, Proc. biol. soc. Washington, x, p. 60. March 19, 1896.

TYPE LOCALITY. — Neosho Falls, Woodson County, Kansas.

According to Rhoads (Proc. acad. nat. sci. Phila., 1897, p. 307, June, 1897), this should stand as *Synaptomys cooperi gossi*.

Subgenus MICTOMYS True.

1894. *Mictomys* TRUE, Diagnoses of new North American mammals, p. 2. April 26, 1894. (Reprint: Proc. U. S. nat. mus., XVII, p. 242. November 15, 1894.) Type.— *Mictomys innuitus* TRUE.

Synaptomys innuitus (True).

1894. *Mictomys innuitus* TRUE, Diagnoses of new North American mammals, p. 3. April 26, 1894. (Reprint: Proc. U. S. nat. mus., XVII, p. 243. November 15, 1894.)

1896. *Synaptomys* (*Mictomys*) *innuitus* MERRIAM, Proc. biol. soc. Washington, x, p. 61. March 19, 1896.

TYPE LOCALITY. — Fort Chimo, Ungava, Labrador.

Synaptomys innuitus medioximus Bangs.

1900. *Synaptomys* (*Mictomys*) *innuitus medioximus* BANGS, Proc. New England zool. club, II, p. 40. September 20, 1900.

TYPE LOCALITY. — Lance au Loup, Strait of Belle Isle, Labrador.

Synaptomys sphagnicola Preble.

1899. *Synaptomys* (*Mictomys*) *sphagnicola* PREBLE, Proc. biol. soc. Washington, XIII, p. 43. May 29, 1899.

TYPE LOCALITY. — Fabyans, Coos County, New Hampshire.

Synaptomys dalli Merriam.

1896. *Synaptomys* (*Mictomys*) *dalli* MERRIAM, Proc. biol. soc. Washington, x, p. 62. March 19, 1896.

TYPE LOCALITY. — Nulato, Alaska.

Synaptomys truei Merriam.

1896. *Synaptomys* (*Mictomys*) *truei* MERRIAM, Proc. biol. soc. Washington, x, p. 62. March 19, 1896.

TYPE LOCALITY. — Skagit Valley, northwestern Washington.

Synaptomys wrangeli Merriam.

1896. *Synaptomys* (*Mictomys*) *wrangeli* MERRIAM, Proc. biol. soc. Washington, x, p. 63. March 19, 1896.

TYPE LOCALITY. — Wrangel, Alaska.

Genus **LEMMUS** Link.

1795. *Lemmus* LINK, Zool. Beyträge, I, pt. II, p. 75. Type. — By elimination, *Mus lemmus* LINNAEUS.

* **Lemmus alascensis** Merriam.

1885. *Myodes obensis* True, Proc. U. S. nat. mus., vii (1884), p. 596. 1885. (Part.)

1900. *Lemmus alascensis* Merriam, Proc. Washington acad. sci., ii, p. 26. March 14, 1900.

Type locality. — Point Barrow, Alaska.

Lemmus nigripes (True).

1894. *Myodes nigripes* True, Diagnoses of new North American mammals, p. 2. April 26, 1894. (Reprint: Proc. U. S. nat. mus., xvii, p. 242. November 15, 1894.)

1896. *L[emmus] nigripes* Miller, North Amer. fauna, no. 12, p. 37. July 23, 1896.

Type locality. — St. George Island, Pribilof Islands, Bering Sea.

Lemmus trimucronatus (Richardson).

1825. *Arvicola trimucronata* Richardson, Journ. Parry's second voyage, app., p. 309.

1900. *Lemmus trimucronatus* Stone, Proc. acad. nat. sci. Phila., p. 35. March 24, 1900.

Type locality. — Point Lake, Mackenzie, Canada.

Lemmus yukonensis Merriam.

1900. *Lemmus yukonensis* Merriam, Proc. Washington acad. sci., ii, p. 27. March 14, 1900.

Type locality. — Charlie Creek, Yukon River, Alaska.

Genus **DICROSTONYX** Gloger.

1841. *Dicrostonyx* Gloger, Gemeinn. Hand- u. Hilfsbuch d. Naturgesch., pp. xxxi, 97. Type. — An American species, probably *Mus hudsonius* Pallas.

Dicrostonyx hudsonius (Pallas).

1778. *Mus hudsonius* Pallas, Nov. sp. quadr. glir. ord., p. 208.

1897. *Dicrostonyx hudsonius* BANGS, Proc. biol. soc. Washington, XI, p. 237. September 17, 1897.

TYPE LOCALITY.—Labrador.

Dicrostonyx hudsonius alascensis Stone.

1900. *Dicrostonyx hudsonius alascensis* STONE, Proc. acad. nat. sci. Phila., p. 37. March 24, 1900.

TYPE LOCALITY.— Point Barrow, Alaska.

* **Dicrostonyx nelsoni** Merriam.

1885. *Cuniculus torquatus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 596. 1885. (Part.)

1900. *Dicrostonyx nelsoni* MERRIAM, Proc. Washington acad. sci., II, p. 25. March 14, 1900.

TYPE LOCALITY.— St. Michael's, Alaska.

Dicrostonyx richardsoni Merriam.

1900. *Dicrostonyx richardsoni* MERRIAM, Proc. Washington acad. sci., II, p. 26. March 14, 1900.

TYPE LOCALITY.— Fort Churchill, west shore of Hudson Bay, Kewatin, Canada.

Dicrostonyx unalascensis Merriam.

1900. *Dicrostonyx unalascensis* MERRIAM, Proc. Washington acad. sci., II, p. 25. March 14, 1900.

TYPE LOCALITY.— Unalaska, Alaska.

Family GEOMYIDAE.

Genus GEOMYS Rafinesque.[1]

1817. *Geomys* RAFINESQUE, Amer. monthly magazine, II, p. 45. November, 1817. Type.— *Geomys pinetis* RAFINESQUE (= *Mus tuza* ORD).

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[1] Revised by Merriam, North Amer. fauna, no. 8, pp. 109-145. January 31, 1895.

* **Geomys tuza** (Ord).

1815. *Mus tuza* Ord, Guthrie's geography, 2d Amer. ed., II, p. 292.

1875. *Geomys tuza* Coues, Proc. acad. nat. sci. Phila., p. 132.

1885. *Geomys tuza* True, Proc. U. S. nat. mus., VII (1884), p. 599. 1885.

Type locality.— Pine barrens, near Augusta, Richmond County, Georgia.

Geomys tuza mobilensis Merriam.

1895. *Geomys tuza mobilensis* Merriam, North Amer. fauna, no. 8, p. 119. January 31, 1895.

Type locality.— Mobile Bay, Baldwin County, Alabama.

Geomys floridanus (Audubon and Bachman).

1854. *Pseudostoma floridana* Audubon and Bachman, Quadr. N. Amer., III, p. 242.

1898. *Geomys floridanus* Bangs, Proc. Boston soc. nat. hist., XXVIII, p. 176. March, 1898.

Type locality.— St. Augustine, St. John County, Florida.

Geomys floridanus austrinus Bangs.

1898. *Geomys floridanus austrinus* Bangs, Proc. Boston soc. nat. hist., XXVIII, p. 177. March, 1898.

Type locality.— Belleair, Hillsboro County, Florida.

Geomys colonus Bangs.

1898. *Geomys colonus* Bangs, Proc. Boston soc. nat. hist., XXVIII, p. 178. March, 1898.

Type locality.— St. Mary's, Camden County, Georgia.

Geomys cumberlandius Bangs.

1898. *Geomys cumberlandius* Bangs, Proc. Boston soc. nat. hist., XXVIII, p. 180. March, 1898.

Type locality.—"Stafford Place," Cumberland Island, Camden County, Georgia.

* **Geomys bursarius** (Shaw).

1800. *Mus bursarius* Shaw, Trans. Linnaean soc. London, V, p. 227.

1829. *Geomys bursarius* Richardson, Fauna Boreali-Americana, I, p. 203.

1885. *Geomys bursarius* True, Proc. U. S. nat. mus., vii (1884), p. 599. 1885.

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

Geomys lutescens (Merriam).

1890. *Geomys bursarius lutescens* Merriam, North Amer. fauna, no. 4, p. 51. October 8, 1890.

1895. *Geomys lutescens* Merriam, North Amer. fauna, no. 8, p. 127. January 31, 1895.

Type locality.— Sandhills on Birdwood Creek, Lincoln County, western Nebraska.

Geomys breviceps Baird.

1855. *Geomys breviceps* Baird, Proc. acad. nat. sci. Phila., vii, p. 335.

1895. *Geomys breviceps* Merriam, North Amer. fauna, no. 8, p. 129. January 31, 1895.

Type locality. — Prairie Mer Rouge, Morehouse Parish, Louisiana.

Geomys breviceps attwateri Merriam.

1895. *Geomys breviceps attwateri* Merriam, North Amer. fauna, no. 8, p. 135. January 31, 1895.

Type locality.— Rockport, Aransas County, Texas.

Geomys texensis Merriam.

1895. *Geomys texensis* Merriam, North Amer. fauna, no. 8, p. 137. January 31, 1895.

Type locality.—Mason, Mason County, Texas.

Geomys arenarius Merriam.

1895. *Geomys arenarius* Merriam, North Amer. fauna, no. 8, p. 139. January 31, 1895.

Type locality.—El Paso, El Paso County, Texas.

Geomys personatus True.

1889. *Geomys personatus* True, Proc. U. S. nat. mus., xi (1888), p. 159. January 5, 1889.

Type locality.— Padre Island, Cameron County, Texas.

Geomys personatus fallax Merriam.

1895. *Geomys personatus fallax* Merriam, North Amer. fauna, no. 8, p. 144. January 31, 1895.

Type locality.— South side of Nueces Bay, Cameron County, Texas.

Genus **PAPPOGEOMYS** Merriam.[1]

1895. *Pappogeomys* Merriam, North Amer. fauna, no. 8, p. 145. January 31, 1895. Type.—*Geomys bulleri* Thomas.

Pappogeomys bulleri (Thomas).

1892. *Geomys bulleri* Thomas, Ann. and mag. nat. hist., 6th ser., x, p. 196. August, 1892.

1895. *Pappogeomys bulleri* Merriam, North Amer. fauna, no. 8, p. 147. January 31, 1895.

Type locality.—Near Talpa, west slope of Sierra de Mascota, State of Jalisco, Mexico. Altitude, 8500 feet.

Pappogeomys albinasus Merriam.

1895. *Pappogeomys albinasus* Merriam, North Amer. fauna, no. 8, p. 149. January 31, 1895.

Type locality.— Atemajac, a suburb of Guadalajara, State of Jalisco, Mexico.

Genus **CRATOGEOMYS** Merriam.[2]

1895. *Cratogeomys* Merriam, North Amer. fauna, no 8, p. 150. January 31, 1895. Type.—*Geomys merriami* Thomas.

Cratogeomys merriami (Thomas).

1893. *Geomys merriami* Thomas, Ann. and mag. nat. hist., 6th ser., xii, p. 271. October, 1893.

1895. *Cratogeomys merriami* Merriam, North Amer. fauna, no. 8, p. 152. January 31, 1895.

Type locality.—"Southern Mexico," probably in the Valley of Mexico.

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[1] Revised by Merriam, North Amer. fauna, no. 8, pp. 145–149. January 31, 1895.

[2] Revised by Merriam, North Amer. fauna, no. 8, pp. 150–162. January 31, 1895.

Cratogeomys perotensis Merriam.

1895. *Cratogeomys perotensis* MERRIAM, North Amer. fauna, no. 8, p. 154. January 31, 1895.

TYPE LOCALITY.— Cofre de Perote, State of Vera Cruz, Mexico. Altitude, 9500 feet.

Cratogeomys estor Merriam.

1895. *Cratogeomys estor* MERRIAM, North Amer. fauna, no. 8, p. 155. January 31, 1895.

TYPE LOCALITY.—Las Vigas, State of Vera Cruz, Mexico. Altitude, 8000 feet.

Cratogeomys oreocetes Merriam.

1895. *Cratogeomys oreocetes* MERRIAM, North Amer. fauna, no. 8, p. 156. January 31, 1895.

TYPE LOCALITY. — Mount Popocatepetl, State of Mexico, Mexico. Altitude, 11,500 feet.

Cratogeomys peregrinus Merriam.

1895. *Cratogeomys peregrinus* MERRIAM, North Amer. fauna, no. 8, p. 158. January 31, 1895.

TYPE LOCALITY. — Mount Iztaccihuatl, State of Mexico, Mexico. Altitude, 11,500 feet.

* **Cratogeomys castanops** (Baird).

1852. *Pseudostoma castanops* BAIRD, Report Stansbury's exped. to Great Salt Lake, p. 313. June, 1852.

1885. *Geomys castanops* TRUE, Proc. U. S. nat. mus., VII (1884), p. 599. 1885.

1895. *Cratogeomys castanops* MERRIAM, North Amer. fauna, no. 8, p. 159. January 31, 1895.

TYPE LOCALITY.— "Prairie road to Bent's Fort," near the present town of Las Animas, Bent County, Colorado, on the Arkansas River.

Cratogeomys castanops goldmani Merriam.

1895. *Cratogeomys castanops goldmani* MERRIAM, North Amer. fauna, no. 8, p. 160. January 31, 1895.

TYPE LOCALITY.—Cañitas, State of Zacatecas, Mexico.

Cratogeomys fulvescens Merriam.

1895. *Cratogeomys fulvescens* MERRIAM, North Amer. fauna, no. 8, p. 161. January 31, 1895.

TYPE LOCALITY.— Chalchicomula, State of Puebla, Mexico.

Genus **PLATYGEOMYS** Merriam.[1]

1895. *Platygeomys* MERRIAM, North Amer. fauna, no. 8, p. 162. January 31, 1895. Type.—*Geomys gymnurus* MERRIAM.

Platygeomys gymnurus (Merriam).

1892. *Geomys gymnurus* MERRIAM, Proc. biol. soc. Washington, VII, p. 166. September 29, 1892.

1895. *Platygeomys gymnurus* MERRIAM, North Amer. fauna, no. 8, p. 164. January 31, 1895.

TYPE LOCALITY.—Zapotlan, State of Jalisco, Mexico.

Platygeomys tylorhinus Merriam.

1895. *Platygeomys tylorhinus* MERRIAM, North Amer. fauna, no. 8, p. 167. January 31, 1895.

TYPE LOCALITY.—Tula, State of Hidalgo, Mexico.

Platygeomys planiceps Merriam.

1895. *Platygeomys planiceps* MERRIAM, North Amer. fauna, no. 8, p. 168. January 31, 1895.

TYPE LOCALITY.—North slope Volcano of Toluca, State of Mexico, Mexico.

Platygeomys fumosus (Merriam).

1892. *Geomys fumosus* MERRIAM, Proc. biol. soc. Washington, VII, p. 165. September 29, 1892.

1895. *Platygeomys fumosus* MERRIAM, North Amer. fauna, no. 8, p. 170. January 31, 1895.

TYPE LOCALITY.— Colima City, State of Colima, Mexico.

Genus **ORTHOGEOMYS** Merriam.[2]

1895. *Orthogeomys* MERRIAM, North Amer. fauna, no. 8, p. 172. January 31, 1895. Type.—*Geomys scalops* THOMAS.

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[1] Revised by Merriam, North Amer. fauna, no. 8, pp. 162–171. January 31, 1895.

[2] Revised by Merriam, North Amer. fauna, no. 8, pp. 172–179. January 31, 1895.

Orthogeomys scalops (Thomas).

1894. *Geomys scalops* Thomas, Ann. and mag. nat. hist., 6th ser., XIII, p. 437. May, 1894.

1895. *Orthogeomys scalops* Merriam, North. Amer. fauna, no. 8, p. 174. January 31, 1895.

Type locality.— Tehuantepec, State of Oaxaca, Mexico.

Orthogeomys grandis (Thomas).

1893. *Geomys grandis* Thomas, Ann. and mag. nat. hist., 6th ser., XII, p. 270. October, 1893.

1895. *Orthogeomys grandis* Merriam, North Amer. fauna, no. 8, p. 175. January 31, 1895.

Type locality. — Dueñas, Guatemala.

Orthogeomys nelsoni Merriam.

1895. *Orthogeomys nelsoni* Merriam, North Amer. fauna, no. 8, p. 176. January 31, 1895.

Type locality. — Mt. Zempoaltepec, State of Oaxaca, Mexico. Altitude, 8000 feet.

Orthogeomys latifrons Merriam.

1895. *Orthogeomys latifrons* Merriam, North Amer. fauna, no. 8, p. 178. January 31, 1895.

Type locality.— Guatemala; exact locality unknown.

Genus HETEROGEOMYS Merriam.[1]

1895. *Heterogeomys* Merriam, North Amer. fauna, no. 8, p. 179. January 31, 1895. Type. — *Geomys hispidus* Le Conte.

* **Heterogeomys hispidus** (Le Conte).

1852. *Geomys hispidus* Le Conte, Proc. acad. nat. sci. Phila., VI, p. 158.

1885. *Geomys hispidus* True, Proc. U. S. nat. mus., VII (1884), p. 599. 1885.

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[1] Revised by Merriam, North Amer. fauna, no. 8, pp. 179–185. January 31, 1895.

1895. *Heterogeomys hispidus* MERRIAM, North Amer. fauna, no. 8, p. 181. January 31, 1895.

TYPE LOCALITY. — Near Jalapa, State of Vera Cruz, Mexico.

Heterogeomys torridus Merriam.

1895. *Heterogeomys torridus* MERRIAM, North Amer. fauna, no. 8, p. 183. January 31, 1895.

TYPE LOCALITY. — Chichicaxtle, State of Vera Cruz, Mexico.

Genus **MACROGEOMYS** Merriam.[1]

1895. *Macrogeomys* MERRIAM, North Amer. fauna, no. 8, p. 185. January 31, 1895. Type. — *Geomys heterodus* PETERS.

Macrogeomys heterodus (Peters).

1865. *Geomys heterodus* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, 1864, p. 177. 1865.

1895. *Macrogeomys heterodus* MERRIAM, North Amer. fauna, no. 8, p. 186. January 31, 1895.

TYPE LOCALITY. — Costa Rica; exact locality unknown.

Macrogeomys dolichocephalus Merriam.

1895. *Macrogeomys dolichocephalus* MERRIAM, North Amer. fauna, no. 8, p. 189. January 31, 1895.

TYPE LOCALITY. — San José, Costa Rica.

Macrogeomys costaricensis Merriam.

1895. *Macrogeomys costaricensis* MERRIAM, North Amer. fauna, no. 8, p. 192. January 31, 1895.

TYPE LOCALITY. — Pacuare, Costa Rica.

Macrogeomys cherriei (Allen).

1893. *Geomys cherriei* ALLEN, Bull. Amer. mus. nat. hist., v, p. 337. December 16, 1893.

1895. *Macrogeomys cherriei* MERRIAM, North Amer. fauna, no. 8, p. 194. January 31, 1895.

TYPE LOCALITY. — Santa Clara, Costa Rica.

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[1] Revised by Merriam, North Amer. fauna, no. 8, pp. 185–195. January 31, 1895.

Genus **ZYGOGEOMYS** Merriam.[1]

1895. *Zygogeomys* Merriam, North Amer. fauna, no. 8, p. 195. January 31, 1895. Type. — *Zygogeomys trichopus* Merriam.

Zygogeomys trichopus Merriam.

1895. *Zygogeomys trichopus* Merriam, North Amer. fauna, no. 8, p. 196. January 31, 1895.

Type locality. — Nahuatzin, State of Michoacan, Mexico.

Genus **THOMOMYS** Wied.

1839. *Thomomys* Wied, Nova acta phys. med. acad. caes. Leop.-Carol., xix, pt. i, p. 377. Type. — *Thomomys rufescens* Wied.

Thomomys alpinus Merriam.

1897. *Thomomys alpinus* Merriam, Proc. biol. soc. Washington, xi, p. 216. July 15, 1897.

Type locality. — Big Cottonwood Meadows eight miles southeast of Mt. Whitney peak, High Sierra, Tulare County, California. Altitude, 10,000 feet.

Thomomys altivallis Rhoads.

1895. *Thomomys altivallis* Rhoads, Proc. acad. nat. sci. Phila., p. 34. February 21, 1895.

Type locality. — San Bernardino Mountains, California. Altitude, 5000 feet.

Thomomys angularis Merriam.

1897. *Thomomys angularis* Merriam, Proc. biol. soc. Washington, xi, p. 214. July 15, 1897.

Type locality. — Los Baños, Merced County, California.

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[1] Revised by Merriam, North Amer. fauna, no. 8, pp. 195–198. January 31, 1895.

Thomomys atrovarius Allen.

1898. *Thomomys atrovarius* ALLEN, Bull. Amer. mus. nat. hist., x, p. 148. April 12, 1898.

TYPE LOCALITY. — Tatemales, State of Sinaloa, Mexico.

Thomomys aureus Allen.

1893. *Thomomys aureus* ALLEN, Bull. Amer. mus. nat. hist., v, p. 49. April 28, 1893.

TYPE LOCALITY. — Bluff City, San Juan County, Utah.

* **Thomomys bottae** (Eydoux and Gervais).

1836. *Oryctomys* (*Saccophorus*) *bottae* EYDOUX and GERVAIS, Mag. de zool., vi, p. 23.

1855. *Thomomys bottae* BAIRD, Proc. acad. nat. sci. Phila., vii, p. 335.

1885. *Thomomys talpoides bulbivorus* TRUE, Proc. U. S. nat. mus., vii (1884), p. 599. 1885. (Part.)

1893. *Thomomys bottae* MILLER, Bull. Amer. mus. nat. hist., v, p. 57. April 28, 1893.

TYPE LOCALITY. — Coast of California. Name applied by Baird in 1855 to the form occurring in the vicinity of Monterey, and re-applied to the same animal by Miller in 1893.

Thomomys bottae pallescens Rhoads.

1895. *Thomomys bottae pallescens* RHOADS, Proc. acad. nat. sci. Phila., p. 36. February 21, 1895.

TYPE LOCALITY. — Grapelands, San Bernardino Valley, California.

Thomomys bulbivorus (Richardson).

1829. *Diplostoma bulbivorum* RICHARDSON, Fauna Boreali-Americana, I, p. 206.

1857. *Thomomys bulbivorus* BAIRD, Mamm. N. Amer., p. 389.

1893. *Thomomys bulbivorus* MILLER, Bull. Amer. mus. nat. hist., v, p. 57. April 28, 1883.

TYPE LOCALITY. — Banks of the Columbia River, Oregon.

Thomomys cervinus Allen.

1895. *Thomomys cervinus* ALLEN, Bull. Amer. mus. nat. hist., vii, p. 203. June 29, 1895.

TYPE LOCALITY. — Phoenix, Maricopa County, Arizona.

* **Thomomys clusius** Coues.

1875. *Thomomys clusius* Coues, Proc. acad. nat. sci. Phila., p. 138. June 15, 1875.

1885. *Thomomys clusius* True, Proc. U. S. nat. mus., vii (1884), p. 598. 1885.

Type locality. — Bridger Pass, Sweetwater County, Wyoming.

Thomomys clusius fuscus Merriam.

1891. *Thomomys clusius fuscus* Merriam, North Amer. fauna, no. 5, p. 70. July 30, 1891.

Type locality. — Mountains at head of Big Lost River, Custer County, Idaho.

Regarded by Allen (Bull. Amer. mus. nat. hist., v, p. 63, April 28, 1893) as a form of *T. douglasii.*

Thomomys douglasii (Richardson).

1829. *Geomys douglasii* Richardson, Fauna Boreali-Americana, i, p. 200.

1893. *Thomomys douglasii* Allen, Bull. Amer. mus. nat. hist., v, p. 66. April 28, 1893.

Type locality. — Near the mouth of the Columbia River, Oregon.

Thomomys douglasii yelmensis Merriam.

1899. *Thomomys douglasi yelmensis* Merriam, Proc. biol. soc. Washington, xiii, p. 21. January 31, 1899.

Type locality. — Tenino, Yelm Prairie, Thurston County, Washington.

Thomomys fossor Allen.

1893. *Thomomys fossor* Allen, Bull. Amer. mus. nat. hist., v, p. 51. April 28, 1893.

Type locality. — Florida, La Plata County, Colorado. Altitude, 7200 feet.

Thomomys fulvus (Woodhouse).

1852. *Geomys fulvus* Woodhouse, Proc. acad. nat. sci. Phila., vi, p. 201.

1857. *Thomomys fulvus* Baird, Mamm. N. Amer., p. 402.

1890. *Thomomys fulvus* Merriam, North Amer. fauna, no. 3, p. 71. September 11, 1890.

Type locality. — San Francisco Mountain, Coconino County, Arizona.

Thomomys fulvus alticola Allen.

1899. *Thomomys fulvus alticolus* Allen, Bull. Amer. mus. nat. hist., xii, p. 13. April 4, 1899.

Type locality.— Sierra Laguna, Lower California, Mexico. Altitude, 7000 feet.

Thomomys fulvus anitae Allen.

1898. *Thomomys fulvus anitae* Allen, Bull. Amer. mus. nat. hist., x, p. 146. April 12, 1898.

Type locality.— Santa Anita, Lower California, Mexico.

Thomomys fulvus intermedius Mearns.

1897. *Thomomys fulvus intermedius* Mearns, Proc. U. S. nat. mus., xix, p. 719. July 30, 1897.

Type locality. — Summit of Huachuca Mountains, southern Arizona. Altitude, 9000 feet.

Thomomys fulvus martirensis Allen.

1898. *Thomomys fulvus martirensis* Allen, Bull. Amer. mus. nat. hist., x, p. 147. April 12, 1898.

Type locality. — San Pedro Martir Mountains, Lower California, Mexico. Altitude, 8200 feet.

Thomomys fulvus nigricans Rhoads.

1895. *Thomomys fulvus nigricans* Rhoads, Proc. acad. nat. sci. Phila., p. 36. February 21, 1895.

Type locality. —Witch Creek, San Diego County, California.

Thomomys laticeps Baird.

1855. *Thomomys laticeps* Baird, Proc. acad. nat. sci. Phila., vii, p. 335. April, 1855.

1893. *Thomomys laticeps* Allen, Bull. Amer. mus. nat. hist., v, p. 63. April 28, 1893.

Type locality. — Humboldt Bay, Humboldt County, California.

Thomomys mazama Merriam.

1897. *Thomomys mazama* Merriam, Proc. biol. soc. Washington, xi, p. 214. July 15, 1897.

Type locality. — Crater Lake, Mount Mazama, Klamath County, Oregon. Altitude, 6000 feet.

Thomomys melanops Merriam.

1899. *Thomomys melanops* Merriam, Proc. biol. soc. Washington, XIII, p. 21. January 31, 1899.

Type locality. — Timberline at head of Soleduc River, Olympic Mountains, Clallam County, Washington.

Thomomys monticola Allen.

1893. *Thomomys monticolus* Allen, Bull. Amer. mus. nat. hist., V, p. 48. April 28, 1893.

Type locality. — Mt. Tallac, El Dorado County, California. Altitude, 7500 feet.

Thomomys monticola pinetorum Merriam.

1899. *Thomomys monticolus pinetorum* Merriam, North Amer. fauna, no. 16, p. 97. October 28, 1899.

Type locality.— Sisson, Siskiyou County, California.

Thomomys nasicus Merriam.

1897. *Thomomys nasicus* Merriam, Proc. biol. soc. Washington, XI, p. 216. July 15, 1897.

Type locality.— Farewell Bend, Des Chutes River, Crook County, Oregon.

Thomomys nevadensis Merriam.

1897. *Thomomys nevadensis* Merriam, Proc. biol. soc. Washington, XI, p. 213. July 15, 1897.

Type locality. — Austin, Lander County, Nevada.

Thomomys operarius Merriam.

1897. *Thomomys operarius* Merriam, Proc. biol. soc. Washington, XI, p. 215. July 15, 1897.

Type locality. — Keeler, east side of Owens Lake, Inyo County, California.

Thomomys orizabae Merriam.

1893. *Thomomys orizabae* Merriam, Proc. biol. soc. Washington, VIII, p. 145. December 29, 1893.

Type locality. — Mt. Orizaba, State of Puebla, Mexico. Altitude, about 9500 feet.

Thomomys peregrinus Merriam.

1893. *Thomomys peregrinus* Merriam, Proc. biol. soc. Washington, VIII, p. 146. December 29, 1893.

Type locality. — Salazar, State of Mexico, Mexico.

Thomomys perpallidus (Merriam).

1886. *Thomomys talpoides perpallidus* Merriam, Science, viii, p. 588. December 24, 1886.

1893. *Thomomys perpallidus* Allen, Bull. Amer. mus. nat. hist., v, p. 54. April 28, 1893.

Type locality. — Colorado Desert, San Diego County, California.

Rhoads (Proc. acad. nat. sci. Phila., 1895, p. 37, March 19, 1895) suggests that this may eventually stand as *Thomomys fulvus perpallidus*.

Thomomys quadratus Merriam.

1897. *Thomomys quadratus* Merriam, Proc. biol. soc. Washington, xi, p. 214. July 15, 1897.

Type locality. — The Dalles, Wasco County, Oregon.

Thomomys rufescens Wied.

1839. *Thomomys rufescens* Wied, Nova acta phys. med. acad. caes. Leop.-Carol., xix, pt. i, p. 378.

1893. *Thomomys rufescens* Allen, Bull. Amer. mus. nat. hist., v, p. 62. April 28, 1893.

Type locality.— Missouri River, exact locality not known (see Allen, Bull. Amer. mus. nat. hist., v, p. 62, April 28, 1893).

Regarded by Allen (Bull. Amer. mus. nat. hist., v, p. 67, April 28, 1893) as questionably distinct from *T. talpoides*.

* **Thomomys talpoides** (Richardson).

1828. *Cricetus talpoides* Richardson, Zool. journ., iii, p. 518.

1857. *Thomomys talpoides* Baird, Mamm. N. Amer., p. 403.

1885. *Thomomys talpoides talpoides* True, Proc. U. S. nat. mus., vii (1884), p. 598. 1885. (Part.)

Type locality. — Probably Saskatchewan, Canada (see Allen, Bull. Amer. mus. nat. hist., v, p. 55, April 28, 1893).

* **Thomomys talpoides umbrinus** (Richardson).

1829. *Geomys umbrinus* Richardson, Fauna Boreali-Americana, i, p. 202.

1857. *Thomomys umbrinus* Baird, Mamm. N. Amer., p. 399.

1885. *Thomomys talpoides umbrinus* True, Proc. U. S. nat. mus., vii (1884), p. 599. 1885. (Part.)

TYPE LOCALITY.—Unknown ("Cadadaguios, a town in the southwestern part of Louisiana").

Regarded by Allen (Bull. Amer. mus. nat. hist., v, p. 56, April 28, 1893) as undeterminable.

Thomomys toltecus Allen.

1893. *Thomomys toltecus* ALLEN, Bull. Amer. mus. nat. hist., v, p. 52. April 28, 1893.

TYPE LOCALITY.—Juarez, State of Chihuahua, Mexico.

Thomomys townsendii (Bachman).

1839. *Geomys townsendii* BACHMAN, Journ. acad. nat. sci. Phila., VIII, p. 105.

1893. *Thomomys townsendii* ALLEN, Bull. Amer. mus. nat. hist., v, p. 61. April 28, 1893.

TYPE LOCALITY.—"Rocky Mountains"; probably southwestern Wyoming (see Allen, Bull. Amer. mus. nat. hist., v, p. 61, April 28, 1893).

Family **HETEROMYIDAE.**

Subfamily DIPODOMYINAE.

Genus **DIPODOMYS** Gray.

1841. *Dipodomys* GRAY, Ann. and mag. nat. hist., VII, p. 521. August, 1841. Type.—*Dipodomys phillipsii* GRAY.

Dipodomys ambiguus Merriam.

1890. *Dipodomys ambiguus* MERRIAM, North Amer. fauna no. 4, p. 42. October 8, 1894.

TYPE LOCALITY.—El Paso, El Paso County, Texas.

Regarded by Merriam (Science, n. s., VII, p. 31, January 7, 1898) as a form of *D. merriami*.

Dipodomys californicus Merriam.

1890. *Dipodomys californicus* Merriam, North Amer. fauna, no. 4, p. 49. October 8, 1890.

Type locality. — Ukiah, Mendocino County, California.

Dipodomys californicus pallidulus Bangs.

1899. *Dipodomys californicus pallidulus* Bangs, Proc. New England zool. club, i, p. 65. July 31, 1899.

Type locality. — Sites, Colusa County, California.

Dipodomys deserti Stephens.

1887. *Dipodomys deserti* Stephens, Amer. nat., xxi, p. 42. January, 1887.

Type locality. — Mojave River, San Bernardino County, California.

Dipodomys elator Merriam.

1894. *Dipodomys elator* Merriam, Proc. biol. soc. Washington, ix, p. 109. June 21, 1894.

Type locality. — Henrietta, Clay County, Texas.

Regarded by Mearns (Proc. biol. soc. Washington, xiii, p. 167, October 31, 1900) as identical with *D. montanus*.

Dipodomys merriami Mearns.

1890. *Dipodomys merriami* Mearns, Bull. Amer. mus. nat. hist., ii, p. 290. February 21, 1890.

Type locality. — New River, between Phoenix and Prescott, Arizona.

Dipodomys merriami atronasus Merriam.

1894. *Dipodomys merriami atronasus* Merriam, Proc. biol. soc. Washington, ix, p. 113. June 21, 1894.

Type locality. — Hacienda La Parada, about 25 miles northwest of the City of San Luis Potosi, State of San Luis Potosi, Mexico.

Dipodomys merriami exilis Merriam.

1894. *Dipodomys merriami exilis* Merriam, Proc. biol. soc. Washington, ix, p. 113. June 21, 1894.

Type locality. — Fresno, San Joaquin Valley, Fresno County, California.

Dipodomys merriami melanurus Merriam.

1893. *Dipodomys merriami melanurus* Merriam, Proc. California acad. sci., 2d ser., III, p. 345. June 5, 1893.

Type locality. — San José del Cabo, Lower California, Mexico.

Dipodomys merriami nevadensis Merriam.

1894. *Dipodomys merriami nevadensis* Merriam, Proc. biol. soc. Washington, IX, p. 111. June 21, 1894.

Type locality. — Pyramid Lake, Washoe County, Nevada.

Dipodomys merriami nitratoides Merriam.

1894. *Dipodomys merriami nitratoides* Merriam, Proc. biol. soc. Washington, IX, p. 112. June 21, 1894.

Type locality. — Tipton, San Joaquin Valley, Tulare County, California.

Dipodomys merriami nitratus Merriam.

1894. *Dipodomys merriami nitratus* Merriam, Proc. biol. soc. Washington, IX, p. 112. June 21, 1894.

Type locality. — Keeler, east side of Owens Lake, Inyo County, California.

Dipodomys mitchelli Mearns.

1897. *Dipodomys mitchelli* Mearns, Proc. U. S. nat. mus., XIX, p. 719. July 30, 1897.

Type locality. — Tiburon Island, Gulf of California, Mexico.

Dipodomys montanus Baird.

1855. *Dipodomys montanus* Baird, Proc. acad. nat. sci. Phila., VII, p. 334.

1900. *Dipodomys montanus* Mearns, Proc. biol. soc. Washington, XIII, p. 167. October 31, 1900.

Type locality. — Fort Massachusetts, on head waters of Rio Grande in San Luis Valley, southern Colorado.

Dipodomys ornatus Merriam.

1894. *Dipodomys ornatus* Merriam, Proc. biol. soc. Washington, IX, p. 110. June 21, 1894.

Type locality. — Berriozabal, State of Zacatecas, Mexico.

Dipodomys parvus Rhoads.

1894. *Dipodomys parvus* Rhoads, Amer. nat., XXVIII, p. 70. January, 1894.

TYPE LOCALITY. — San Bernardino, San Bernardino County, California.

Regarded by Merriam (Science, n. s., VII, p. 31, January 7, 1898) as a form of *D. merriami*.

Dipodomys perotensis Merriam.

1894. *Dipodomys perotensis* MERRIAM, Proc. biol. soc. Washington, IX, p. 111. June 21, 1894.

TYPE LOCALITY. — Perote, State of Vera Cruz, Mexico.

Dipodomys phillipsii Gray.

1841. *Dipodomys phillipii* (err. typ.) GRAY, Ann. and mag. nat. hist., VII, p. 522. August, 1841.

1893. *Dipodomys phillipsi* MERRIAM, Proc. biol. soc. Washington, VIII, p. 91. July 18, 1893.

TYPE LOCALITY. — Valley of Mexico, Mexico.

The *Dipodomys phillipsi phillipsi* of TRUE (Proc. U. S. nat. mus., VII (1884), p. 599, 1885) is not this animal, but an aggregate of numerous small species of *Dipodomys* and *Perodipus*.

Dipodomys similis Rhoads.

1894. *Dipodomys similis* RHOADS, Proc. acad. nat. sci. Phila., 1893, p. 411. January 27, 1894.

TYPE LOCALITY. — White Water, San Diego County, California.

Regarded by Merriam (Science, n. s., VII, p. 31, January 7, 1898) as identical with *D. simiolus*.

Dipodomys simiolus Rhoads.

1894. *Dipodomys simiolus* RHOADS, Proc. acad. nat. sci. Phila., 1893, p. 410. January 30, 1894.

TYPE LOCALITY. — Agua Caliente, Mohave Desert, California.

Regarded by Mearns (Proc. U. S. nat. mus., XIX, p. 720, July 30, 1897) as a form of *D. merriami*.

Dipodomys spectabilis Merriam.

1890. *Dipodomys spectabilis* MERRIAM, North Amer. fauna, no. 4, p. 46. October 8, 1890.

TYPE LOCALITY. — Dos Cabezos, Cochise County, Arizona.

Genus **PERODIPUS** Fitzinger.

1867. *Perodipus* FITZINGER, Sitzungsber. math.-nat. Classe, k. Akad. Wissensch. Wien, LVI, p. 126. Type. — *Dipodomys agilis* GAMBEL.

Perodipus agilis (Gambel).

1848. *Dipodomys agilis* GAMBEL, Proc. acad. nat. sci. Phila., IV, p. 77.

1886. *Dipodomys agilis* TRUE, Proc. U. S. nat. mus., IX, p. 410. October 30, 1886.

1894. *Perodipus agilis* ALLEN, Abstract proc. Linn. soc. New York, 1893–1894, p. 28. July 20, 1894.

TYPE LOCALITY. — Los Angeles, Los Angeles County, California.

Perodipus chapmani (Mearns).

1890. *Dipodomys chapmani* MEARNS, Bull. Amer. mus. nat. hist., II, p. 291. February 21, 1890.

1894. *Perodipus chapmani* ALLEN, Abstract proc. Linn. soc. New York, 1893–1894, p. 29. July 20, 1894.

TYPE LOCALITY. — Fort Verde, Yavapai County, Arizona.

Regarded by Merriam (Science, n. s., II, p. 417, September 17, 1895) as identical with *P. ordii*.

Perodipus compactus (True).

1888. *Dipodomys compactus* TRUE, Proc. U. S. nat. mus., XI, p. 160. January 5, 1888.

1894. *Perodipus compactus* ALLEN, Abstract proc. Linn. soc. New York, 1893–1894, p. 29. July 20, 1894.

TYPE LOCALITY. — Padre Island, Cameron County, Texas.

Perodipus longipes (Merriam).

1890. *Dipodops longipes* MERRIAM, North Amer. fauna, no. 3, p. 72. September 11, 1890.

1894. *Perodipus longipes* ALLEN, Abstract proc. Linn. soc. New York, 1893–1894, p. 29. July 20, 1894.

TYPE LOCALITY. — Foot of Echo Cliffs, Painted Desert, Coconino County, Arizona.

* **Perodipus ordii** (Woodhouse).

1853. *Dipodomys ordii* Woodhouse, Proc. acad. nat. sci. Phila., vi, p. 235.

1885. *Dipodomys phillipsi ordii* True, Proc. U. S. nat. mus., vii (1884), p. 599. 1885. (Part.)

1894. *P*[*erodipus*] *ordi* Merriam, Proc. biol. soc. Washington, ix, p. 115. June 21, 1894.

Type locality. — El Paso, El Paso County, Texas.

Perodipus ordii columbianus Merriam.

1894. *Perodipus ordi columbianus* Merriam, Proc. biol. soc. Washington, ix, p. 115. June 21, 1894.

Type locality. — Umatilla, at mouth of Umatilla River, Plains of Columbia, Umatilla County, Oregon.

Perodipus ordii palmeri (Allen).

1891. *Dipodops ordii palmeri* Allen, Bull. Amer. mus. nat. hist., iii, p. 276. June 30, 1891.

1894. *Perodipus ordii palmeri* Allen, Abstract proc. Linn. soc. New York, 1893–1894, p. 28. July 20, 1894.

Type locality. — San Luis Potosi, State of San Luis Potosi, Mexico.

Perodipus panamintinus Merriam.

1894. *Perodipus panamintinus* Merriam, Proc. biol. soc. Washington, ix, p. 114. June 21, 1894.

Type locality. — Head of Willow Creek, Panamint Mountains, Inyo County, California.

Perodipus richardsoni (Allen).

1891. *Dipodops richardsoni* Allen, Bull. Amer. mus. nat. hist., iii, p. 277. June 30, 1891.

1894. *P*[*erodipus*] *richardsoni* Merriam, Proc. biol. soc. Washington, ix, p. 114. June 21, 1894.

Type locality. — On one of the sources of Beaver River, in the extreme northwestern corner of Indian Territory.

Perodipus sennetti (Allen).

1891. *Dipodops sennetti* Allen, Bull. Amer. mus. nat. hist., iii, p. 226. April 29, 1891.

1894. *Perodipus sennetti* Allen, Abstract proc. Linn. soc. New York, 1893–1894, p. 29. July 20, 1894.

Type locality. — Near Brownsville, Cameron County, Texas.

Perodipus streatori Merriam.

1894. *Perodipus streatori* Merriam, Proc. biol. soc. Washington, ix, p. 113. June 21, 1894.

Type locality.—Carbondale, Mariposa County, California.

Genus **MICRODIPODOPS** Merriam.

1891. *Microdipodops* Merriam, North Amer. fauna, no. 5, p. 115. July 30, 1891. Type.—*Microdipodops megacephalus* Merriam.

Microdipodops megacephalus Merriam.

1891. *Microdipodops megacephalus* Merriam, North Amer. fauna, no. 5, p. 116. July 30, 1891.

Type locality.—Halleck, East Humboldt Valley, Elko County, Nevada.

Subfamily Heteromyinae.

Genus **PEROGNATHUS** Wied.[1]

1839. *Perognathus* Wied, Nova acta phys. med. acad. caes. Leop.-Carol., xix, pt. i, p. 368. Type.—*Perognathus fasciatus* Wied.

Subgenus Perognathus.

*__Perognathus fasciatus__ Wied.

1839. *Perognathus fasciatus* Wied, Nova acta phys. med. acad. caes. Leop.-Carol., xix, pt. i, p. 369.

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[1] Revised by Merriam (North Amer. fauna, no. 1, October 25, 1889) and Osgood (North Amer. fauna, no. 18, September 20, 1900).

1885. *Perognathus fasciatus* True, Proc. U. S. nat. mus., VII (1884), p. 599. 1885.

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

Perognathus fasciatus infraluteus (Thomas).

1893. *Perognathus infraluteus* Thomas, Ann. and mag. nat. hist., 6th ser., XI, p. 406. May, 1893.

1900. *Perognathus fasciatus infraluteus* Osgood, North Amer. fauna, no. 18, p. 19. September 20, 1900.

Type locality. — Loveland, Larimer County, Colorado.

Perognathus flavescens (Merriam).

1889. *Perognathus fasciatus flavescens* Merriam, North Amer. fauna, no. 1, p. 11. October 25, 1889.

1900. *Perognathus flavescens* Osgood, North Amer. fauna, no. 18, p. 20. September 20, 1900.

Type locality. — Kennedy, Cherry County, Nebraska.

Perognathus merriami Allen.

1892. *Perognathus merriami* Allen, Bull. Amer. mus. nat. hist., IV, p. 45. March 25, 1892.

Type locality. — Brownsville, Cameron County, Texas.

Perognathus merriami gilvus Osgood.

1900. *Perognathus merriami gilvus* Osgood, North Amer. fauna, no. 18, p. 22. September 20, 1900.

Type locality. — Eddy, Eddy County, New Mexico.

* **Perognathus flavus** Baird.

1855. *Perognathus flavus* Baird, Proc. acad. nat. sci. Phila., VII, p. 332.

1885. *Cricetodipus flavus* True, Proc. U. S. nat. mus., VII (1884), p. 399. 1885.

Type locality. — El Paso, El Paso County, Texas.

Perognathus flavus bimaculatus (Merriam).

1889. *Perognathus bimaculatus* Merriam, North Amer. fauna, no. 1, p. 12. October 25, 1889.

1900. *Perognathus flavus bimaculatus* Osgood, North Amer. fauna, no. 18, p. 24. September 20, 1900.

Type locality. — Fort Whipple, Yavapai County, Arizona.

Perognathus flavus fuliginosus (Merriam).

1890. *Perognathus fuliginosus* Merriam, North Amer. fauna, no. 3, p. 74. September 11, 1890.

1900. *Perognathus flavus fuliginosus* Osgood, North Amer. fauna, no. 18, p. 25. September 20, 1900.

Type locality. — Cedar belt northeast of San Francisco Mountain, Coconino County Arizona. Altitude, 7000 feet.

Perognathus flavus mexicanus Merriam.

1894. *Perognathus flavus mexicanus* Merriam, Proc. acad. nat. sci. Phila., p. 265. September 27, 1894.

Type locality. — Tlalpam, Federal District, Mexico.

Perognathus apache Merriam.

1889. *Perognathus apache* Merriam, North Amer. fauna, no. 1, p. 14. October 25, 1889.

Type locality. — Keam Canyon, Apache County, Arizona.

Perognathus apache melanotis Osgood.

1900. *Perognathus apache melanotis* Osgood, North Amer. fauna, no. 18, p. 27. September 20, 1900.

Type locality.— Casas Grandes, State of Chihuahua, Mexico.

Perognathus callistus Osgood.

1900. *Perognathus callistus* Osgood, North Amer. fauna, no. 18, p. 28. September 20, 1900.

Type locality. — Kinney Ranch, Green River Basin, near Bitter Creek, Sweetwater County, Wyoming.

Perognathus panamintinus (Merriam).

1894. *Perognathus longimembris panamintinus* Merriam, Proc. acad. nat. sci. Phila., p. 265. September 27, 1894.

1900. *Perognathus panamintinus* Osgood, North Amer. fauna, no. 18, p. 28. September 20, 1900.

Type locality. — Perognathus Flat, Panamint Mountains, Inyo County, California. Altitude, 5200 feet.

Perognathus panamintinus arenicola Stephens.

1900. *Perognathus panamintinus arenicola* Stephens, Proc. biol. soc. Washington, xiii, p. 153. June 13, 1900.

Type locality. — San Felipe Narrows, San Diego County, California.

Perognathus panamintinus bangsi (Mearns).

1898. *Perognathus longimembris bangsi* Mearns, Bull. Amer. mus. nat. hist., x, p. 300. August 31, 1898.

1900. *Perognathus panamintinus bangsi* Osgood, North Amer. fauna, no. 18, p. 29. September 20, 1900.

Type locality. — Palm Springs, Colorado Desert, Riverside County, California.

Perognathus panamintinus brevinasus Osgood.

1900. *Perognathus panamintinus brevinasus* Osgood, North Amer. fauna, no. 18, p. 30. September 20, 1900.

Type locality. — San Bernardino, San Bernardino County, California.

Perognathus nevadensis Merriam.

1894. *Perognathus nevadensis* Merriam, Proc. acad. nat. sci. Phila., p. 264. September 27, 1894.

Type locality. — Halleck, East Humboldt Valley, Elko County, Nevada.

Perognathus pacificus Mearns.

1898. *Perognathus pacificus* Mearns, Bull. Amer. mus. nat. hist., x, p. 299. August 31, 1900.

Type locality. — Mexican boundary monument, no. 258, shore of Pacific Ocean, San Diego County, California.

Perognathus amplus Osgood.

1900. *Perognathus amplus* Osgood, North Amer. fauna, no. 18, p. 32. September 20, 1900.

Type locality. — Fort Verde, Yavapai County, Arizona.

Perognathus longimembris (Coues).

1875. *O[tognosis] longimembris* Coues, Proc. acad. nat. sci. Phila., p. 305. August 31, 1875.

1889. *Perognathus longimembris* Merriam, North Amer. fauna, no. 1, p. 13. October 25, 1889.

Type locality. — Old Fort Tejon, in mountains south of Kern Lake, Kern County, California.

***Perognathus parvus** (Peale).

1848. *Cricetodipus parvus* Peale, U. S. explor. exp., viii, mamm. and ornith., p. 53.

1858. *Perognathus parvus* Cassin, U. S. explor. exped., mamm. and ornith., p. 48.

1885. *Perognathus monticola* and *Cricetodipus parvus* True, Proc. U. S. nat. mus., VII (1884), p. 599. 1885.

Type locality. — Oregon; probably in neighborhood of The Dalles, Wasco County.

Perognathus parvus mollipilosus (Coues).

1875. *P[erognathus] mollipilosus* Coues, Proc. acad. nat. sci. Phila., p. 296. August 31, 1875.

1900. *Perognathus parvus mollipilosus* Osgood, North Amer. fauna, no. 18, p. 36. September 20, 1900.

Type locality. — Fort Crook, Shasta County, California.

Perognathus parvus olivaceus (Merriam).

1889. *Perognathus olivaceus* Merriam, North Amer. fauna, no. 1, p. 15. October 25, 1889.

1900. *Perognathus parvus olivaceus* Osgood, North Amer. fauna, no. 18, p. 37. September 20, 1900.

Type locality. — Kelton, near north end of Great Salt Lake, Boxelder County, Utah.

Perognathus parvus magruderensis Osgood.

1900. *Perognathus parvus magruderensis* Osgood, North Amer. fauna, no. 18, p. 38. September 20, 1900.

Type locality. — Mount Magruder, Nevada, near boundary between Inyo County, California, and Esmeralda County, Nevada. Altitude, 8000 feet.

Perognathus alticola Rhoads.

1894. *Perognathus alticolus* Rhoads, Proc. acad. nat. sci. Phila., 1893, p. 412. January 30, 1894.

Type locality. — Squirrel Inn, San Bernardino Mountains, San Bernardino County, California.

Perognathus lordi (Gray).

1868. *Abromys lordi* Gray, Proc. zool. soc. London, p. 202.

1889. *Perognathus lordi* Merriam, North Amer. fauna, no. 1, p. 28. October 25, 1889.

1894. *Perognathus lordi* Rhoads, Proc. acad. nat. sci. Phila., 1893, p. 405. January 30, 1894.

Type locality. — Southern British Columbia, Canada.

Perognathus lordi columbianus (Merriam).

1894. *Perognathus columbianus* Merriam, Proc. acad. nat. sci. Phila., p. 263. September 27, 1894.

1900. *Perognathus lordi columbianus* OSGOOD, North Amer. fauna, no. 18, p. 40. September 20, 1900.

TYPE LOCALITY. — Pasco, Franklin County, Washington.

Perognathus formosus Merriam.

1889. *Perognathus formosus* MERRIAM, North Amer. fauna, no. 1, p. 17. October 25, 1889.

TYPE LOCALITY. — St. George, Washington County, Utah.

Subgenus CHAETODIPUS Merriam.

1889. *Chaetodipus* MERRIAM, North Amer. fauna, no. 1, p. 5. October 25, 1889. Type.—*Perognathus spinatus* MERRIAM.

Perognathus baileyi Merriam.

1894. *Perognathus baileyi* MERRIAM, Proc. acad. nat. sci. Phila., p. 262. September 27, 1894.

TYPE LOCALITY. — Magdalena, State of Sonora, Mexico.

* **Perognathus hispidus** Baird.

1857. *Perognathus hispidus* BAIRD, Mamm. N. Amer., p. 421.

1885. *Perognathus hispidus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 599. 1885.

TYPE LOCALITY. — Charco Escondido, State of Tamaulipas, Mexico.

Perognathus hispidus paradoxus (Merriam).

1889. *Perognathus paradoxus* MERRIAM, North Amer. fauna, no. 1, p. 24. October 25, 1889.

1900. *Perognathus hispidus paradoxus* OSGOOD, North Amer. fauna, no. 18, p. 44. September 20, 1900.

TYPE LOCALITY. — Banner, Trego County, Kansas.

Perognathus hispidus zacatecae Osgood.

1900. *Perognathus hispidus zacatecae* OSGOOD, North Amer. fauna, no. 18, p. 45. September 20, 1900.

TYPE LOCALITY. — Valparaiso, State of Zacatecas, Mexico.

* **Perognathus penicillatus** Woodhouse.

1852. *Perognathus penicillatus* Woodhouse, Proc. acad. nat. sci. Phila., vi, p. 200.

1885. *Perognathus penicillatus* True, Proc. U. S. nat. mus., vii (1884), p. 599. 1885.

Type locality. — San Francisco Mountain, Coconino County, Arizona.

Perognathus penicillatus angustirostris Osgood.

1900. *Perognathus penicillatus angustirostris* Osgood, North Amer. fauna, no. 18, p. 47. September 20, 1900.

Type locality. — Carriso Creek, Colorado Desert, San Diego County, California.

Perognathus penicillatus pricei (Allen).

1894. *Perognathus pricei* Allen, Bull. Amer. mus. nat. hist., vi, p. 318. November 7, 1894.

1900. *Perognathus penicillatus pricei* Osgood, North Amer. fauna, no. 18, p. 47. September 20, 1900.

Type locality. — Oposura, State of Sonora, Mexico.

Perognathus penicillatus eremicus (Mearns).

1898. *Perognathus* (*Chaetodipus*) *eremicus* Mearns, Bull. Amer. mus. nat. hist., x, p. 300. August 31, 1898.

1900. *Perognathus penicillatus eremicus* Osgood, North Amer. fauna, no. 18, p. 48. September 20, 1900.

Type locality. — Fort Hancock, El Paso County, Texas.

Perognathus stephensi Merriam.

1894. *Perognathus* (*Chaetodipus*) *stephensi* Merriam, Proc. acad. nat. sci. Phila., p. 267. September 27, 1894.

Type locality. — Mesquite Valley, northwest arm of Death Valley, Inyo County, California.

Perognathus arenarius Merriam.

1894. *Perognathus arenarius* Merriam, Proc. California acad. sci., 2d ser., iv, p. 461. September 25, 1894.

Type locality. — San Jorge, near Comondu, Lower California, Mexico.

Perognathus pernix Allen.

1898. *Perognathus pernix* Allen, Bull. Amer. mus. nat. hist., x, p. 149. April 12, 1898.

Type locality. — Rosario, State of Sinaloa, Mexico.

Perognathus pernix rostratus Osgood.

1900. *Perognathus pernix rostratus* Osgood, North Amer. fauna, no. 18, p. 51. September 20, 1900.

Type locality. — Camoa, Rio Mayo, State of Sonora, Mexico.

Perognathus intermedius Merriam.

1889. *Perognathus intermedius* Merriam, North Amer. fauna, no. 1, p. 18. October 25, 1889.

Type locality. — Mud Spring, Mohave County, Arizona.

Perognathus nelsoni Merriam.

1894. *Perognathus* (*Chaetodipus*) *nelsoni* Merriam, Proc. acad. nat. sci. Phila., p. 266. September 27, 1894.

Type locality. — Hacienda La Parada, about 25 miles northwest of the City of San Luis Potosi, State of San Luis Potosi, Mexico.

Perognathus nelsoni canescens (Merriam).

1894. *Perognathus* (*Chaetodipus*) *intermedius canescens* Merriam, Proc. acad. nat. sci. Phila., p. 267. September 27, 1894.

1900. *Perognathus nelsoni canescens* Osgood, North Amer. fauna, no. 18, p. 54. September 20, 1900.

Type locality. — Jaral, State of Coahuila, Mexico.

Perognathus goldmani Osgood.

1900. *Perognathus goldmani* Osgood, North Amer. fauna, no. 18, p. 54. September 20, 1900.

Type locality. — Sinaloa, State of Sinaloa, Mexico.

Perognathus artus Osgood.

1900. *Perognathus artus* Osgood, North Amer. fauna, no. 18, p. 55. September 20, 1900.

Type locality. — Batopilas, State of Chihuahua, Mexico.

Perognathus fallax Merriam.

1889. *Perognathus fallax* Merriam, North Amer. fauna, no. 1, p. 19. October 25, 1889.

Type locality. — Reche Canyon, three miles southeast of Colton, San Bernardino County, California.

Perognathus anthonyi Osgood.

1900. *Perognathus anthonyi* Osgood, North Amer. fauna, no. 18, p. 56. September 20, 1900.

TYPE LOCALITY. — South Bay, Cerros Island, Lower California, Mexico.

Perognathus femoralis Allen.

1891. *Perognathus* (*Chaetodipus*) *femoralis* ALLEN, Bull. Amer. mus. nat. hist., III, p. 281. June 30, 1891.

TYPE LOCALITY. — Dulzura, San Diego County, California.

Perognathus californicus Merriam.

1889. *Perognathus californicus* MERRIAM, North Amer. fauna, no. 1, p. 26. October 25, 1889.

TYPE LOCALITY. — Berkeley, Alameda County, California.

Perognathus californicus dispar Osgood.

1900. *Perognathus californicus dispar* OSGOOD, North Amer. fauna, no. 18, p. 58. September 20, 1900.

TYPE LOCALITY. — Carpenteria, Santa Barbara County, California.

Perognathus spinatus Merriam.

1889. *Perognathus spinatus* MERRIAM, North Amer. fauna, no. 1, p. 21. October 25, 1889.

TYPE LOCALITY. — Twenty-five miles below the Needles, Colorado River, San Bernardino County, California.

Perognathus spinatus peninsulae Merriam.

1894. *Perognathus spinatus peninsulae* MERRIAM, Proc. California acad. sci., 2d ser., IV, p. 460. September 25, 1894.

TYPE LOCALITY. — San José del Cabo, Lower California, Mexico.

Perognathus bryanti Merriam.

1894. *Perognathus bryanti* MERRIAM, Proc. California acad. sci., 2d ser., IV, p. 458. September 25, 1894.

TYPE LOCALITY. — San José Island, Lower California, Mexico.

Perognathus margaritae Merriam.

1894. *Perognathus margaritae* MERRIAM, Proc. California acad. sci., 2d ser., IV, p. 459. September 25, 1894.

TYPE LOCALITY. — Santa Margarita Island, Lower California, Mexico.

Genus **HETEROMYS** Desmarest.[1]

1817. *Heteromys* DESMAREST, Mammalogie, p. 313. Type.—*Mus anomalus* THOMPSON.

Heteromys adspersus Peters.

1874. *Heteromys adspersus* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 357.

TYPE LOCALITY. — Panama.

Heteromys albolimbatus Gray.

1868. *Heteromys albolimbatus* GRAY, Proc. zool. soc. London, p. 205.

TYPE LOCALITY. — "La Parda" (State of San Luis Potosi ?), Mexico.

Heteromys alleni Coues.

1881. *Heteromys alleni* COUES, Bull. mus. comp. zool., VIII, p. 187.

1891. *Heteromys alleni* ALLEN, Bull. Amer. mus. nat. hist., III, p. 268. June 30, 1891.

TYPE LOCALITY. — Rio Verde, State of San Luis Potosi, Mexico.

Heteromys bulleri Thomas.

1893. *Heteromys bulleri* THOMAS, Ann. and mag. nat. hist., 6th ser., XI, p. 330. April, 1893.

TYPE LOCALITY. — La Laguna, Sierra de Juanacatlan, State of Jalisco, Mexico.

*__Heteromys desmarestianus__ Gray.

1868. *Heteromys desmarestianus* GRAY, Proc. zool. soc. London, p. 204.

1885. *Heteromys desmarestianus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 599. 1885.

TYPE LOCALITY. — Coban, Guatemala.

Heteromys gaumeri Allen and Chapman.

1897. *Heteromys gaumeri* ALLEN and CHAPMAN, Bull. Amer. mus. nat. hist., IX, p. 9. February 23, 1897.

TYPE LOCALITY. — Chichen-Itza, Yucatan.

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[1] List of species: Allen, Bull. Amer. mus. nat. hist., IX, p. 57. March 15, 1897.

Heteromys hispidus Allen.

1897. *Heteromys hispidus* Allen, Bull. Amer. mus. nat. hist., IX, p. 56. March 15, 1897.

Type locality.— Compostella, Terro Tepic, State of Jalisco, Mexico.

Heteromys irroratus Gray.

1868. *Heteromys irroratus* Gray, Proc. zool. soc. London, p. 205.

Type locality. — State of Oaxaca, Mexico.

* **Heteromys longicaudatus** Gray.

1868. *Heteromys longicaudatus* Gray, Proc. zool. soc. London, p. 204.

1885. *Heteromys longicaudatus* True, Proc. U. S. nat. mus., VII (1884), p. 599. 1885.

Type locality. — "Mexico."

Heteromys pictus Thomas.

1893. *Heteromys pictus* Thomas, Ann. and mag. nat. hist., 6th ser., XII, p. 233. September, 1893.

Type locality. — Mineral San Sebastian, State of Jalisco, Mexico. Altitude, 4300 feet.

Heteromys salvini Thomas.

1893. *Heteromys salvini* Thomas, Ann. and mag. nat. hist., 6th ser., XI, p. 331. April, 1893.

Type locality.— Dueñas, Guatemala.

Heteromys salvini nigrescens Thomas.

1893. *Heteromys salvini nigrescens* Thomas, Ann. and mag. nat. hist., 6th ser., XII, p. 234. September, 1893.

Type locality.— Costa Rica.

Family **DIPODIDAE**.

Subfamily Zapodinae.

Genus **ZAPUS** Coues.[1]

1875. *Zapus* Coues, Bull. U. S. geol. surv. terr., 2d ser., i, p. 253. Type. — *Dipus hudsonius* Zimmermann.

* **Zapus hudsonius** (Zimmermann).

1780. *Dipus hudsonius* Zimmermann, Geogr. Gesch., ii, p. 358.
1875. *Zapus hudsonius* Coues, Bull. U. S. geol. surv. terr., 2d ser., i, p. 253.
1885. *Zapus hudsonius* True, Proc. U. S. nat. mus., vii (1884), p. 600. 1885.
Type locality. — Hudson Bay.

Zapus hudsonius ladas Bangs.

1899. *Zapus hudsonius ladas* Bangs, Proc. New England zool. club, i, p. 10. February 28, 1899.
Type locality. — Rigoulette, Hamilton Inlet, Labrador.

Zapus hudsonius alascensis Merriam.

1897. *Zapus hudsonius alascensis* Merriam, Proc. biol. soc. Washington, xi, p. 223. July 15, 1897.
Type locality. — Yakutat Bay, Alaska.

Zapus hudsonius americanus (Barton).

1799. *Dipus americanus* Barton, Trans. Amer. philos. soc., iv, p. 115.
1899. *Zapus hudsonius americanus* Batchelder, Proc. New England zool. club, i, p. 6. February 8, 1899.
Type locality. — Near Philadelphia, Pennsylvania.

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[1] Revised by Preble, North Amer. fauna, No. 15. August 8, 1899.

Zapus hudsonius campestris Preble.

1899. *Zapus hudsonius campestris* Preble, North Amer. fauna, no. 15, p. 20. August 8, 1899.

Type locality. — Bear Lodge Mountains, Crook County, Wyoming.

Zapus tenellus Merriam.

1897. *Zapus tenellus* Merriam, Proc. biol. soc. Washington, xi, p. 103. April 26, 1897.

Type locality. — Kamloops, British Columbia, Canada.

Zapus princeps Allen.

1893. *Zapus princeps* Allen, Bull. Amer. mus. nat. hist., v, p. 71. April 28, 1893.

Type locality. — Florida, La Plata County, Colorado.

Zapus princeps minor Preble.

1899. *Zapus princeps minor* Preble, North Amer. fauna, no. 15, p. 23. August 8, 1899.

Type locality.—Wingard, near Carlton House, Saskatchewan, Canada.

Zapus princeps oregonus Preble.

1899. *Zapus princeps oregonus* Preble, North Amer. fauna, no. 15, p. 24. August 8, 1899.

Type locality. — Elgin, Blue Mountains, Union County, Oregon.

Zapus major Preble.

1899. *Zapus major* Preble, North Amer. fauna, no. 15, p. 24. August 8, 1899.

Type locality. — Warner Mountains, Lake County, Oregon.

Zapus nevadensis Preble.

1899. *Zapus nevadensis* Preble, North Amer. fauna, no. 15, p. 25. August 8, 1899.

Type locality. —Ruby Mountains, Elko County, Nevada.

Zapus trinotatus Rhoads.

1894. *Zapus trinotatus* Rhoads, Proc. acad. nat. sci. Phila., p. 421. January 15, 1895.

Type locality. — Lulu Island, mouth of Fraser River, British Columbia, Canada.

Zapus trinotatus alleni (Elliot).

1898. *Zapus alleni* Elliot, Field Colum. mus., publication 27, zool. ser., I, p. 212. March, 1898.

1899. *Zapus trinotatus alleni* Preble, North Amer. fauna, no. 15, p. 27. August 8, 1899.

Type locality. — Pyramid Peak, Lake Tahoe, Eldorado County, California.

Zapus montanus (Merriam).

1897. *Zapus trinotatus montanus* Merriam, Proc. biol. soc. Washington, XI, p. 104. April 26, 1897.

1899. *Zapus montanus* Preble, North Amer. fauna, no. 15, p. 28. August 8, 1899.

Type locality. — Crater Lake, Mount Mazama, Klamath County, Oregon.

Zapus orarius Preble.

1899. *Zapus orarius* Preble, North Amer. fauna, no. 15, p. 29. August 8, 1899.

Type locality. — Point Reyes, Marin County, California.

Zapus pacificus Merriam.

1897. *Zapus pacificus* Merriam, Proc. biol. soc. Washington, XI, p. 104. April 26, 1897.

Type locality. — Prospect, Rogue River Valley, Jackson County, Oregon.

Zapus saltator Allen.

1899. *Zapus saltator* Allen, Bull. Amer. mus. nat. hist., XII, p. 3. March 4, 1899.

Type locality. — Telegraph Creek, Stikine River, British Columbia, Canada.

Genus **NAPAEOZAPUS** Preble.[1]

1899. *Napaeozapus* Preble, North Amer. fauna, no. 15, p. 33. August 8, 1899. Type. — *Zapus insignis* Miller.

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[1] Characterized as a subgenus by Preble, but regarded as a genus by Miller (Bull. N. Y. State museum, VI, p. 330, November 18, 1899).

Napaeozapus insignis (Miller).

1891. *Zapus insignis* Miller, Amer. nat., xxv, p. 742. August, 1891.

1899. *Napaeozapus insignis* Miller, Bull. N. Y. State museum, vi, p. 330. November 18, 1899.

Type locality. — Restigouche River, New Brunswick, Canada.

Napaeozapus insignis roanensis (Preble).

1899. *Zapus (Napaeozapus) insignis roanensis* Preble, North Amer. fauna, no. 15, p. 35. August 8, 1899.

1900. *Napaeozapus insignis roanensis* Miller, Bull. N. Y. State museum, viii, p. 114. November 21, 1900.

Type locality. — Roan Mountain, Mitchell County, North Carolina.

Napaeozapus insignis abietorum (Preble).

1899. *Zapus (Napaeozapus) insignis abietorum* Preble, North Amer. fauna, no. 15, p. 36. August 8, 1899.

1900. *Napaeozapus insignis abietorum* Miller, Bull. N. Y. State museum, viii, p. 114. November 21, 1900.

Type locality. — Peninsula Harbor, north shore of Lake Superior, Ontario, Canada.

Family OCTODONTIDAE.

Subfamily Loncherinae.

Genus LONCHERES Illiger.

1811. *Loncheres* Illiger, Prodr. syst. mamm. et avium, p. 90.

Type. — *Myoxus chrysurus* Zimmermann.

Loncheres armatus (Is. Geoffroy).

1838. *Nelomys armatus* Is. Geoffroy, Ann. sci. nat., 2d ser., x, p. 125.

1843. *L[oncheres] armata* Wagner, Schreber's Säugthiere, Suppl., III, p. 335.

1885. *Loncheres armatus* True, Proc. U. S. nat. mus., VII (1884), p. 550. 1885.

Type locality. — Cayenne, French Guiana.

Genus **PROECHIMYS** Allen.

1899. *Proechimys* Allen, Bull. Amer. mus. nat. hist., XII, p. 264. December 26, 1899. Type. — *Echimys trinitatis* Allen and Chapman.

Proechimys centralis (Thomas).

1896. *Echinomys centralis* Thomas, Ann. and mag. nat. hist., 6th ser., XVIII, p. 312. October, 1896.

1899. *Proechimys centralis* Allen, Bull. Amer. mus. nat. hist., XII, p. 264. December 26, 1899.

Type locality. — San Emilio, north end of Lake Nicaragua, Nicaragua.

Proechimys centralis chiriquinus Thomas.

1900. *Proechimys centralis chiriquinus* Thomas, Ann. and mag. nat. hist., 7th ser., V, p. 220. February, 1900.

Type locality. — Bogava, Chiriqui, Panama. Altitude, 800 feet.

Subfamily Capromyinae.

Genus **CAPROMYS** Desmarest.

1822. *Capromys* Desmarest, Mém. soc. d' hist. nat., I, p. 43. Type. — *Capromys fournieri* Desmarest=*Isodon pilorides* Say.

* **Capromys brachyurus** Hill.

1851. *Capromys brachyurus* HILL, Gosse's Nat. sojourn in Jamaica, p. 471.

1885. *Capromys brachyurus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — Jamaica.

Capromys brachyurus thoracatus True.

1888. *Capromys brachyurus thoracatus* TRUE, Proc. U. S. nat. mus., p. 469. September 3, 1888.

TYPE LOCALITY. — Little Swan Island, Gulf of Honduras.

Capromys ingrahami Allen.

1891. *Capromys ingrahami* ALLEN, Bull. Amer. mus. nat. hist., III, p. 329. August 31, 1891.

TYPE LOCALITY. — Plana Key, Bahama Islands.

* **Capromys melanurus** Poey.

1864. *Capromys melanurus* POEY, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 384.

1885. *Capromys melanurus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — Manzanillo, Cuba.

* **Capromys pilorides** (Say).

1822. *I*[*sodon*] *pilorides* SAY, Journ. acad. nat. sci. Phila., II, p. 333.

1848. *Capromys pilorides* WATERHOUSE, Nat. hist. of mamm., II, p. 287.

1885. *Capromys pilorides* TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — "South America or one of the West Indian islands." (Cuba.)

* **Capromys prehensilis** Poeppig.

1824. *Capromys prehensilis* POEPPIG, Journ. acad. nat. sci. Phila., IV, p. 11.

1885. *Capromys prehensilis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — Wooded parts of southern Cuba.

Genus **PLAGIODONTIA** F. Cuvier.

1836. *Plagiodontia* F. CUVIER, Ann. sci. nat., 2d ser., VI p. 347. Type. — *Plagiodontia aedium* F. CUVIER.

* **Plagiodontia aedium** F. Cuvier.

1836. *Plagiodontia aedium* F. CUVIER, Ann. sci. nat., 2d ser., VI, p. 347.

1885. *Plagiodontia aedium* TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — San Domingo.

Family ERETHIZONTIDAE.

Subfamily ERETHIZONTINAE.

Genus **ERETHIZON** F. Cuvier.

1822. *Erethizon* F. CUVIER, Mém. mus. d' hist. nat., Paris, IX, p. 426. Type. — *Hystrix dorsata* LINNAEUS.

* **Erethizon dorsatum** (Linnaeus).

1758. [*Hystrix*] *dorsata* LINNAEUS, Syst. nat., X ed., I, p. 57.

1822. *E*[*rethizon*] *dorsatum* F. CUVIER, Mém. mus. d' hist. nat., Paris, IX, p. 432.

1885. *Erethizon dorsatus dorsatus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — Eastern Canada.

Erethizon dorsatum picinum Bangs.

1900. *Erethizon dorsatus picinus* BANGS, Proc. New England zool. club, II, p. 37. September 20, 1900.

TYPE LOCALITY. — Lance au Loup, Strait of Belle Isle, Labrador.

* **Erethizon epixanthum** Brandt.

1835. *Erethizon epixanthus* Brandt, Mém. acad. imp. des sci., St. Petersburg, 6th ser., i, p. 390.

1885. *Erethizon dorsatus epixanthus* True, Proc. U. S. nat. mus., vii (1884), p. 600. 1885.

Type locality. — Northwestern America.

Erethizon epixanthum couesi Mearns.

1897. *Erethizon epixanthus couesi* Mearns, Proc. U. S. nat. mus., xix, p. 723. July 30, 1897.

Type locality. — Fort Whipple, Yavapai County, Arizona.

Erethizon epixanthum myops Merriam.

1900. *Erethizon epixanthus myops* Merriam, Proc. Washington acad. sci., ii, p. 27. March 14, 1900.

Type locality. — Portage Bay, Alaska Peninsula, Alaska.

Genus **COENDOU** Lacépède.

1799. *Coendou* Lacépède, Tableau des divisions, sous-divisions, ordres et genres des mammifères, p. 11 (published as supplement to Discours d' ouverture et de clôture du cours d'histoire naturelle et tableaux méthodiques des mammifères et des oiseaux.) Type.— *Hystrix prehensilis* Linnaeus.

This name was formally adopted in place of *Sinetherus* F. Cuvier (Mém. mus. d'hist. nat., Paris, ix, p. 433, 1822) by Trouessart in 1897 (Catal. mamm., pt. iii, p. 621).

* **Coendou mexicanum** (Kerr).

1792. *Hystrix mexicana* Kerr, Anim. kingd., i, p. 214.

1885. *Synetheres mexicanus* True, Proc. U. S. nat. mus., vii (1884), p. 600. 1885.

Type locality. — Mountains of Mexico.

Coendou pallidum (Waterhouse).

1848. *Cercolabes pallidus* Waterhouse, Nat. hist. of mamm., ii, p. 434.

1897. [*Coendu*] *pallidus* TROUESSART, Catal. mamm., pt. III, p. 622.

TYPE LOCALITY. — "Said to be . . . . the West Indies."

Family DASYPROCTIDAE.

Genus DASYPROCTA Illiger.

1811. *Dasyprocta* ILLIGER, Prodr. syst. mamm. et avium, p. 93. Included two species — *aguti* and *acuchy*.

* **Dasyprocta cristata** (Desmarest).

1816. *Cavia cristata* DESMAREST, Nouv. dict. d'hist. nat., I, p. 213.

1820. *Dasyprocta cristata* DESMAREST, Mamm., p. 358.

1885. *Dasyprocta cristata*, TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — "Surinam"; this is erroneous according to Alston, who states that the animal is West Indian.

* **Dasyprocta isthmica** Alston.

1876. *Dasyprocta isthmica* ALSTON, Proc. zool. soc. London, p. 347.

1885. *Dasyprocta isthmica* TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — Colon, Colombia.

* **Dasyprocta mexicana** Saussure.

1860. *Dasyprocta mexicana* SAUSSURE, Revue et magasin de zoologie, 2d ser., XII, p. 53.

1885. *Dasyprocta mexicana* TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — "Hot zone of Mexico"; probably in the State of Vera Cruz.

* **Dasyprocta punctata** Gray.

1842. *Dasyprocta punctata* GRAY, Ann. and mag. nat. hist., X, p. 264.

1885. *Dasyprocta punctata* TRUE, Proc. U. S. nat. mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — South America.

Genus **AGOUTI** Lacépède.

1799. *Agouti* LACÉPÈDE, Tableau des divisions, sous-divisions, ordres et genres des mammifères, p. 9 (published as supplement to Discours d'ouverture et de clôture du cours d'histoire naturelle et tableaux méthodiques des mammifères et des oiseaux.) Type. — *Mus paca* LINNAEUS.

The fact that this name antedates *Coelogenus* F. Cuvier (Ann. du mus. d' hist. nat., Paris, X, p. 203, 1807) has been pointed out by Palmer (Proc. biol. soc. Washington, XI, pp. 243, 248, December 17, 1897).

* **Agouti paca** (Linnaeus).

1766. [*Mus*] *paca* LINNAEUS, Syst. nat., XII ed., I, p. 81.

1799. *Agouti paca* LACÉPÈDE, Tableau des divisions, sous-divisions, ordres et genres des mammifères, p. 9.

1885. *Coelogenys paca* TRUE, Proc. U. S. nat mus., VII (1884), p. 600. 1885.

TYPE LOCALITY. — Brazil.

Suborder DUPLICIDENTATA.

Family OCHOTONIDAE.

Genus **OCHOTONA** Link.

1795. *Ochotona* LINK, Zool. Beyträge, I, pt. II, p. 74. Included the species *pusillus*, *alpinus*, and *ochotona*.

Ochotona collaris (Nelson).

1893. *Lagomys collaris* Nelson, Proc. biol. soc. Washington, VIII, p. 117. December 21, 1893.

1897. [*Ochotona*] *collaris* Trouessart, Catal. mamm., pt. III, p. 648.

Type locality. — Near head of Tanana River, about 200 miles south of Fort Yukon, Alaska.

Ochotona cuppes Bangs.

1899. *Ochotona cuppes* Bangs, Proc. New England zool. club, I, p. 40. June 5, 1899.

Type locality. — Monishee Divide, Gold Range, British Columbia, Canada. Altitude, 4000 feet.

Ochotona princeps (Richardson).

1828. *Lepus* (*Lagomys*) *princeps* Richardson, Zool. journ., III, p. 520.

1897. [*Ochotona*] *princeps* Trouessart, Catal. mamm., pt. III, p. 648.

Type locality. — "Stony places in the Rocky Mountains"; probably mountains of northern British Columbia.

* **Ochotona saxatilis** Bangs.

1885. *Lagomys princeps* True, Proc. U. S. nat. mus., VII (1884), p. 600. 1885. (Part.)

1899. *Ochotona saxatilis* Bangs, Proc. New England zool. club, I, p. 41. June 5, 1899.

Type locality. — Near timberline, Snowy Range, Montgomery, Park County, Colorado.

Ochotona schisticeps (Merriam).

1889. *Lagomys schisticeps* Merriam, North Amer. fauna, no. 2, p. 11. October 30, 1889.

1897. *Ochotona schisticeps* Merriam, Mazama, I, p. 223. October, 1897.

Type locality. — Donner, Placer County, California.

Family LEPORIDAE.

Genus ROMEROLAGUS Merriam.

1896. *Romerolagus* MERRIAM, Proc. biol. soc. Washington, x, p. 173. December 29, 1896. Type. — *Romerolagus nelsoni* MERRIAM.

Romerolagus nelsoni Merriam.

1896. *Romerolagus nelsoni* MERRIAM, Proc. biol. soc. Washington, x, p. 173. December 29, 1896.

TYPE LOCALITY. — West slope of Mount Popocatepetl, State of Mexico, Mexico. Altitude, 11,000 feet.

According to an anonymous reviewer in Natural Science (x, p. 151, March, 1897) this animal received the name *Lepus diazi* in 1893 (Ferrari-Pérez, Exposición Internacional Columbiana de Chicago en 1893. Catalogo Comision Geográfico-Explorada de la República Mexicana, pl. 42, March, 1893).

Genus LEPUS Linnaeus.

1758. *Lepus* LINNAEUS, Syst. nat., x ed., I, p. 57. Type.—*Lepus timidus* LINNAEUS.

Subgenus LEPUS Linnaeus.

* **Lepus americanus** Erxleben.

1777. [*Lepus*] *americanus* ERXLEBEN, Syst. regni anim., I, p. 330.

1885. *Lepus americanus americanus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885.

TYPE LOCALITY. — Vicinity of Hudson Bay, Canada.

* **Lepus americanus bairdii** (Hayden).

1869. *Lepus bairdii* HAYDEN, Amer. nat., III, p. 115. May, 1869.

1874. *Lepus americanus* var. *bairdii* Allen, Bull. Essex inst., vi, p. 61.

1885. *Lepus americanus bairdii* True, Proc. U. S. nat. mus., vii (1884), p. 601. 1885.

Type locality. — Columbia Valley, Wind River Mountains, Fremont County, Wyoming.

Lepus americanus columbiensis Rhoads.

1895. *Lepus americanus columbiensis* Rhoads, Proc. acad. nat. sci. Phila., p. 242. July 2, 1895.

Type locality. — Vernon, British Columbia, Canada.

Lepus americanus dalli Merriam.

1900. *Lepus americanus dalli* Merriam, Proc. Washington acad. sci., ii, p. 29. March 14, 1900.

Type locality. — Nulato River, Alaska.

Lepus americanus macfarlani Merriam.

1900. *Lepus americanus macfarlani* Merriam, Proc. Washington acad. sci., ii, p. 30. March 14, 1900.

Type locality. — Fort Anderson, near mouth of Anderson River, Mackenzie, Canada.

Lepus americanus phaeonotus Allen.

1899. *Lepus americanus phaeonotus* Allen, Bull. Amer. mus. nat. hist., xii, p. 11. March 4, 1899.

Type locality. — Hallock, Kittson County, Minnesota.

Lepus americanus struthopus Bangs.

1898. *Lepus americanus struthopus* Bangs, Proc. biol. soc. Washington, xii, p. 81. March 24, 1898.

Type locality. — Digby, Nova Scotia, Canada.

* **Lepus americanus virginianus** (Harlan).

1825. *Lepus virginianus* Harlan, Fauna Americana, p. 196.

1877. [*Lepus americanus*] var. *virginianus* Allen, Monogr. N. Amer. rodentia, p. 307. August, 1877.

1885. *Lepus americanus virginianus* True, Proc. U. S. nat. mus., vii (1884), p. 601. 1885.

Type locality. — Blue Mountains, northeast of Harrisburg, Pennsylvania.

Lepus arcticus Ross.[1]

1819. *Lepus arcticus* Ross, Ross's voyage, 8vo. ed., II, append. IV, p. 151.

1896. *Lepus arcticus* RHOADS, Amer. nat., XXX, p. 235. March, 1896.

TYPE LOCALITY. — Baffin Land, southeast of Cape Bowen.

On page 170 of the same volume this species is named *Lepus glacialis* by Leach (see Rhoads, Amer. nat., XXX, pp. 234–235, March, 1896; Stone, Auk, XIII, p. 183–187, April, 1896; Merriam, Science, n. s., III, pp. 564–565, April 10, 1896; Rhoads, Science, n. s., III, pp. 843–844, June 5, 1896; Merriam, Science, n. s., III, p. 845, June 5, 1896).

Lepus arcticus bangsii Rhoads.

1896. *Lepus arcticus bangsii* RHOADS, Amer. nat., XXX, p. 236. March, 1896.

TYPE LOCALITY. — Codroy, Newfoundland.

Regarded by Miller (Proc. biol. soc. Washington, XIII, p. 39, May 29, 1899) as a distinct species.

Lepus bishopi Allen.

1899. *Lepus bishopi* ALLEN, Bull. Amer. mus. nat. hist., XII, p. 11. March 4, 1899.

TYPE LOCALITY. — Mill Lake, Turtle Mountains, near northern border of North Dakota.

* **Lepus campestris** Bachman.

1837. *Lepus campestris* BACHMAN, Journ. acad. nat. sci. Phila., VII, p. 349.

1885. *Lepus campestris* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885.

TYPE LOCALITY. — Plains of the Saskatchewan, Canada.

Lepus groenlandicus Rhoads.

1896. *Lepus groenlandicus* RHOADS, Amer. nat., XXX, p. 236. March, 1896.

TYPE LOCALITY. — Robertson's Bay (lat. 78° N.), Greenland.

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[1] The polar hares were revised by Rhoads in 1896 (Proc. acad. nat. sci. Phila., pp. 351–376, Aug. 4, 1896), but numerous changes in the status and nomenclature of the species have since been made.

Lepus klamathensis Merriam.

1899. *Lepus klamathensis* MERRIAM, North Amer. fauna, no. 16, p. 100. October 28, 1899.

TYPE LOCALITY. — Fort Klamath, Klamath County, Oregon.

* **Lepus labradorius** Miller.

1885. *Lepus timidus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885. (Part.)

1899. *Lepus labradorius* MILLER, Proc. biol. soc. Washington, XIII, p. 39. May 29, 1899.

TYPE LOCALITY. — Fort Chimo, Ungava, Labrador.

Lepus othus Merriam.

1896. *Lepus tschuktschorum* RHOADS, Proc. acad. nat. sci. Phila., 371. August 4, 1896. (Part.)

1900. *Lepus othus* MERRIAM, Proc. Washington acad. sci., II, p. 28. March 14, 1900.

TYPE LOCALITY. — St. Michaels, Norton Sound, Alaska.

Lepus poadromus Merriam.

1900. *Lepus poadromus* MERRIAM, Proc. Washington acad. sci., II, p. 29. March 14, 1900.

TYPE LOCALITY. — Stepovak Bay, Alaska Peninsula, Alaska.

* **Lepus washingtonii** Baird.

1855. *Lepus washingtonii* BAIRD, Proc. acad. nat. sci. Phila., VII, p. 333.

1885. *Lepus americanus washingtoni* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885.

1895. *Lepus washingtoni* RHOADS, Proc. acad. nat. sci. Phila., p. 241. July 2, 1895.

TYPE LOCALITY. — Puget Sound.

Subgenus MACROTOLAGUS Mearns.

1896. *Macrotolagus* MEARNS, Proc. U. S. nat. mus., XVIII, p. 552. Type. — *Lepus alleni* MEARNS.

Lepus alleni Mearns.

1890. *Lepus alleni* MEARNS, Bull. Amer. mus. nat. hist., II, p. 294. February 21, 1890.

TYPE LOCALITY. — Rillito, on the Southern Pacific Railroad, Pima County, Arizona.

Lepus alleni palitans Bangs.

1900. *Lepus* (*Macrotolagus*) *alleni palitans* BANGS, Proc. New England zool. club, I, p. 85. February 23, 1900.

TYPE LOCALITY. — Aguacaliente, about forty miles southeast of Mazatlan, State of Sinaloa, Mexico.

Lepus asellus Miller.

1899. *Lepus asellus* MILLER, Proc. acad. nat. sci. Phila., p. 380. October 5, 1899.

TYPE LOCALITY. — San Luis Potosi, State of San Luis Potosi, Mexico.

* **Lepus californicus** Gray.

1837. *Lepus californica* GRAY, Charlesworth's mag. nat. hist., I, p. 586.

1885. *Lepus californicus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885.

TYPE LOCALITY. — "St. Antoine" (Santa Barbara County?), California.

Lepus californicus xanti Thomas.

1898. *Lepus californicus xanti* THOMAS, Ann. and mag. nat. hist., 7th ser., I, p. 45. January, 1898.

TYPE LOCALITY. — Santa Anita, Lower California, Mexico.

* **Lepus callotis** Wagler.

1830. *Lepus callotis* WAGLER, Nat. Syst. der Amphibien, p. 23.

1885. *Lepus callotis callotis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885. (Part.)

TYPE LOCALITY. — "Mexico."

Lepus gaillardi Mearns.

1896. *Lepus gaillardi* MEARNS, Proc. U. S. nat. mus., XVIII, p. 560. June 24, 1896.

TYPE LOCALITY. — West Fork of the Playas Valley, near monument no. 63, Mexican boundary line, Grant County, New Mexico.

Lepus insularis Bryant.

1891. *Lepus insularis* Bryant, Proc. California acad. sci., 2d ser., III, p. 92. April 23, 1891.

1895. *Lepus edwardsi* St. Loup, Bull. mus. d' hist. nat., Paris, I, p. 5.

Type locality. — Espiritu Santo Island, Lower California, Mexico.

Lepus martirensis Stowell.

1895. *Lepus martirensis* Stowell, Proc. California acad. sci., 2d ser., V, p. 51. May 28, 1895.

Type locality. — San Pedro Martir Mountains, Lower California, Mexico.

* **Lepus melanotis** Mearns.

1885. *Lepus callotis texianus* True, Proc. U. S. nat. mus., VII (1884), p. 601. 1885. (Part.)

1890. *Lepus melanotis* Mearns, Bull. Amer. mus. nat. hist., II, p. 297. February 21, 1890.

Type locality.— Independence, Montgomery County, Kansas.

Lepus merriami Mearns.

1896. *Lepus merriami* Mearns, Preliminary diagnoses of new mammals from the Mexican border of the United States, p. 2. March 25, 1896. (Reprint: Proc. U. S. nat. mus., XVIII, p. 443. May 23, 1896.)

Type locality. — Fort Clark, Kinney County, Texas.

Lepus texianus Waterhouse.

1848. *Lepus texianus* Waterhouse, Nat. hist. mamm., II, p. 136.

1890. *Lepus texianus* Mearns, Bull. Amer. mus. nat. hist., II, p. 294. February 21, 1890.

Type locality. — Unknown, but probably in Arizona (see Mearns, Bull. Amer. mus. nat. hist., II, p. 296, February 21, 1890).

Lepus texianus deserticola Mearns.

1896. *Lepus texianus deserticola* Mearns, Proc. U. S. nat. mus., XVIII, p. 564. June 24, 1896.

Type locality. — Western edge of Colorado Desert, at the base of Coast Range Mountains, San Diego County, California.

Lepus texianus eremicus Allen.

1894. *Lepus texianus eremicus* Allen, Bull. Amer. mus. nat. hist., vi, p. 347. December 7, 1894.

Type locality. — Fairbank, Cochise County, Arizona.

Lepus texianus griseus Mearns.

1896. *Lepus texianus griseus* Mearns, Proc. U. S. nat. mus., xviii, p. 562. June 24, 1896.

Type locality. — Fort Hancock, El Paso County, Texas.

Subgenus Limnolagus Mearns.

1897. *Limnolagus* Mearns, Science, n. s., v, p. 393. March 5, 1897. Type. — *Lepus aquaticus* Bachman.

* **Lepus aquaticus** Bachman.

1837. *Lepus aquaticus* Bachman, Journ. acad. nat. sci. Phila., vii, p. 319.

1885. *Lepus aquaticus* True, Proc. U. S. nat. mus., vii (1884), p. 601. 1885. (Part.)

Type locality. — Swamps of Alabama and Mississippi.

Lepus aquaticus attwateri Allen.

1895. *Lepus aquaticus attwateri* Allen, Bull. Amer. mus. nat. hist., vii, p. 327. November 8, 1895.

Type locality. — Medina River, eighteen miles south of San Antonio, Bexar County, Texas.

* **Lepus palustris** Bachman.

1837. *Lepus palustris* Bachman, Journ. acad. nat. sci. Phila., vii, p. 194.

1885. *Lepus palustris* True, Proc. U. S. nat. mus., vii (1884), p. 601. 1885. (Part.)

Type locality. — Eastern South Carolina.

Lepus palustris paludicola (Miller and Bangs).

1894. *Lepus paludicola* Miller and Bangs, Proc. biol. soc. Washington, ix, p. 105. June 9, 1894.

1894. *Lepus palustris paludicola* Chapman, Bull. Amer. mus. nat. hist., vi, p. 340. November 30, 1894.

Type locality. — Fort Island, near Crystal River, Citrus County, Florida.

Lepus telmalemonus Elliot.

1899. *Lepus telmalemonus* Elliot, Field Columbian mus., publication 38, zool. ser., i, p. 285. May 24, 1899.

Type locality. — Washita River, near Dougherty, Chickasaw Nation, Indian Territory.

Lepus truei Allen.

1890. *Lepus truei* Allen, Bull. Amer. mus. nat. hist., iii, p. 192. December 10, 1890.

Type locality. — Mirador, State of Vera Cruz, Mexico.

Subgenus Sylvilagus Gray.

1867. *Sylvilagus* Gray, Ann. and mag. nat. hist., 3d ser., xx, p. 221. Type. — *Lepus sylvaticus* Bachman.

Forsyth Major has recently (Trans. Linn. soc. London, zool., 2d ser., vii, pp. 433–520, November, 1899) united *Sylvilagus*, *Limnolagus*, *Romerolagus*, and *Tapeti* to form a group, *Sylvilagus*, coordinate in rank with *Caprolagus*, *Nesolagus*, and *Oryctolagus*. He remarks (p. 514) that whether these four groups "are to be considered as genera or subgenera is for the present quite immaterial."

* **Lepus arizonae** (Allen).

1877. [*Lepus sylvaticus*] var. *arizonae* Allen, Monogr. N. Amer. rodentia, p. 332. August, 1877.

1885. *Lepus sylvaticus arizonae* True, Proc. U. S. nat. mus., vii (1884), p. 601. 1885.

1890. *Lepus arizonae* Merriam, North Amer. fauna, no. 3, p. 76. September 11, 1890.

Type locality. — Beal's Springs, fifty miles west of Fort Whipple, Yavapai County, Arizona.

Lepus arizonae confinis Allen.

1898. *Lepus arizonae confinis* ALLEN, Bull. Amer. mus. nat. hist., x, p. 146. April 12, 1898.

TYPE LOCALITY. — Playa Maria, Lower California, Mexico.

Lepus arizonae major Mearns.

1896. *Lepus arizonae major* MEARNS, Proc. U. S. nat. mus., XVIII, p. 557. June 24, 1896.

TYPE LOCALITY. — Calabasas, Pima County, Arizona.

Lepus arizonae minor Mearns.

1896. *Lepus arizonae minor* MEARNS, Proc. U. S. nat. mus., XVIII, p. 557. June 24, 1896.

TYPE LOCALITY. — El Paso, El Paso County, Texas.

Lepus baileyi Merriam.

1897. *Lepus baileyi* MERRIAM, Proc. biol. soc. Washington, XI, p. 148. June 9, 1897.

TYPE LOCALITY. — Spring Creek, east side of Bighorn Basin, Bighorn County, Wyoming.

Lepus floridanus (Allen).

1890. *Lepus sylvaticus floridanus* ALLEN, Bull. Amer. mus. nat. hist., III, p. 160. October 8, 1890.

1899. *Lepus floridanus* ALLEN, Bull. Amer. mus. nat. hist., XII, p. 13. March 4, 1899.

TYPE LOCALITY. — Sebastian River, Brevard County, Florida.

Lepus floridanus alacer (Bangs).

1896. *Lepus sylvaticus alacer* BANGS, Proc. biol. soc. Washington, x, p. 136. December 28, 1896.

TYPE LOCALITY. — Stilwell, Boston Mountains, Indian Territory.

* **Lepus floridanus audubonii** (Baird).

1857. *Lepus audubonii* BAIRD, Mamm. N. Amer., p. 608.

1885. *Lepus sylvaticus auduboni* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885.

1899. *Lepus floridanus auduboni* MILLER, Proc. acad. nat. sci. Phila., p. 389. October, 1899.

TYPE LOCALITY. — San Francisco, California.

The combination *Lepus floridanus audubonii* is untenable.

Lepus floridanus aztecus (Allen).

1890. *Lepus sylvaticus aztecus* ALLEN, Bull. Amer. mus. nat. hist., III, p. 188. December 10, 1890.

TYPE LOCALITY.— City of Tehuantepec, State of Oaxaca, Mexico.

Lepus floridanus caniclunis Miller.

1899. *Lepus floridanus caniclunis* MILLER, Proc. acad. nat. sci. Phila., p. 388. October 5, 1899.

TYPE LOCALITY. — Fort Clark, Kinney County, Texas.

Lepus floridanus chapmani Allen.

1894. *Lepus sylvaticus bachmani* ALLEN, Bull. Amer. mus. nat. hist., VI, p. 170. May 31, 1894.

1899. *Lepus floridanus chapmani* ALLEN, Bull. Amer. mus. nat. hist., XII, p. 12. March 4, 1899.

TYPE LOCALITY. — Corpus Christi, Nueces County, Texas.

Lepus floridanus holzneri (Mearns).

1896. *Lepus sylvaticus holzneri* MEARNS, Proc. U. S. nat. mus., XVIII, p. 554. June 24, 1896.

TYPE LOCALITY. — Douglas spruce zone, near summit of Huachuca Mountains, southern Arizona.

* **Lepus floridanus mallurus** (Thomas).

1885. *Lepus sylvaticus sylvaticus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885. (Part.)

1898. *L[epus] n[uttalli] mallurus* THOMAS, Ann. and mag. nat. hist., 7th ser., II, p. 320. October, 1898.

1899. *Lepus floridanus mallurus* ALLEN, Bull. Amer. mus. nat. hist., XII, p. 13. March 4, 1899.

TYPE LOCALITY. — Raleigh, Wake County, North Carolina.

Lepus floridanus mearnsi (Allen).

1894. *Lepus sylvaticus mearnsi* ALLEN, Bull. Amer. mus. nat. hist., VI, p. 171. May 31, 1894.

1899. *Lepus floridanus mearnsi* ALLEN, Bull. Amer. mus. nat. hist., XII, p. 13. March 4, 1899.

TYPE LOCALITY.— Fort Snelling, Hennepin County, Minnesota.

Lepus floridanus pinetis (Allen).

1894. *Lepus sylvaticus pinetis* ALLEN, Bull. Amer. mus. nat. hist., VI, p. 348. December 7, 1894.

TYPE LOCALITY. — White Mountains, Apache County, Arizona.

Lepus floridanus rigidus (Mearns).

1896. [*Lepus sylvaticus*] subspecies *rigidus* MEARNS, Proc. U. S. nat. mus., XVIII, p. 555. June 24, 1896.

TYPE LOCALITY. — Carrizalillo Mountains, near monument no. 31, Mexican boundary line, Grant County, New Mexico.

Lepus floridanus sanctidiegi Miller.

1899. *Lepus floridanus sanctidiegi* MILLER, Proc. acad. nat. sci. Phila., p. 389. October 5, 1899.

TYPE LOCALITY. — Mexican boundary monument no. 258, shore of Pacific Ocean, San Diego County, California.

Lepus floridanus subcinctus Miller.

1899. *Lepus floridanus subcinctus* MILLER, Proc. acad. nat. sci. Phila., p. 386. October 5, 1899.

TYPE LOCALITY.— Hacienda El Molino, near Negrete, State of Michoacan, Mexico.

Lepus floridanus transitionalis (Bangs).

1895. *Lepus sylvaticus transitionalis* BANGS, Proc. Boston soc. nat. hist., XXVI, p. 405. January 31, 1895.

1899. *Lepus floridanus transitionalis* ALLEN, Bull. Amer. mus. nat. hist., XII, p. 13. March 4, 1899.

TYPE LOCALITY.— Liberty Hill, New London County, Connecticut.

Lepus floridanus yucatanicus Miller.

1899. *Lepus floridanus yucatanicus* MILLER, Proc. acad. nat. sci. Phila., p. 384. October 5, 1899.

TYPE LOCALITY.— Merida, Yucatan.

Lepus grangeri (Allen).

1895. *Lepus sylvaticus grangeri* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 264. August 21, 1895.

1896. *Lepus grangeri* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 246. November 25, 1896.

TYPE LOCALITY.— Hill City, Black Hills, Custer County, South Dakota.

* **Lepus graysoni** Allen.

1877. *Lepus graysoni* ALLEN, Monogr. N. Amer. rodentia, p. 347. August, 1877.

1885. *Lepus graysoni* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885.

Type locality.— Tres Marias Islands; State of Jalisco, Mexico; probably Maria Madre Island (see Nelson, North Amer. fauna, no. 14, p. 16, April 29, 1899).

Lepus insolitus Allen.

1890. *Lepus insolitus* Allen, Bull. Amer. mus. nat. hist., iii, p. 189. December 10, 1890.

Type locality. — Plains of Colima, State of Jalisco, Mexico.

* **Lepus nuttallii** Bachman.

1837. *Lepus nuttallii* Bachman, Journ. acad. nat. sci. Phila., vii, p. 345.

1885. *Lepus sylvaticus nuttalli* True, Proc. U. S. nat. mus., vii (1884), p. 601. 1885. (Part.)

1898. *Lepus nuttalli* Thomas, Ann. and mag. nat. hist., 7th ser., ii, p. 320. October, 1898.

Type locality. — Vicinity of the junction of the Snake and Columbia Rivers, Washington.

Lepus orizabae Merriam.

1893. *Lepus orizabae* Merriam, Proc. biol. soc. Washington, viii, p. 143. December 29, 1893.

Type locality. — Mount Orizaba, State of Puebla, Mexico. Altitude, about 9500 feet.

Lepus veraecrucis Thomas.

1890. *Lepus veraecrucis* Thomas, Proc. zool. soc. London, p. 74.

Type locality. — Las Vigas, State of Vera Cruz, Mexico.

Subgenus Microlagus Trouessart.

1897. *Microlagus* Trouessart, Catal. mamm., pt. iii, p. 660. Type. — *Lepus cinerascens* Allen.

Regarded by Merriam (Science, n. s., vii, p. 32, January 7, 1898) as identical with *Sylvilagus*.

* **Lepus bachmani** Waterhouse.

1838. *Lepus bachmani* WATERHOUSE, Proc. zool. soc. London, VI, p. 103.

1885. *Lepus trowbridgei* TRUE, Proc. U. S. nat. mus., VII (1884), p. 601. 1885.

1898. *Lepus bachmani* THOMAS, Ann. and mag. nat. hist., 7th ser., II, p. 320. October, 1898.

TYPE LOCALITY. — California.

Lepus bachmani ubericolor Miller.

1899. *Lepus bachmani ubericolor* MILLER, Proc. acad. nat. sci. Phila., p. 383. October 5, 1899.

TYPE LOCALITY. — Beaverton, Washington County, Oregon.

Lepus cerrosensis Allen.

1898. *Lepus cerrosensis* ALLEN, Bull. Amer. mus. nat. hist., X, p. 145. April 12, 1898.

TYPE LOCALITY. — Cerros Island, Lower California, Mexico.

Lepus cinerascens Allen.

1890. *Lepus cinerascens* ALLEN, Bull. Amer. mus. nat. hist., III, p. 159. October 8, 1890.

TYPE LOCALITY. — San Fernando, Los Angeles County, California.

Regarded by Merriam (Science, n. s., VII, p. 32, January 7, 1898) as probably a form of *L. bachmani*.

Lepus peninsularis Allen.

1898. *Lepus peninsularis* ALLEN, Bull. Amer. mus. nat. hist., X, p. 144. April 12, 1898.

TYPE LOCALITY. — Santa Anita, Lower California, Mexico.

Subgenus BRACHYLAGUS Miller.

1900. *Brachylagus* MILLER, Proc. biol. soc. Washington, XIII, p. 157. June 13, 1900. Type. — *Lepus idahoensis* MERRIAM.

Lepus idahoensis Merriam.

1891. *Lepus idahoensis* Merriam, North Amer. fauna, no. 5, p. 76. July 30, 1891.

Type locality.— Pahsimeroi Valley, central Idaho.

Subgenus Tapeti Gray.

1867. *Tapeti* Gray, Ann. and mag. nat. hist., 3d ser., xx, p. 224. September, 1867. Type.— *Lepus brasiliensis* Linnaeus (*L. tapeti* Pallas).

* **Lepus gabbi** (Allen).

1877. *Lepus brasiliensis* var. *gabbi* Allen, Monogr. N. Amer. rodentia, p. 349. August, 1877.

1885. *Lepus brasiliensis gabbi* True, Proc. U. S. nat. mus., vii (1884), p. 602. 1885.

1891. *Lepus gabbi* Allen, Bull. Amer. mus. nat. hist., iii, p. 216. April 17, 1891.

Type locality.— Talamanca, Costa Rica.

Order PINNIPEDIA.

Family OTARIIDAE.

Genus ZALOPHUS Gill.

1866. *Zalophus* Gill, Comm. Essex inst., v, p. 7. Type.— *Otaria gillespii* McBain = *Otaria californiana* Lesson.

* **Zalophus californianus** (Lesson).

1828. *Otaria californiana* Lesson, Dict. class. d' hist. nat., xiii, p. 420.

1880. *Zalophus californianus* Allen, Monogr. N. Amer. pinnipeds, p. 276.

1885. *Zalophus californianus* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.

Type locality. — California.

Genus **EUMETOPIAS** Gill.

1866. *Eumetopias* Gill, Comm. Essex inst., v, p. 7. Type. — "*Otaria californianus*" = *Otaria stelleri* Lesson.

* **Eumetopias stelleri** (Lesson).

1828. *Otaria stelleri* Lesson, Dict. class. d' hist. nat., xiii, p. 420.

1866. *Eumetopias stelleri* Gray, Ann. and mag. nat. hist., 3d ser., xviii, p. 233.

1885. *Eumetopias stelleri* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.

Type locality. — North Pacific Ocean.

Genus **CALLOTARIA** Palmer.

1892. *Callotaria* Palmer, Proc. biol. soc. Washington, vii, p. 156. July 27, 1892. Type. — *Phoca ursina* Linnaeus.

According to Jordan and Clark (The fur seals and fur seal islands of the North Pacific Ocean, pt. iii, p. 2, November, 1899) this genus should stand as *Callorhinus* Gray (Proc. zool. soc. London, 1859, p. 359).

* **Callotaria alascana** (Jordan and Clark).

1885. *Callorhinus ursinus* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.

1899. *Callorhinus alascanus* Jordan and Clark, The fur seals and fur seal islands of the North Pacific Ocean, pt. iii, p. 2. November, 1899.

Type locality. — Pribilof Islands, Bering Sea.

Genus **ARCTOCEPHALUS** F. Cuvier.

1827. *Arctocephalus* F. Cuvier, Dict. des sci. nat., xxxix, p. 554. Type. — *Arctocephalus ursinus* F. Cuvier =*Phoca ursina* Linnaeus.

Arctocephalus townsendi Merriam.

1897. *Arctocephalus townsendi* Merriam, Proc. biol. soc. Washington, xi, p. 178. July 1, 1898.

Type locality. — Guadalupe Island, off Lower California, Mexico.

Family **PHOCIDAE**

Genus **PHOCA** Linnaeus.

1758. *Phoca* Linnaeus, Syst. nat., x ed., i, p. 37. Type. — *Phoca vitulina* Linnaeus.

Subgenus Histriophoca Gill.

1873. *Histriophoca* Gill, Amer. nat., vii, p. 179. March, 1873. Type. — *Phoca fasciata* Zimmermann.

* **Phoca fasciata** Zimmermann.

1873. *Phoca fasciata* ZIMMERMANN, Geogr. Gesch., III, p. 277.

1885. *Phoca fasciata* TRUE, Proc. U. S. nat. mus., VII (1884), p. 607. 1885.

TYPE LOCALITY. — Kurile Islands, Japan.

Subgenus PUSA Scopoli.

1777. *Pusa* SCOPOLI, Introd. hist. nat., p. 490. Type. — *Phoca foetida* FABRICIUS = *P. hispida* SCHREBER.

* **Phoca hispida** Schreber.

1775. *Phoca hispida* SCHREBER, Säugthiere, III, p. 312.

1885. *Phoca foetida* TRUE, Proc. U. S. nat. mus., VII (1884), p. 607. 1885.

1898. *Phoca hispida* THOMAS, The zoologist, 4th ser., II, pp. 100, 102. March, 1898.

TYPE LOCALITY. — Coasts of Greenland and Labrador.

Subgenus PAGOPHILUS Gray.

1844. *Pagophilus* GRAY, Zoology of the Erebus and Terror, p. 3. Type. — *Phoca groenlandica* FABRICIUS.

The name *Pagophila* was used in ornithology by Kaup in 1829 (Skizzirte Entw.-Gesch. u. natürl. Syst. d. europ. Thierw., I, pp. 68, 69, and 196, type, *Larus eburneus* Phipps).

* **Phoca groenlandica** Erxleben.

1777. *Phoca groenlandica* ERXLEBEN, Syst. regni anim., I, p. 588.

1885. *Phoca groenlandica* TRUE, Proc. U. S. nat. mus., VII (1884), p. 607. 1885.

TYPE LOCALITY. — Greenland and Newfoundland.

Subgenus Phoca Linnaeus.

Phoca largha Pallas.

1831. *Phoca largha* Pallas, Zoog. Rosso-Asiat., I, p. 113.

1896. *Phoca largha* Stejneger, Bull. U. S. fish comm., 1896, p. 21.

1899. *Phoca largha* True, The fur seals and fur seal islands of the North Pacific Ocean, pt. III, p. 351. November, 1899.

Type locality. — Kamtschatka.

* **Phoca vitulina** Linnaeus.

1758. *Phoca vitulina* Linnaeus, Syst. nat., x ed., I, p. 38.

1885. *Phoca vitulina* True, Proc. U. S. nat. mus., VII (1884), p. 607. 1885.

Type locality. — Europe.

Genus **ERIGNATHUS** Gill.

1866. *Erignathus* Gill, Comm. Essex inst., V, p. 9. Type. — *Phoca barbata* Erxleben.

* **Erignathus barbatus** (Erxleben).

1777. [*Phoca*] *barbata* Erxleben, Syst. regni anim., I, p. 590.

1866. *Erignathus barbatus* Gill, Comm. Essex inst., V, p. 12.

1885. *Erignathus barbatus* True, Proc. U. S. nat. mus., VII (1884), p. 607. 1885.

Type locality. — Coasts of Scotland, southern Greenland and Iceland.

Genus **HALICHOERUS** Nilsson.

1820. *Halichoerus* Nilsson, Skand. fauna, I, p. 376. Type. — *Halichoerus griseus* Nilsson = *Phoca grypus* Fabricius.

* **Halichoerus grypus** (Fabricius).

1791. *Phoca grypus* Fabricius, Skriv. af naturh.-selsk., i, 2, p. 167, pl. xiii, f. 4.

1841. *Halichoerus grypus* Nilsson, Wiegmann's Arch. f. Naturg., vii, bd. i, p. 318.

1885. *Halichoerus grypus* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.

Type locality. — Greenland.

Genus **MONACHUS** Fleming.

1822. *Monachus* Fleming, Phil. zool., ii, p. 187. Type. — *Phoca monachus* Hermann.

* **Monachus tropicalis** (Gray).

1850. *Phoca tropicalis* Gray, Cat. seals Brit. mus., p. 28.

1866. *Monachus tropicalis* Gray, Cat. seals and whales Brit. mus., p. 20.

1885. *Monachus tropicalis* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.

Type locality. — Jamaica.

Genus **CYSTOPHORA** Nilsson.

1820. *Cystophora* Nilsson, Skand. fauna, i, p. 382. Type. — *Cystophora borealis* Nilsson = *Phoca cristata* Erxleben.

* **Cystophora cristata** (Erxleben).

1777. *Phoca cristata* Erxleben, Syst. regni anim., i, p. 590.

1841. *Cystophora cristata* Nilsson, Wiegmann's Arch. f. Naturg., vii, bd. i, p. 326.

1885. *Cystophora cristata* True, Proc. U. S. nat. mus., vii (1884), p. 608. 1885.

Type locality. — Southern Greenland and Newfoundland.

Genus **MACRORHINUS** F. Cuvier.

1826. *Macrorhinus* F. Cuvier, Dict. des sci. nat., xxxix, p. 552. Type. — *Phoca proboscidea* Péron = *P. leoninus* Linnaeus.

* **Macrorhinus angustirostris** Gill.

1866. *Macrorhinus angustirostris* Gill, Proc. Chicago acad. sci., i, p. 33.

1885. *Macrorhinus angustirostris* True, Proc. U. S. nat. mus., vii (1884), p. 608. 1885.

Type locality. — Saint Bartholomew's Bay, Lower California, Mexico.

Family ODOBENIDAE.

Genus **ODOBENUS** Brisson.

1762. *Odobenus* Brisson, Regni anim., ii ed., p. 30. Type. — *Odobenus* Brisson = *Phoca rosmarus* Linnaeus.

According to Trouessart (Catal. mamm., pt. iii, p. 453, 1897) the terms applied to genera by Brisson are monomial specific names without status in the Linnaean binomial system of nomenclature. If this view be adopted, the proper name for the present genus is *Rosmarus* Scopoli (Introd. hist. nat., p. 490, 1777, type, *Phoca rosmarus* Linnaeus).

* **Odobenus obesus** (Illiger).

1815. *Trichechus obesus* Illiger, Abhandl. k. preuss. Akad. Wissensch. Berlin, p. 64.

1880. *Odobaenus obesus* Allen, Hist. N. Amer. pinnipeds, p. 147.

1885. *Odobaenus obesus* True, Proc. U. S. nat. mus., vii (1884), p. 608. 1885.

Type locality. — Coast of northeastern Asia.

* **Odobenus rosmarus** (Linnaeus).

1758. *Phoca rosmarus* Linnaeus, Syst. nat., x ed., i, p. 38.

1859. *O[dobaenus] rosmarus* Sundevall, Öfver. k. vet. akad. forh., Stockholm, 1859, p. 446.

1885. *Odobaenus rosmarus* True, Proc. U. S. nat. mus., vii (1884), p. 608. 1885.

Type locality. — Arctic regions.

Order CARNIVORA.

Family FELIDAE.

Genus **FELIS** Linnaeus.

1758. *Felis* Linnaeus, Syst. nat., x ed., i, p. 41. Type. — *Felis catus* Linnaeus.

* **Felis concolor** Linnaeus.

1771. [*Felis*] *concolor* Linnaeus, Mantissa plantarum, p. 522.

1885. *Felis concolor* True, Proc. U. S. nat. mus., vii (1884), p. 610. 1885. (Part.)

Type locality. — Brazil.

Felis coryi Bangs.

1896. *Felis concolor floridanus* Cory, Hunting and fishing in Florida, p. 109. (Not *F. floridana* Desmarest, 1820).

1899. *Felis coryi* Bangs, Proc. biol. soc. Washington, xiii, p. 15. January 31, 1899.

Type locality. — Wilderness back of Sebastian, Brevard County, Florida.

* **Felis eyra** Desmarest.

1820. *Felis eyra* Desmarest, Mammalogie, i, p. 231.

1885. *Felis eyra* True, Proc. U. S. nat. mus., vii (1884), p. 611. 1885.

Type locality. — Paraguay.

* **Felis onca** Linnaeus.

1758. [*Felis*] *onca* Linnaeus, Syst. nat., x ed., i, p. 42.

1885. *Felis onca* True, Proc. U. S. nat. mus., vii (1884), p. 610. 1885.

Type locality. — Brazil.

Felis oregonensis Rafinesque.

1832. *Felix* (sic) *oregonensis* Rafinesque, Atlantic journal, i, p. 62.

1897. *Felis hippolestes olympus* Merriam, Proc. biol. soc. Washington, xi, p. 220. July 15, 1897.

1899. *Felis oregonensis* Stone, Science, n. s., ix, p. 35. January 6, 1899.

Type locality. — Northwest coast of the United States (see Stone, Science, n. s., ix, p. 35, January 6, 1899).

Felis oregonensis hippolestes (Merriam).

1897. *Felis hippolestes* Merriam, Proc. biol. soc. Washington, xi, p. 219. July 15, 1897.

1899. *Felis oregonensis hippolestes* Stone, Science, n. s., ix, p. 35. January 6, 1899.

Type locality. — Wind River Mountains, Fremont County, Wyoming.

* **Felis pardalis** Linnaeus.

1758. [*Felis*] *pardalis* Linnaeus, Syst. nat., x ed., i, p. 42.

1885. *Felis pardalis* True, Proc. U. S. nat. mus., vii (1884), p. 610. 1885.

Type locality. — Mexico.

* **Felis tigrina** Erxleben.

1777. [*Felis*] *tigrina* Erxleben, Syst. regni anim., i, p. 517.

1885. *Felis tigrina* True, Proc. U. S. nat. mus., vii (1884), p. 611. 1885.

Type locality. — South America.

* **Felis yagoüaroundi** Desmarest.

1820. *Felis yagouaroundi* Desmarest, Mammalogie, i, p. 230.

1885. *Felis yaguarundi* True, Proc. U. S. nat. mus., VII (1884), p. 611. 1885. (Part.)

Type locality. — Paraguay.

Felis yagouaroundi tolteca Thomas.

1898. *Felis yaguarondi tolteca* Thomas, Ann. and mag. nat. hist., 7th ser., I, p. 41. January, 1898.

Type locality. — Tatemales, State of Sinaloa, Mexico.

Genus **LYNX** Kerr.

1792. *Lynx* Kerr, Anim. kingd., I, systematic catalogue inserted between pages 32 and 33 (description, p. 155). Type. — *Lynx vulgaris* Kerr = *Felis lynx* Linnaeus.

Subgenus Lynx Kerr.

* **Lynx canadensis** Kerr.

1792. *Lynx canadensis* Kerr, Anim. kingd., I, systematic catalogue inserted between pages 32 and 33 (description, p. 157).

1885. *Lynx borealis canadensis* True, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.

1887. *L[ynx] canadensis* True, Proc. U. S. nat. mus., X, p. 9.

Type locality. — Eastern Canada.

Lynx canadensis mollipilosus Stone.

1900. *Lynx canadensis mollipilosus* Stone, Proc. acad. nat. sci. Phila., p. 48. March 24, 1900.

Type locality. — Wainwright Inlet, Point Barrow, Alaska.

Lynx subsolanus Bangs.

1897. *Lynx subsolanus* Bangs, Proc. biol. soc. Washington, XI, p. 49. March 16, 1897.

Type locality. — Codroy, Newfoundland.

Subgenus Cervaria Gray.

1867. *Cervaria* Gray, Proc. zool. soc. London, p. 276. Type.— *Felis pardina* Temminck.

Lynx baileyi Merriam.

1890. *Lynx baileyi* MERRIAM, North Amer. fauna, no. 3, p. 79. September 11, 1890.

TYPE LOCALITY. — Moccasin Spring, Coconino County, Arizona.

Lynx fasciatus Rafinesque.

1817. *Lynx fasciatus* RAFINESQUE, American monthly magazine, II, p. 46. November, 1817.

1897. *Lynx fasciatus* MERRIAM, Mazama, I, p. 224. October, 1897.

TYPE LOCALITY. — "Northwest coast"; probably near the mouth of the Columbia River.

Lynx fasciatus oculeus Bangs.

1899. *Lynx fasciatus oculeus* BANGS, Proc. New England zool. club, I, p. 23. March 31, 1899.

TYPE LOCALITY. — Nicasio, Marin County, California.

Lynx fasciatus pallescens Merriam.

1899. *Lynx fasciatus pallescens* MERRIAM, North Amer. fauna, no. 16, p. 104. October 28, 1899.

TYPE LOCALITY. — South side of Mount Adams, near Trout Lake, Skamania County, Washington.

Lynx gigas Bangs.

1897. *Lynx gigas* BANGS, Proc. biol. soc. Washington, XI, p. 50. March 16, 1897.

TYPE LOCALITY. — Fifteen miles back of Bear River, Nova Scotia.

* **Lynx ruffus** (Güldenstaedt).

1776. *Felis ruffa* GÜLDENSTAEDT, Nov. comm. acad. scient. imp. Petrop., XX (1775), p. 484.

1817. *Lynx rufa* RAFINESQUE, American monthly magazine, II, p. 46. November, 1817.

1885. *Lynx rufus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885. (Part.)

TYPE LOCALITY. — New York.

Lynx ruffus californicus Mearns.

1897. *Lynx rufus californicus* MEARNS, Preliminary diagnoses of new mammals of the genera Lynx, Urocyon, Spilogale, and Mephitis, from the Mexican boundary line, p. 2.

January 12, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 458. December 24, 1897.)

TYPE LOCALITY. — San Diego, San Diego County, California.

Regarded by Merriam (North Amer. fauna, no. 16, p. 104, October 28, 1899) as a distinct species.

Lynx ruffus eremicus Mearns.

1897. *Lynx rufus eremicus* MEARNS, Preliminary diagnoses of new mammals of the genera Lynx, Urocyon, Spilogale, and Mephitis, from the Mexican boundary line, p. 1. January 12, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 457. December 24, 1897.)

TYPE LOCALITY. — New River, near Laguna Station, Colorado Desert, San Diego County, California.

Lynx ruffus floridanus (Rafinesque).

1817. *Lynx floridanus* RAFINESQUE, American monthly magazine, II, p. 46. November, 1817.

1857. *Lynx rufus* var. *floridanus* BAIRD, Mamm. N. Amer., p. 91.

1893. [*Lynx rufus floridanus*] ALLEN, Bull. Amer. mus. nat. hist., v, p. 32. March 16, 1893.

TYPE LOCALITY. — Florida.

Lynx ruffus peninsularis Thomas.

1898. *Lynx rufus peninsularis* THOMAS, Ann. and mag. nat. hist., 7th ser., I, p. 42. January, 1898.

TYPE LOCALITY. — Santa Anita, Lower California, Mexico.

* **Lynx ruffus texensis** (Allen).

1885. *Lynx maculatus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.

1890. *Lynx texensis* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 188. June 20, 1895.

1897. *Lynx rufus texensis* MEARNS, Preliminary diagnoses of new mammals of the genera Lynx, Urocyon, Spilogale, and Mephitis, from the Mexican boundary line, p. 2. January 12, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 458. December 24, 1897.)

TYPE LOCALITY. — "Mexico."

Family **CANIDAE**.

Genus **UROCYON** Baird.

1857. *Urocyon* Baird, Mamm. N. Amer., p. 121. Type.—*Canis virginianus* Erxleben (= *Canis cinereoargenteus* Schreber).

Urocyon californicus (Mearns).

1897. *Urocyon cinereoargenteus californicus* Mearns, Preliminary diagnoses of new mammals of the genera Lynx, Urocyon, Spilogale, and Mephitis, from the Mexican boundary line, p. 3. January 12, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 459. December 24, 1897.)

1899. *U[rocyon] californicus* Merriam, North Amer. fauna, no. 16, p. 103. October 28, 1899.

Type locality.—San Jacinto Mountains, Riverside County, California. Altitude, 8000 feet.

Urocyon californicus townsendi Merriam.

1899. *Urocyon californicus townsendi* Merriam, North Amer. fauna, no. 16, p. 103. October 28, 1899.

Type locality.—Baird, Shasta County, California.

* **Urocyon cinereoargenteus** (Schreber).

1775. *Canis cinereoargenteus* Schreber, Säugthiere, iii, pl. xcii.

1885. *Urocyon virginianus virginianus* True, Proc. U. S. nat. mus., vii (1884), p. 610. 1885. (Part.)

1894. *Urocyon cinereoargenteus* Rhoads, Amer. nat., xxviii, p. 524. June, 1894.

Type locality.—Eastern North America.

Urocyon cinereoargenteus floridanus Rhoads.

1895. *Urocyon cinereoargenteus floridanus* Rhoads, Proc. acad. nat. sci. Phila., p. 42. April 9, 1895.

Type locality.—Tarpon Springs, Hillsboro County, Florida.

Urocyon cinereoargenteus fraterculus Elliot.

1896. *Urocyon cinereoargentatus* (sic) *fraterculus* Elliot, Field Columbian mus., publication 11, zool. ser., I, p. 80. May, 1896.

TYPE LOCALITY. — San Felipe, Yucatan.

Regarded by Miller (Proc. acad. nat. sci. Phila., 1899, p. 276, July 26, 1899) as a distinct species.

Urocyon cinereoargenteus ocythous Bangs.

1899. *Urocyon cinereoargenteus ocythous* BANGS, Proc. New England zool. club, I, p. 43. June 5, 1899.

TYPE LOCALITY. — Platteville, Grant County, Wisconsin.

Urocyon cinereoargenteus scottii (Mearns).

1891. *Urocyon virginianus scottii* MEARNS, Bull. Amer. mus. nat. hist., III, p. 236. June 5, 1891.

1895. *Urocyon cinereoargenteus scottii* ALLEN, Bull. Amer. mus. nat. hist., VII, p. 253. June 29, 1895.

TYPE LOCALITY. — Pinal County, Arizona.

Urocyon cinereoargenteus texensis Mearns.

1897. *Urocyon cinereoargenteus texensis* MEARNS, Preliminary diagnoses of new mammals of the genera Lynx, Urocyon, Spilogale, and Mephitis, from the Mexican boundary line, p. 2. January 12, 1897. (Reprint: Proc. U. S. nat. mus., XX, p. 459. December 24, 1897.)

TYPE LOCALITY. — San Pedro, near Eagle Pass, Maverick County, Texas.

Urocyon guatemalae Miller.

1899. *Urocyon guatemalae* MILLER, Proc. acad. nat. sci. Phila., p. 278. July 26, 1899.

TYPE LOCALITY. — Nenton, Guatemala.

* **Urocyon littoralis** (Baird).

1857. *Vulpes (Urocyon) littoralis* BAIRD, Mamm. N. Amer., p. 143.

1885. *Urocyon virginianus littoralis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 610. 1885.

1888. *Urocyon littoralis* MERRIAM, Proc. biol. soc. Washington, IV, p. 135. February 18, 1888.

TYPE LOCALITY. — San Miguel Island, Santa Barbara Islands, Santa Barbara County, California.

Urocyon parvidens Miller.

1899. *Urocyon parvidens* Miller, Proc. acad. nat. sci. Phila., p. 276. July 26, 1899.

Type locality. — Merida, Yucatan.

Genus **VULPES** Brisson.[1]

1762. *Vulpes* Brisson, Regn. anim., II ed., p. 173. Type. — *Vulpes* Brisson = *Canis vulpes* Linnaeus.

According to Trouessart (Catal. mamm., pt. III, p. 453, 1897) the terms applied to genera by Brisson are monomial specific names without status in the Linnaean binomial system of nomenclature. If this view be adopted the generic name *Vulpes* was first used by Richardson (Fauna Boreali-Americana, I, p. 83, 1829, type, *Canis vulpes* Linnaeus).

* **Vulpes fulvus** (Desmarest).

1820. *Canis fulvus* Desmarest, Mammalogie, I, p. 203.

1842. *Vulpes fulvus* De Kay, Zool. of New York, mamm., p. 44.

1885. *Vulpes fulvus fulvus* True, Proc. U. S. nat. mus., VII (1884), p. 610. 1885. (Part.)

1894. *Vulpes pennsylvanicus* Rhoads, Amer. nat., XXVIII, p. 524. June, 1894.

1899. *Vulpes fulvus* Miller, Bull. N. Y. State mus., VI, p. 342. November 18, 1899.

Type locality. — Virginia.

* **Vulpes macrourus** Baird.

1852. *Vulpes macrourus* Baird, Stansbury's expl. Great Salt Lake, p. 309. June, 1852.

1885. *Vulpes macrurus* True, Proc. U. S. nat. mus., VII (1884), p. 610. 1885.

Type locality. — Wasatch Mountains bordering Great Salt Lake, Utah.

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[1] American red foxes revised by Merriam, Proc. Washington acad. sci., II, pp. 661-676. December 28, 1900.

Vulpes necator Merriam.

1900. *Vulpes necator* Merriam, Proc. Washington acad. sci., II, p. 664. December 28, 1900.

Type locality. — Whitney Meadows, near Mount Whitney, High Sierra, Tulare County, California. Altitude, 9500 feet.

Vulpes cascadensis Merriam.

1900. *Vulpes cascadensis* Merriam, Proc. Washington acad. sci., II, p. 665. December 28, 1900.

Type locality. — Trout Lake, south base of Mount Adams, Cascade Mountains, Skamania County, Washington.

Vulpes rubricosa (Bangs).

1897. *Vulpes pennsylvanica vafra* Bangs, Proc. biol. soc. Washington, XI, p. 53. March 16, 1897 (not *Vulpes vafer* Leidy, 1869).

1898. *Vulpes pennsylvanica rubricosa* Bangs, Science, n. s., VII, p. 272. February 25, 1898.

1900. *Vulpes rubricosa* Merriam, Proc. Washington acad. sci., II, p. 666. December 28, 1900.

Type locality. — Digby, Nova Scotia, Canada.

Vulpes rubricosa bangsi Merriam.

1900. *Vulpes rubricosa bangsi* Merriam, Proc. Washington, acad. sci., II, p. 667. December 28, 1900.

Type locality. — Lance au Loup, Strait of Belle Isle, Labrador.

Vulpes deletrix Bangs.

1898. *Vulpes deletrix* Bangs, Proc. biol. soc. Washington, XII, p. 36. March 24, 1898.

Type locality. — Bay St. George, Newfoundland.

Vulpes alascensis Merriam.

1900. *Vulpes alascensis* Merriam, Proc. Washington acad. sci., II, p. 668. December 28, 1900.

Type locality. — Andreafski, near mouth of Yukon River, Alaska.

Vulpes alascensis abietorum Merriam.

1900. *Vulpes alascensis abietorum* Merriam, Proc. Washington acad. sci., II, p. 669. December 28, 1900.

Type locality. — Stuart Lake, British Columbia, Canada.

Vulpes kenaiensis Merriam.

1900. *Vulpes kenaiensis* Merriam, Proc. Washington acad. sci., ii, p. 670. December 28, 1900.

Type locality. — Kenai Peninsula, Alaska.

Vulpes harrimani Merriam.

1900. *Vulpes harrimani* Merriam, Proc. Washington acad. sci., ii, p. 14. March 14, 1900.

Type locality. — Kadiak Island, Alaska.

Vulpes regalis Merriam.

1900. *Vulpes regalis* Merriam, Proc. Washington acad. sci., ii, p. 672. December 28, 1900.

Type locality. — Elk River, Sherburn County, Minnesota.

Vulpes hallensis Merriam.

1900. *Vulpes hallensis* Merriam, Proc. Washington acad. sci., ii, p. 15. March 14, 1900.

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

* **Vulpes lagopus** (Linnaeus).

1758. [*Canis*] *lagopus* Linnaeus, Syst. nat., x ed., i, p. 40.

1854. *Vulpes lagopus* Audubon and Bachman, Quadr. N. Amer., iii, p. 89.

1885. *Vulpes lagopus* True, Proc. U. S. nat. mus., vii (1884), p. 610. 1885.

Type locality. — Lapland.

Vulpes macrotis Merriam.

1888. *Vulpes macrotis* Merriam, Proc. biol. soc. Washington, iv, p. 136. February 18, 1888.

Type locality. — Riverside, San Bernardino County, California.

* **Vulpes velox** (Say).

1823. [*Canis*] *velox* Say, Long's exped. Rocky Mts., i, p. 487.

1851. *Vulpes velox* Audubon and Bachman, Quadr. N. Amer., ii, p. 13.

1885. *Vulpes velox* True, Proc. U. S. nat. mus., vii (1884), p. 610. 1885.

Type locality. — Vicinity of Cherry Creek, Laramie County, Wyoming.

Genus **CANIS** Linnaeus.

1758. *Canis* LINNAEUS, Syst. nat., x ed., I, p. 38. Type.— *Canis familiaris* LINNAEUS.

Canis albus (Sabine).

1823. *Canis lupus albus* SABINE, Franklin's narrative, journ. to Polar Sea, p. 655.

1898. *Canis albus* BANGS, Amer. nat., XXXII, p. 505. July, 1898.

TYPE LOCALITY. — Fort Enterprize, Mackenzie, Canada.

Canis ater (Richardson).

1829. *Canis lupus occidentalis* var. *lupus ater* RICHARDSON, Fauna Boreali-Americana, I, p. 70.

1898. *Canis ater* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 233. March, 1898.

TYPE LOCALITY. — North America. The name restricted by Bangs to the Florida wolf.

* **Canis griseus** (Sabine).

1823. *Canis lupus griseus* SABINE, Franklin's narrative, journ. to Polar Sea, p. 654. (Not of BODDAERT, 1784.)

1885. *Canis lupus griseo-albus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 610. 1885. (Part.)

1897. *Canis griseus* MERRIAM, Mazama, I, p. 224. October, 1897.

TYPE LOCALITY. — Cumberland House, Saskatchewan, Canada.

Canis mexicanus Linnaeus.

1766. [*Canis*] *mexicanus* LINNAEUS, Syst. nat., XII ed., I, p. 60.

1894. *Canis mexicanus* RHOADS, Amer. nat., XXVIII, p. 524. June, 1894.

TYPE LOCALITY. — Mexico.

Canis mexicanus nubilus (Say).

1823. *Canis nubilus* SAY, Long's exped. Rocky Mts., I, p. 169.

1894. *Canis mexicanus nubilus* RHOADS, Amer. nat., XXVIII, p. 524. June, 1894.

TYPE LOCALITY. — Vicinity of Council Bluffs, Pottawattamie County, Iowa.

* **Canis latrans** Say.[1]

1823. *Canis latrans* SAY, Long's exped. Rocky Mts., I, p. 168.

1885. *Canis latrans* TRUE, Proc. U. S. nat. mus., VII (1884), p. 610. 1885. (Part.)

TYPE LOCALITY. — Vicinity of Council Bluffs, Pottawattamie County, Iowa.

Canis nebracensis Merriam.

1897. *Canis pallidus* MERRIAM, Proc. biol. soc. Washington, XI, p. 24. March 15, 1897. (Not of Rüppell, 1826.)

1898. *Canis nebracensis* MERRIAM, Science, n. s., VIII, p. 782. December 2, 1898.

TYPE LOCALITY. — Johnstown, Brown County, Nebraska.

Canis lestes Merriam.

1897. *Canis lestes* MERRIAM, Proc. biol. soc. Washington, XI, p. 25. March 15, 1897.

TYPE LOCALITY. — Toyabe Mountains, near Cloverdale, Nye County, Nevada.

Canis frustror Woodhouse.

1851. *Canis frustror* WOODHOUSE, Proc. acad. nat. sci. Phila., V, p. 147.

1897. *Canis frustror* MERRIAM, Proc. biol. soc. Washington, XI, p. 26. March 15, 1897.

TYPE LOCALITY. — Fort Gibson, at junction of the Neosho River with the Arkansas, Indian Territory.

Canis cagottis (Hamilton Smith).

1839. *Lyciscus cagottis* HAMILTON SMITH, Jardine's nat. library, XVIII (mammalia: dogs), p. 164.

1897. *Canis cagottis* MERRIAM, Proc. biol. soc. Washington, XI, p. 27. March 15, 1897.

TYPE LOCALITY. — Rio Frio, between City of Mexico and Puebla, Mexico.

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[1] The coyotes, the remaining species of the genus, have been revised by Merriam, Proc. biol. soc. Washington, XI, pp. 19-33. March 15, 1897.

Canis peninsulae Merriam.

1897. *Canis peninsulae* MERRIAM, Proc. biol. soc. Washington, XI, p. 28. March 15, 1897.

TYPE LOCALITY. — Santa Anita, Cape St. Lucas, Lower California, Mexico.

Canis microdon Merriam.

1897. *Canis microdon* MERRIAM, Proc. biol. soc. Washington, XI, p. 29. March 15, 1897.

TYPE LOCALITY. — Mier, on the Rio Grande, State of Tamaulipas, Mexico.

Canis mearnsi Merriam.

1897. *Canis mearnsi* MERRIAM, Proc. biol. soc. Washington, XI, p. 30. March 15, 1897.

TYPE LOCALITY. — Quitobaquita, Pima County, Arizona.

Canis estor Merriam.

1897. *Canis estor* MERRIAM, Proc. biol. soc. Washington, XI, p. 31. March 15, 1897.

TYPE LOCALITY. — Noland's Ranch, San Juan River, San Juan County, Utah.

Canis ochropus Eschscholtz.

1829. *Canis ochropus* ESCHSCHOLTZ, Zool. atlas, III, pp. 1–2.

1897. *Canis ochropus* MERRIAM, Proc. biol. soc. Washington, XI, p. 32. March 15, 1897.

TYPE LOCALITY. — California; specimens from Tracy, San Joaquin County, assumed to be typical (see Merriam, Proc. biol. soc. Washington, XI, p. 32, March 15, 1897).

Canis vigilis Merriam.

1897. *Canis vigilis* MERRIAM, Proc. biol. soc. Washington, XI, p. 33. March 15, 1897.

TYPE LOCALITY. — Manzanillo, State of Colima, Mexico.

Family **MUSTELIDAE**.

Subfamily LUTRINAE.

Genus **LATAX** Gloger.

1827. *Latax* GLOGER, Nova acta phys. med. acad. caes. Leop.-Carol., XIII, pt. II, p. 511. Type. — *Lutra marina* ERXLEBEN = *Mustela lutris* LINNAEUS.

* **Latax lutris** (Linnaeus).

1758. [*Mustela*] *lutris* LINNAEUS, Syst. nat., X ed., I, p. 45.
1885. *Enhydris lutris* TRUE, Proc. U. S. nat. mus., VII (1884), p. 609. 1885.
1885. *Latax lutris* STEJNEGER, Deutsch. geograph. blätter, VIII, p. 253.
TYPE LOCALITY. — Coasts of Bering Sea.

Genus **LUTRA** Brisson.

1762. *Lutra* BRISSON, Regn. anim., II ed., p. 201. Type. — *Lutra* BRISSON = *Mustela lutra* LINNAEUS.

According to Trouessart (Catal. mamm., pt. III, p. 453, 1897) the terms applied to genera by Brisson are monomial specific names without status in the Linnaean binomial system of nomenclature. If this view be adopted the generic name *Lutra* was first used by Erxleben (Syst. regni anim., I, p. 445, 1777, type *Lutra vulgaris* Erxleben = *Mustela lutra* Linnaeus).

* **Lutra annectens** Major.

1885. *Lutra felina* and *Lutra brasiliensis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 609. 1885.

1897. *Lutra annectens* MAJOR, Zool. anzeiger, XX, p. 142. April 26, 1897. Ann. and mag. nat. hist., 6th ser., XIX, p. 618. June, 1897.

TYPE LOCALITY. — Terro Tepic, Rio de Tepic, State of Jalisco, Mexico.

* **Lutra canadensis** (Schreber).[1]

1776. *Mustela lutra canadensis* SCHREBER, Säugthiere, pl. CXXVI B.

1823. *Lutra canadensis* SABINE, Franklin's narrative, journ. to Polar Sea, p. 653.

1885. *Lutra canadensis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 609. 1885.

1898. *Lutra hudsonica* RHOADS, Trans. Amer. philos. soc., n. s., XIX, p. 424. September, 1898.

1898. *Lutra canadensis* ALLEN, Bull. Amer. mus. nat. hist., X, p. 460. November 10, 1898.

TYPE LOCALITY. — Eastern Canada.

Lutra canadensis lataxina (F. Cuvier).

1823. *Lutra lataxina* F. CUVIER, Dict. des sci. nat., XXVII, p. 242.

1898. *Lutra hudsonica lataxina* RHOADS, Trans. Amer. philos. soc., n. s., XIX, p. 427. September, 1898.

1898. *Lutra canadensis lataxina* ALLEN, Bull. Amer. mus. nat. hist., X, p. 460. November 10, 1898.

TYPE LOCALITY. — South Carolina.

Lutra canadensis vaga (Bangs).

1898. *Lutra hudsonica vaga* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 224. March, 1898.

1898. *Lutra canadensis vaga* ALLEN, Bull. Amer. mus. nat. hist., X, p. 460. November 10, 1898.

TYPE LOCALITY. — Micco, Brevard County, Florida.

Lutra canadensis pacifica (Rhoads).

1898. *Lutra hudsonica pacifica* RHOADS, Trans. Amer. philos. soc., n. s., XIX, p. 429. September, 1898.

1898. *Lutra canadensis pacifica* ALLEN, Bull. Amer. mus. nat. hist., X, p. 460. November 10, 1898.

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[1] North American otters revised by Rhoads, Trans. Amer. philos. soc., n. s., XIX, pp. 417-439. September, 1898.

TYPE LOCALITY. — Lake Kichelos, Kittitas County, Washington. Altitude, 8000 feet.

Lutra canadensis sonora (Rhoads).

1898. *Lutra hudsonica sonora* RHOADS, Trans. Amer. philos. soc., n. s., XIX, p. 431. September, 1898.

1898. *Lutra canadensis sonora* ALLEN, Bull. Amer. mus. nat. hist., X, p. 460. November 10, 1898.

TYPE LOCALITY. — Montezuma Well, Beaver Creek, Yavapai County, Arizona.

Lutra degener Bangs.

1898. *Lutra degener* BANGS, Proc. biol. soc. Washington, XII, p. 35. March 24, 1898.

TYPE LOCALITY. — Bay St. George, Newfoundland.

Subfamily MELINAE.

Genus **MEPHITIS** Cuvier.

1800. *Mephitis* CUVIER, Leçons d'anat. comp., I, [tabl. I (described but not named in 1798, Tabl. élém. de l' hist. nat. des anim., p. 116). Type. — Genus based on "Les Moufettes."

Mephitis avia Bangs.

1898. *Mephitis avia* BANGS, Proc. biol. soc. Washington, XII, p. 32. March 24, 1898.

TYPE LOCALITY. — San Jose, Mason County, Illinois.

Mephitis elongata (Bangs).

1895. *Mephitis mephitica elongata* BANGS, Proc. Boston soc. nat. hist., XXVI, p. 531. July 31, 1895.

1896. *Mephitis elongata* BANGS, Proc. biol. soc. Washington, X, p. 142. December 28, 1896.

TYPE LOCALITY. — Micco, Brevard County, Florida.

Mephitis estor Merriam.

1890. *Mephitis estor* Merriam, North Amer. fauna, no. 3, p. 81. September 11, 1890.

Type locality. — San Francisco Mountain, Coconino County, Arizona.

Mephitis foetulenta Elliot.

1899. *Mephitis foetulenta* Elliot, Field Columbian mus., publication 32, zool. ser., I, p. 269. March, 1899.

Type locality. — Lagune, near Port Angeles, Clallam County, Washington.

Mephitis hudsonica (Richardson).

1829. *Mephitis americana* var. *hudsonica* Richardson, Fauna Boreali-Americana, I, p. 55.

1895. *Mephitis hudsonica* Bangs, Proc. Boston soc. nat. hist., XXVI, p. 534. July 31, 1895.

Type locality.— Plains of the Saskatchewan (see Bangs, Proc. Boston soc. nat. hist., XXVI, p. 536, July 31, 1895).

* **Mephitis macroura** Lichtenstein.

1834. *Mephitis macroura* Lichtenstein, Darstellung neuer oder wenig bekannter Säugethiere, pl. 46.

1885. *Mephitis macrurus* True, Proc. U. S. nat. mus., VII (1884), p. 609. 1885.

Type locality. — Northwestern Mexico.

* **Mephitis mephitica** (Shaw).

1792. *Viverra mephitica* Shaw, Museum Leverianum, p. 171.

1857. *Mephitis mephitica* Baird, Mamm. N. Amer., p. 195.

1885. *Mephitis mephitica* True, Proc. U. S. nat. mus., VII (1884), p. 609. 1885.

Type locality. — North America. Name restricted by Bangs (Proc. Bost. soc. nat. hist., XXVI, pp. 530–533, July 31, 1895) to the northern form of the eastern skunk.

Mephitis mephitica scrutator Bangs.

1896. *Mephitis mephitica scrutator* Bangs, Proc. biol. soc. Washington, X, p. 141. December 28, 1896.

Type locality. — Cartville, Acadia Parish, Louisiana.

Mephitis milleri Mearns.

1897. *Mephitis milleri* Mearns, Preliminary diagnoses of new mammals of the genera Mephitis, Dorcelaphus, and Dicotyles, from the Mexican boundary of the United States, p. 1. February 11, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 467. December 24, 1897.)

Type locality. — Fort Lowell, near Tucson, Pima County, Arizona.

Mephitis occidentalis Baird.

1857. *Mephitis occidentalis* Baird, Mamm. N. Amer., p. 194.

1897. *Mephitis occidentalis* Mearns, Preliminary diagnoses of new mammals of the genera Lynx, Urocyon, Spilogale, and Mephitis, from the Mexican boundary line, p. 5. January 12, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 461. December 24, 1897.)

Type locality. — Petaluma, Sonoma County, California.

Mephitis occidentalis holzneri Mearns.

1897. *Mephitis occidentalis holzneri* Mearns, Preliminary diagnoses of new mammals of the genera Lynx, Urocyon, Spilogale, and Mephitis, from the Mexican boundary line, p. 4. January 12, 1897. (Reprint: Proc. U. S. nat. mus., xx, p. 461. December 24, 1897.)

Type locality. — San Isidro Ranch, Lower California, Mexico, near border of San Diego County, California.

Mephitis spissigrada Bangs.

1898. *Mephitis spissigrada* Bangs, Proc. biol. soc. Washington, xii, p. 31. March 24, 1898.

Type locality. — Sumas, British Columbia, Canada.

Genus **SPILOGALE** Gray.[1]

1865. *Spilogale* Gray, Proc. zool. soc. London, p. 150. Type. — *Mephitis interrupta* Rafinesque.

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[1] A revision of this genus was published by Merriam in 1890 (North Amer. fauna, no. 4, pp. 1-15, October 8, 1890), but so many forms have since then been described that the species are here arranged alphabetically.

***Spilogale ambarvalis** Bangs.

1885. *Mephitis putorius* True, Proc. U. S. nat. mus., VII (1884), p. 609. 1885. (Part.)

1898. *Spilogale ambarvalis* Bangs, Proc. Boston soc. nat. hist., XXVIII, p. 222. March, 1898.

Type locality.—Oak Lodge, East Peninsula, opposite Micco, Brevard County, Florida.

Spilogale ambigua Mearns.

1897. *Spilogale ambigua* Mearns, Preliminary diagnoses of new mammals of the genera Lynx, Urocyon, Spilogale, and Mephitis, from the Mexican boundary line, p. 3. January 12, 1897. (Reprint: Proc. U. S. nat. mus., XX, p. 460. December 24, 1897.)

Type locality.—Eagle Mountain, State of Chihuahua, Mexico, about four miles south of border of Donna Ana County, New Mexico.

Spilogale gracilis Merriam.

1890. *Spilogale gracilis* Merriam, North Amer. fauna, no. 3, p. 83. September 11, 1890.

Type locality.—Grand Canyon of the Colorado, north of San Francisco Mountain, Coconino County, Arizona.

Spilogale indianola Merriam.

1890. *Spilogale indianola* Merriam, North Amer. fauna, no. 4, p. 10. October 8, 1890.

Type locality.—Indianola, Matagorda Bay, Matagorda County, Texas.

Spilogale interrupta (Rafinesque).

1820. *Mephitis interrupta* Rafinesque, Annals of nature, I, p. 3.

1890. *Spilogale interrupta* Merriam, North Amer. fauna, no. 4, p. 8. October 8, 1890.

Type locality.—Upper Missouri (see Lichtenstein, Abhandl. k. preuss. Akad. Wissensch. Berlin, 1836, p. 281, 1838).

Spilogale leucoparia Merriam.

1890. *Spilogale leucoparia* Merriam, North Amer. fauna, no. 4, p. 11. October 8, 1890.

Type locality.—Mason, Mason County, Texas.

Spilogale lucasana Merriam.

1890. *Spilogale lucasana* Merriam, North Amer. fauna, no. 4, p. 11. October 8, 1890.

Type locality.—Cape St. Lucas, Lower California, Mexico.

Spilogale olympica Elliot.

1899. *Spilogale olympica* Elliot, Field Columbian mus. publication 32, zool. ser., i, p. 270. March, 1899.

Type locality.—Lake Southerland, Olympic Mountains, Clallam County, Washington.

Spilogale phenax Merriam.

1890. *Spilogale phenax* Merriam, North Amer. fauna, no. 4, p. 13. October 8, 1890.

Type locality.—Nicasio, Marin County, California.

Spilogale phenax arizonae Mearns.

1891. *Spilogale phenax arizonae* Mearns, Bull. Amer. mus. nat. hist., iii, p. 256. June 5, 1891.

Type locality.—Fort Verde, Yavapai County, Arizona.

Spilogale phenax latifrons Merriam.

1890. *Spilogale phenax latifrons* Merriam, North Amer. fauna, no. 4, p. 15. October 8, 1890.

Type locality.—Roseburg, Douglas County, Oregon.

Spilogale pygmaea Thomas.

1898. *Spilogale pygmaea* Thomas, Proc. zool. soc. London, 1897, p. 898. April 1, 1898.

Type locality.—Rosario, State of Sinaloa, Mexico.

Spilogale ringens Merriam.

1890. *Spilogale ringens* Merriam, North Amer. fauna, no. 4, p. 9. October 8, 1890.

Type locality.—Greensborough, Hale County, Alabama.

Spilogale saxatilis Merriam.

1890. *Spilogale saxatilis* Merriam, North Amer. fauna, no. 4, p. 13. October 8, 1890.

Type locality.—Provo, Utah County, Utah.

Genus **CONEPATUS** Gray.

1837. *Conepatus* Gray, Charlesworth's mag. nat. hist., i, p. 581. November, 1837. Type. — *Conepatus humboldtii* Gray.

* **Conepatus mapurito** (Gmelin).

1788. [*Viverra*] *mapurito* Gmelin, Syst. nat., i, p. 88.

1875. *Conepatus mapurito* Coues, Bull. U. S. geol. and geog. surv. terr., 2d ser., i, p. 14.

1885. *Conepatus mapurito* True, Proc. U. S. nat. mus., vii (1884), p. 609. 1885.

Type locality. — Vicinity of Pamplona, State of Santander, Colombia.

Genus **TAXIDEA** Storr.

1780. *Taxidea* Storr, Prodr. meth. mamm., p. 34. Type. — *Ursus taxus* Schreber.

* **Taxidea taxus** (Schreber).

1778. *Ursus taxus* Schreber, Säugthiere, iii, p. 520.

1885. *Taxidea americana americana* True, Proc. U. S. nat. mus., vii (1884), p. 609. 1885.

1894. *Taxidea taxus* Rhoads, Amer. nat., xxviii, p. 524. June, 1894.

Type locality. — Labrador and Hudson Bay.

* **Taxidea taxus berlandieri** (Baird).

1857. *Taxidea berlandieri* Baird, Mamm. N. Amer., p. 205.

1885. *Taxidea americana berlandieri* True, Proc. U. S. nat. mus,, vii (1884), p. 609. 1885.

1895. *Taxidea taxus berlandieri* Allen, Bull. Amer. mus. nat. hist., vii, p. 256. June 29, 1895.

Type locality. — Llano Estacado, Texas, near border of New Mexico.

Taxidea taxus infusca Thomas.

1898. *Taxidea taxus infusca* Thomas, Proc. zool. soc. London, 1897, p. 899. April 1, 1898.

Type locality. — Santa Anita, Lower California, Mexico.

Taxidea taxus neglecta (Mearns).

1891. *Taxidea americana neglecta* Mearns, Bull. Amer. mus. nat. hist., iii, p. 250. June 5, 1891.

Type locality. — Fort Crook, Shasta County, California.

Subfamily MUSTELINAE.

Genus **GULO** Storr.

1780. *Gulo* Storr, Prodr. meth. mamm., p. 34. Type. — *Ursus gulo* Linnaeus.

* **Gulo luscus** (Linnaeus).

1766. [*Ursus*] *luscus* Linnaeus, Syst. nat., xii ed., i, p. 71.

1823. *Gulo luscus* Sabine, Franklin's narrative, journ. to Polar Sea, p. 650.

1885. *Gulo luscus* True, Proc. U. S. nat. mus., vii (1884), p. 609. 1885.

Type locality. — Hudson Bay.

Genus **GALICTIS** Bell.

1837. *Galictis* Bell, Proc. zool. soc. London, p. 45. Included *Galictis vittata* and *allamandi*.

Subgenus GALICTIS Bell.

Galictis allamandi Bell.

1837. *Galictis allamandi* BELL, Proc. zool. soc. London, p. 47.

1885. *Galictis* (*Grisonia*) *crassidens* NEHRING, Sitzungsber. der Gesellsch. naturforsch. Freunde zu Berlin, p. 167. (Minas-Geraes, Brazil.)

1887. *Galictis crassidens* NEHRING, Zool. garten, XXVIII, p. 254. (Guatemala.)

1897. [*Galictis*] *allamandi* TROUESSART, Catal. mamm., pt. II, p. 264.

TYPE LOCALITY. — Unknown.

Subgenus GALERA Gray.

1843. *Galera* GRAY, List spec. mamm. Brit. mus., p. 67. Type. — *Mustela barbara* LINNAEUS.

Regarded by Nehring (Sitzungsber. der Gesellsch. naturforsch. Freunde zu Berlin, 1885, p. 169) as a distinct genus.

Galictis barbara biologiae Thomas.

1900. *Galictis barbara biologiae* THOMAS, Ann. and mag. nat. hist., 7th ser., V, p. 146. January, 1900.

TYPE LOCALITY. — Calovevora, Veragua, Panama.

* **Galictis barbara senex** Thomas.

1885. *Galictis barbara* TRUE, Proc. U. S. nat. mus., VII (1884), p. 609. 1885. (Part.)

1900. *Galictis barbara senex* THOMAS, Ann. and mag. nat. hist., 7th ser., V, p. 146. January, 1900.

TYPE LOCALITY. — Hacienda Tortugas, Jalapa, State of Vera Cruz, Mexico. Altitude, about 600 feet.

Genus **PUTORIUS** Cuvier.

1817. *Putorius* Cuvier, Règne animal, i, p. 147. Type. — *Mustela putorius* Linnaeus.

Subgenus Lutreola Wagner.

1841. *Lutreola* Wagner, Schreber's Säugthiere, Suppl. ii, p. 239. Type. — *Mustela lutreola* Linnaeus.

Recognized as a genus by Merriam, North Amer. fauna, no. 11, p. 7, June 30, 1897, and Mazama, i, no. 2, p. 227, October, 1897. The combination *Lutreola vison energumenos* occurs in the latter paper (p. 227).

Putorius lutensis Bangs.

1898. *Putorius* (*Lutreola*) *lutensis* Bangs, Proc. Boston soc. nat. hist., xxviii, p. 229. March, 1898.

Type locality. — Salt marsh off Matanzas Inlet, St. John County, Florida.

* **Putorius vison** (Schreber).

1778. *Mustela vison* Schreber, Säugthiere, iii, p. 463.

1830. *Putorius vison* Gapper, Zool. journ., v, p. 202.

1885. *Putorius vison* True, Proc. U. S. nat. mus., vii (1884), p. 609. 1885. (Part.)

Type locality. — Eastern Canada.

Putorius vison energumenos Bangs.

1896. *Putorius vison energumenos* Bangs, Proc. Boston soc. nat. hist., xxvii, p. 5. March, 1896.

Type locality. — Sumas, British Columbia, Canada.

Putorius vison ingens (Osgood).

1900. *Lutreola vison ingens* Osgood, North Amer. fauna, no. 19, p. 42. October 6, 1900.

Type locality. — Fort Yukon, Alaska.

Putorius vison lutreocephalus (Harlan).

1825. *Mustela lutreocephala* Harlan, Fauna Americana, p. 63.

1896. *Putorius vison lutreocephalus* BANGS, Proc. Boston soc. nat. hist., XXVII, p. 4. March, 1896.
TYPE LOCALITY. — Maryland.

Putorius vison vulgivagus (Bangs).
1895. *Putorius* (*Lutreola*) *vulgivagus* BANGS, Proc. Boston soc. nat. hist., XXVI, p. 539. July 31, 1895.
1896. *Putorius vison vulgivagus* BANGS, Proc. Boston soc. nat. hist., XXVII, p. 5. March, 1896.
TYPE LOCALITY. — Burbridge, Plaquemines Parish, Louisiana.

Subgenus PUTORIUS Cuvier.[1]

* **Putorius nigripes** Audubon and Bachman.
1851. *Putorius nigripes* AUDUBON and BACHMAN, Quadr. N. Amer., II, p. 297.
1885. *Putorius nigripes* TRUE, Proc. U. S. nat. mus., VII (1884), p. 609. 1885.
TYPE LOCALITY. — Plains of the Platte River, Nebraska.

Subgenus ICTIS Kaup.[2]

1829. *Ictis* KAUP, Skizziete Entw.-Gesch. u. natürl. Syst. der europ. Thierw., p. 40. Type. — *Mustela vulgaris* = *M. nivalis* LINNAEUS.

* **Putorius cicognanii** (Bonaparte).
1838. *Mustela cicognanii* BONAPARTE, Iconogr. fauna Ital., I, fasc. XXII, p. 4.
1839. *Putorius cicognanii* RICHARDSON, Zoology of Beechey's voyage, p. 10*.
1885. *Putorius vulgaris* TRUE, Proc. U. S. nat. mus., VII (1884), p. 609. 1885. (Part.)
1896. *Putorius cicognani* MERRIAM, North Amer. fauna, no. 11, p. 10. June 30, 1896.
TYPE LOCALITY. — Northeastern North America.

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[1] Revised by Merriam, North Amer. fauna, no. 11, pp. 7–9. June 30, 1896.

[2] Revised by Merriam, North Amer. fauna, no. 11, pp. 9–33. June 30, 1896.

Putorius cicognanii richardsonii (Bonaparte).

1838. *Mustela richardsonii* Bonaparte, Charlesworth's mag. nat. hist., ii, p. 38.

1896. *Putorius cicognani richardsoni* Merriam, North Amer. fauna, no. 11, p. 11. June 30, 1896.

Type locality. — Fort Franklin, Great Bear Lake, Mackenzie, Canada.

Putorius cicognanii alascensis (Merriam).

1896. *Putorius richardsoni alascensis* Merriam, North Amer. fauna, no. 11, p. 12. June 30, 1896.

1897. [*Putorius cicognani*] *alascensis* Trouessart, Catal. mamm., pt. ii, p. 277.

Type locality. — Juneau, Alaska.

Putorius streatori Merriam.

1896. *Putorius streatori* Merriam, North Amer. fauna, no. 11, p. 13. June 30, 1896.

Type locality. — Mount Vernon, Skagit Valley, Skagit County, Washington.

Putorius muricus Bangs.

1899. *Putorius* (*Arctogale*) *muricus* Bangs, Proc. New England zool. club, i, p. 71. July 31, 1899.

Type locality. — Echo, El Dorado County, California.

Putorius rixosus Bangs.

1896. *Putorius rixosus* Bangs, Proc. biol. soc. Washington, x, p. 21. February 25, 1896.

Type locality. — Osler, Saskatchewan, Canada.

Putorius rixosus eskimo Stone.

1900. *Putorius rixosus eskimo* Stone, Proc. acad. nat. sci. Phila., p. 44. March 24, 1900.

Type locality. — Point Barrow, Alaska.

Putorius arcticus Merriam.

1896. *Putorius arcticus* Merriam, North Amer. fauna, no. 11, p. 15. June 30, 1896.

Type locality. — Point Barrow, Alaska.

Putorius kadiacensis (Merriam).

1896. [*Putorius arcticus*] subspecies *kadiacensis* Merriam, North Amer. fauna, no. 11, p. 16. June 30, 1896.

1898. *Putorius kadiacensis* PREBLE, Proc. biol. soc. Washington, XII, p. 169. August 10, 1898.

TYPE LOCALITY.— Kadiak Island, Alaska.

Putorius haidarum Preble.

1898. *Putorius haidarum* PREBLE, Proc. biol. soc. Washington, XII, p. 169. August 10, 1898.

TYPE LOCALITY. — Massett, Graham Island, Queen Charlotte Islands, British Columbia, Canada.

* **Putorius noveboracensis** Emmons.

1840. *Putorius noveboracensis* EMMONS, Rep. quadr. Massachusetts, p. 45.

1885. *Putorius erminea* TRUE, Proc. U. S. nat. mus., VII (1884), p. 609. 1885. (Part.)

TYPE LOCALITY. — Southern New York.

Putorius noveboracensis notius Bangs.

1899. *Putorius noveboracensis notius* BANGS, Proc. New England zool. club, I, p. 53. June 9, 1899.

TYPE LOCALITY. — Weaverville, Buncombe County, North Carolina.

Putorius occisor Bangs.

1899. *Putorius occisor* BANGS, Proc. New England zool. club, I, p. 54. June 9, 1899.

TYPE LOCALITY. — Bucksport, near mouth of Penobscot River, Hancock County, Maine.

Putorius washingtoni Merriam.

1896. *Putorius washingtoni* MERRIAM, North Amer. fauna, no. 11, p. 18. June 30, 1896.

TYPE LOCALITY. — Trout Lake, south base of Mount Adams, Skamania County, Washington.

Putorius peninsulae Rhoads.

1894. *Putorius peninsulae* RHOADS, Proc. acad. nat. sci. Phila., p. 152. June 19, 1894.

TYPE LOCALITY. — Hudson's, Pasco County, fourteen miles north of Tarpon Springs, Hillsboro County, Florida.

* **Putorius longicauda** (Bonaparte).

1838. *Mustela longicauda* BONAPARTE, Charlesworth's mag. nat. hist., II, p. 38.

1839. *Putorius longicauda* Richardson, Zoology of Beechey's voyage, p. 10*.

1885. *Putorius longicauda* True, Proc. U. S. nat. mus., vii (1884), p. 609. 1885.

Type locality. — Carlton House, on North Saskatchewan River, Saskatchewan, Canada.

Putorius longicauda oribasus Bangs.

1899. *Putorius (Arctogale) longicauda oribasus* Bangs, Proc. New England zool. club, i, p. 81. December 27, 1899.

Type locality. — Source of Kettle River, British Columbia, Canada. Altitude, 7500 feet.

Putorius longicauda spadix Bangs.

1896. *Putorius longicauda spadix* Bangs, Proc. biol. soc. Washington, x, p. 8. February 25, 1896.

Type locality. — Fort Snelling, Hennepin County, Minnesota.

Putorius saturatus Merriam.

1896. *Putorius saturatus* Merriam, North Amer. fauna, no. 11, p. 21. June 30, 1896.

Type locality. — Siskiyou, Jackson County, Oregon. Altitude, 4000 feet.

Putorius arizonensis Mearns.

1891. *Putorius arizonensis* Mearns, Bull. Amer. mus. nat. hist., iii, p. 234. June 5, 1891.

Type locality. — San Francisco forest, a few miles south of Flagstaff, Coconino County, Arizona.

Putorius alleni Merriam.

1896. *Putorius alleni* Merriam, North Amer. fauna, no. 11, p. 24. June 30, 1896.

Type locality. — Custer, Black Hills, Custer County, South Dakota.

Putorius xanthogenys (Gray).

1843. *Mustela xanthogenys* Gray, Ann. and mag. nat. hist., xi, p. 118. February, 1843.

1857. *Putorius xanthogenys* Baird, Mamm. N. Amer., p. 176.

1896. *Putorius xanthogenys* Merriam, North Amer. fauna, no. 11, p. 25. June 30, 1896.

Type locality. — Southern California, probably in the vicinity of San Diego, San Diego County.

Putorius xanthogenys mundus Bangs.

1899. *Putorius xanthogenys mundus* BANGS, Proc. New England zool. club, I, p. 56. June 9, 1899.

TYPE LOCALITY. — Point Reyes, Marin County, California.

Putorius xanthogenys oregonensis Merriam.

1896. *Putorius xanthogenys oregonensis* MERRIAM, North Amer. fauna, no. 11, p. 25. June 30, 1896.

TYPE LOCALITY. — Grant's Pass, Rogue River Valley, Josephine County, Oregon.

* **Putorius frenatus** (Lichtenstein).

1832. *Mustela frenata* LICHTENSTEIN, Darstellung neuer oder wenig bekannter Säugethiere, pl. XLII.

1857. *Putorius frenatus* BAIRD, Mamm. N. Amer., p. 173.

1885. *Putorius brasiliensis frenatus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 610. 1885. (Part.)

1896. *Putorius frenatus* MERRIAM, North Amer. fauna, no. 11, p. 26. June 30, 1896.

TYPE LOCALITY. — Valley of Mexico, near City of Mexico, Mexico.

Putorius frenatus goldmani Merriam.

1896. *Putorius frenatus goldmani* MERRIAM, North Amer. fauna, no. 11, p. 28. June 30, 1896.

TYPE LOCALITY. — Pinabete, State of Chiapas, Mexico. Altitude, about 8200 feet.

Putorius frenatus leucoparia Merriam.

1896. *Putorius frenatus leucoparia* MERRIAM, North Amer. fauna, no. 11, p. 29. June 30, 1896.

TYPE LOCALITY. — Patzcuaro, State of Michoacan, Mexico.

Putorius frenatus neomexicanus Barber and Cockerell.

1898. *Putorius frenatus neomexicanus* BARBER and COCKERELL, Proc. acad. nat. sci. Phila., p. 188. May 3, 1898.

TYPE LOCALITY. — Armstrong's Lake, Mesilla Valley, Donna Ana County, New Mexico.

Putorius tropicalis Merriam.

1896. *Putorius tropicalis* MERRIAM, North. Amer. fauna, no. 11, p. 30. June 30, 1896.

TYPE LOCALITY. — Jico, State of Vera Cruz, Mexico. Altitude, 6000 feet.

*[**Putorius affinis** (Gray).

1874. *Mustela affinis* GRAY, Ann. and mag. nat. hist., 4th ser., XIV, p. 375. November, 1874.

1885. *Putorius brasiliensis aequitorialis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 610. 1885. (Part.)

1896. *Putorius affinis* MERRIAM, North Amer. fauna, no. 11, p. 31. June 30, 1896.

TYPE LOCALITY. — Colombia.

Genus **MUSTELA** Linnaeus.

1758. *Mustela* LINNAEUS, Syst. nat., X ed., I, p. 45. Type. — *Mustela martes* LINNAEUS.

*[**Mustela americana** Turton.

1806. [*Mustela*] *americanus* TURTON, Linnaeus, system of nature, I, p. 60.

1885. *Mustela americana* TRUE, Proc. U. S. nat. mus., VII (1884), p. 610. 1885. (Part.)

TYPE LOCALITY. — Eastern North America.

Mustela americana actuosa Osgood.

1900. *Mustela americana actuosa* OSGOOD, North Amer. fauna, no. 19, p. 43. October 6, 1900.

TYPE LOCALITY. — Fort Yukon, Alaska.

Mustela atrata Bangs.

1897. *Mustela atrata* BANGS, Amer. nat., XXXI, p. 162. February, 1897.

TYPE LOCALITY. — Bay St. George, Newfoundland.

Mustela brumalis Bangs.

1898. *Mustela brumalis* BANGS, Amer. nat., XXXII, p. 502. July, 1898.

TYPE LOCALITY. — Okak, Labrador.

Mustela caurina Merriam.

1890. *Mustela caurina* MERRIAM, North Amer. fauna, no. 4, p. 27. October 8, 1890.

Type locality. — Near Gray's Harbor, Chehalis County, Washington.

* **Mustela pennanti** Erxleben.

1777. [*Mustela*] *pennanti* Erxleben, Syst. regni anim., I, p. 470.

1885. *Mustela pennanti* True, Proc. U. S. nat. mus., VII (1884), p. 610. 1885.

1898. *Mustela canadensis* Rhoads, Trans. Amer. philos. soc., n. s., XIX, p. 434. September, 1898.

1898. *Mustela pennanti* Allen, Bull. Amer. mus. nat. hist., X, p. 461. November 10, 1898.

Type locality. — Eastern Canada.

Mustela pennanti pacifica (Rhoads).

1898. *Mustela canadensis pacifica* Rhoads, Trans. Amer. philos. soc., n. s., XIX, p. 435. September, 1898.

Type locality. — Lake Kichelos, Kittitas County, Washington. Altitude, 8000 feet.

Family PROCYONIDAE.

Genus POTOS Cuvier and Geoffroy.

1795. *Potos* Cuvier and Geoffroy, Méthode mammalogique, in Mag. encyclopédique, II, p. 187. Type.— *Viverra caudivolvula* Schreber.

For use of this name in place of *Cercoleptes* (Illiger, Prodr. meth. mamm., p. 127, 1811) see Palmer, Proc. biol. soc. Washington, XI, p. 174, June 9, 1897.

* **Potos caudivolvulus** (Schreber).

1777. *Viverra caudivolvula* Schreber, Säugthiere, III, p. 453.

1803. *Potos caudivolvulus* E. Geoffroy, Catal. des mamm. du mus. national d'hist. nat., p. 90.

1885. *Cercoleptes caudivolvulus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 608. 1885.

TYPE LOCALITY. — Surinam.

Genus **NASUA** Storr.

1780. *Nasua* STORR, Prodr. meth. mamm., p. 35. Type. — *Viverra nasua* LINNAEUS.

* **Nasua narica** (Linnaeus).

1766. [*Viverra*] *narica* LINNAEUS, Syst. nat., XII ed., I, p. 64.

1879. *Nasua narica* ALLEN, Bull. U. S. geol. and geogr. surv. terr., V, p. 162.

1885. *Nasua narica* TRUE, Proc. U. S. nat. mus., VII (1884), p. 608. 1885.

TYPE LOCALITY. — Tropical America.

Genus **PROCYON** Storr.

1780. *Procyon* STORR, Prodr. meth. mamm., p. 35. Type. — *Ursus lotor* LINNAEUS.

* **Procyon cancrivorus** (Cuvier).

1798. *Ursus cancrivorus* CUVIER, Tabl. élém. d' hist. nat., p. 113.

1819. *Procyon cancrivorus* DESMAREST, Dict. d'hist. nat., XXIX, p. 93.

1885. *Procyon cancrivorus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 608. 1885.

TYPE LOCALITY. — Cayenne, French Guiana.

* **Procyon lotor** (Linnaeus).

1758. [*Ursus*] *lotor* LINNAEUS, Syst. nat., X ed., I, p. 48.

1819. *Procyon lotor* DESMAREST, Dict. d' hist. nat., XXIX, p. 91.

1885. *Procyon lotor* TRUE, Proc. U. S. nat. mus., VII (1884), p. 608. 1885. (Part.)

TYPE LOCALITY. — Eastern United States.

Procyon lotor elucus Bangs.

1898. *Procyon lotor elucus* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 219. March, 1898.

TYPE LOCALITY. — Oak Lodge, East Peninsula, opposite Micco, Brevard County, Florida.

Procyon lotor hernandezii (Wagler).

1831. *Procyon hernandezii* WAGLER, Isis, XXIV, p. 514.

1890. *Procyon lotor hernandezi* ALLEN, Bull. Amer. mus. nat. hist., III, p. 176. December 10, 1890.

TYPE LOCALITY. — Southern Mexico.

Procyon lotor insularis Merriam.

1898. *Procyon lotor insularis* MERRIAM, Proc. biol. soc. Washington, XII, p. 17. January 27, 1898.

TYPE LOCALITY. — Maria Madre Island, Tres Marias Islands, State of Jalisco, Mexico.

Procyon maynardi Bangs.

1898. *Procyon maynardi* BANGS, Proc. biol. soc. Washington, XII, p. 92. April 30, 1898.

TYPE LOCALITY. — New Providence Island, Bahamas.

Procyon pallidus Merriam.

1900. *Procyon pallidus* MERRIAM, Proc. biol. soc. Washington, XIII, p. 151. June 13, 1900.

TYPE LOCALITY. — New River, Colorado Desert, San Diego County, California.

Procyon psora Gray.

1842. *Procyon psora* GRAY, Ann. and mag. nat. hist., X, p. 261. December, 1842.

1899. [*Procyon*] *psora* MERRIAM, North Amer. fauna, no. 16, p. 107. October 28, 1899.

TYPE LOCALITY. — Sacramento, Sacramento County, California.

Procyon psora pacifica Merriam.

1899. *Procyon psora pacifica* MERRIAM, North Amer. fauna, no. 16, p. 107. October 28, 1899.

TYPE LOCALITY. — Lake Kichelos, Kittitas County, Washington. Altitude, 8000 feet.

Genus **BASSARISCUS** Coues.

1887. *Bassariscus* COUES, Science, IX, p. 516. May 27, 1887.
Type. — By elimination, *Bassaris astuta* LICHTENSTEIN.

* **Bassariscus astutus** (Lichtenstein).

1831. *Bassaris astuta* LICHTENSTEIN, Isis, XXIV, p. 513.

1885. *Bassaris astuta* TRUE, Proc. U. S. nat. mus., VII (1884), p. 608. 1885.

1887. *Bassariscus astutus* COUES, Science, IX, p. 516. May 27, 1887.

TYPE LOCALITY. — Southern Mexico.

Bassariscus astutus flavus Rhoads.

1894. *Bassariscus astutus flavus* RHOADS, Proc. acad. nat. sci. Phila., 1893, p. 417. January 30, 1894.

TYPE LOCALITY.— Texas, exact locality unknown.

Bassariscus astutus oregonus (Rhoads).

1894. *Bassariscus flavus oregonus* RHOADS, Proc. acad. nat. sci. Phila., 1893, p. 416. January 30, 1894.

TYPE LOCALITY.— Grant's Pass, Josephine County, Oregon.

According to Merriam (Proc. biol. soc. Washington, XI, pp. 186–187, July 1, 1897) this should stand as *Bassariscus raptor*. (*Bassaris raptor* BAIRD, Mamm. Mexican boundary, p. 19, 1859. Type caught in the city of Washington, D. C., where it had evidently escaped from captivity.)

Bassariscus saxicola Merriam.

1897. *Bassariscus saxicola* MERRIAM, Proc. biol. soc. Washington, XI, p. 185. July 1, 1897.

TYPE LOCALITY.— Espiritu Santo Island, Lower California, Mexico.

Genus **WAGNERIA** Jentink.

1886. *Wagneria* Jentink, Notes from the Leyden museum, viii, p. 129. Type.—*Paradoxurus annulatus* Wagner.

According to Merriam (Science, n. s., vii, p. 31, January 7, 1898) the name *Wagneria* is preoccupied and the genus identical with *Bassariscus*.

* **Wagneria annulata** (Wagner).

1841. *P*[*aradoxurus*] *annulatus* Wagner, Schreber's Säugthiere, Suppl., ii, p. 353.

1885. *Bassaris sumichrasti* True, Proc. U. S. nat. mus., vii (1884), p. 608. 1885.

1886. *Wagneria annulata* Jentink, Notes from the Leyden museum, viii, p. 129.

Type locality.— Unknown; probably Central America.

Genus **BASSARICYON** Allen.

1876. *Bassaricyon* Allen, Proc. acad. nat. sci. Phila., p. 20. Type.—*Bassaricyon gabbii* Allen.

* **Bassaricyon gabbii** Allen.

1876. [*Bassaricyon*] *gabbii* Allen, Proc. acad. nat. sci. Phila., p. 23. April 18, 1876.

1885. *Bassaricyon gabbii* True, Proc. U. S. nat. mus., vii (1884), p. 608. 1885.

Type locality.— Costa Rica.

Family **URSIDAE**.

Genus **URSUS** Linnaeus.[1]

1758. *Ursus* Linnaeus, Syst. nat., x ed., i, p. 47. Type.—*Ursus arctos* Linnaeus.

Subgenus Ursus Linnaeus.

Ursus middendorffi Merriam.

1896. *Ursus middendorffi* Merriam, Proc. biol. soc. Washington, x, p. 69. April 13, 1896.

Type locality. — Kadiak Island, Alaska.

Ursus dalli Merriam.

1896. *Ursus dalli* Merriam, Proc. biol. soc. Washington, x, p. 71. April 13, 1896.

Type locality. —Yakutat Bay, Alaska.

Ursus sitkensis Merriam.

1896. *Ursus sitkensis* Merriam, Proc. biol. soc. Washington, x, p. 73. April 13, 1896.

Type locality.— Near Sitka, Alaska.

Regarded by Lydekker (Proc. zool. soc. London, 1897, p. 424) as identical with *U. dalli.*

Subgenus Danis Gray.

1825. *Danis* Gray, Ann. of philos., n. s., x, p. 60. Type. — *Ursus ferox* Desmarest = *Ursus horribilis* Ord.

* **Ursus horribilis** Ord.

1815. *Ursus horribilis* Ord, Guthrie's geography, 2d Amer. ed., ii, p. 291, described on p. 299.

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[1] American species revised by Merriam, Proc. biol. soc. Washington x, pp. 65–83. April 13, 1896.

1885. *Ursus horribilis* True, Proc. U. S. nat. mus., VII (1884), p. 608. 1885. (Part.)

Type locality.— Montana.

Ursus horribilis alascensis Merriam.

1896. *Ursus horribilis alascensis* Merriam, Proc. biol. soc. Washington, x, p. 74. April 13, 1896.

Type locality.— Norton Sound, Alaska.

Ursus horribilis californicus Merriam.

1896. [*Ursus horribilis*] subspecies *californicus* Merriam, Proc. biol. soc. Washington, x, p. 76. April 13, 1896.

Type locality. — Monterey, Monterey County, California.

Ursus horribilis horriaeus Baird.

1859. *Ursus horribilis* var. *horriaeus* Baird, Rep. Mexican boundary survey, II, pt. II, p. 24.

1896. *Ursus horribilis horriaeus* Merriam, Proc. biol. soc. Washington, x, p. 75. April 13, 1896.

Type locality. — Los Nogales, State of Sonora, Mexico, near border of Pima County, Arizona.

* **Ursus richardsoni** Swainson.

1838. *Ursus richardsoni* Swainson, Anim. in menageries, p. 54.

1885. *Ursus richardsoni* True, Proc. U. S. nat. mus., VII (1884), p. 608. 1885.

Type locality. — Shore of the Arctic Ocean, Mackenzie, Canada.

Subgenus Euarctos Gray.

1864. *Euarctos* Gray, Proc. zool. soc. London, p. 692. Type. — *Ursus americanus* Pallas.

* **Ursus americanus** Pallas.

1780. *Ursus americanus* Pallas, Spicilegia zoologica, fasc. XIV, p. 5.

1885. *Ursus americanus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 608. 1885.

TYPE LOCALITY. — Eastern North America.

Ursus americanus sornborgeri Bangs.

1898. *Ursus* (*Euarctos*) *americanus sornborgeri* BANGS, Amer. nat., XXXII, p. 500. July, 1898.

TYPE LOCALITY. — Okak, Labrador.

Ursus luteolus Griffith.

1821. *Ursus luteolus* GRIFFITH, Carnivorous animals, p. 236.

1893. *Ursus luteolus* MERRIAM, Proc. biol. soc. Washington, VIII, p. 147. December 29, 1893.

TYPE LOCALITY. — Louisiana.

Ursus floridanus Merriam.

1896. *Ursus floridanus* MERRIAM, Proc. biol. soc. Washington, X, p. 81. April 13, 1896.

TYPE LOCALITY. — Key Biscayne, Dade County, Florida.

Ursus emmonsii (Dall).

1895. [*Ursus americanus*] var. *emmonsii* DALL, Science, n. s., II, p. 87. July 26, 1895.

1896. *Ursus emmonsi* MERRIAM, Proc. biol. soc. Washington, X, p. 82. April 13, 1896.

1897. *Ursus glacilis* (sic) KELLS, Canadian natural science news, I, p. 12. April, 1897. (Mt. Saint Elias, Alaska.)

TYPE LOCALITY.— Saint Elias Alps, near Yakutat Bay, Alaska.

Genus **THALARCTOS** Gray.

1825. *Thalarctos* GRAY, Ann. of philos., n. s., X, p. 62. Type. — *Thalarctos polaris* GRAY = *Ursus maritimus* PHIPPS.

* **Thalarctos maritimus** (Phipps).

1774. *Ursus maritimus* PHIPPS, Voyage toward N. Pole, p. 185.

1862. *Thalarctos maritimus* GRAY, Catal. bones mamm. Brit. mus., p. 105.

1885. *Thalassarctos maritimus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 608. 1885.

TYPE LOCALITY. — Spitzbergen.

Order INSECTIVORA.

Family SORICIDAE.

Subfamily Soricinae.

Genus SOREX Linnaeus.[1]

1758. *Sorex* Linnaeus, Syst. nat., x ed., i, p. 53. Type.—*Sorex araneus* Linnaeus.

Subgenus Sorex Linnaeus.

* **Sorex personatus** I. Geoffroy.

1827. *Sorex personatus* I. Geoffroy, Mém. mus. d'hist. nat., Paris, xv, p. 122.

1885. *Sorex platyrhinus* and *Sorex cooperi* True, Proc. U. S. nat. mus., vii (1884), p. 606. 1885.

Type locality.—Eastern United States.

Sorex personatus haydeni (Baird).

1857. *Sorex haydeni* Baird, Mamm. N. Amer., p. 29.

1896. *Sorex personatus haydeni* Allen, Bull. Amer. mus. nat. hist., viii, p. 257. November 25, 1896.

Type locality.—Fort Union, now Buford, Military Reservation, North Dakota.

Sorex personatus lesueurii (Duvernoy).

1842. *Amphisorex lesueurii* Duvernoy, Mag. de zool., 2d ser., mamm., p. 33. November, 1842.

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[1] Revised by Merriam, North Amer. fauna, no. 11, pp. 57–98. December 31, 1895.

1895. [*Sorex personatus*] *lesueuri* MERRIAM, North Amer. fauna, no. 10, p. 61. December 31, 1895.

TYPE LOCALITY. — Wabash River, Indiana.

Sorex personatus miscix Bangs.

1899. *Sorex personatus miscix* BANGS, Proc. New England zool. club, I, p. 15. February 28, 1899.

TYPE LOCALITY. — Black Bay, Strait of Belle Isle, Labrador.

Sorex personatus arcticus Merriam.

1900. *Sorex personatus arcticus* MERRIAM, Proc. Washington acad. sci., II, p. 17. March 14, 1900.

TYPE LOCALITY. — St. Michaels, Norton Sound, Alaska.

Sorex personatus streatori Merriam.

1895. *Sorex personatus streatori* MERRIAM, North Amer. fauna, no. 10, p. 62. December 31, 1895.

TYPE LOCALITY. — Yakutat, Alaska.

Sorex macrurus Batchelder.

1896. *Sorex macrurus* BATCHELDER, Proc. biol. soc. Washington, X, p. 133. December 8, 1896.

TYPE LOCALITY. — Beede's (sometimes called Keene Heights), Essex County, New York.

Sorex richardsonii Bachman.

1837. *Sorex richardsonii* BACHMAN, Journ. acad. nat. sci. Phila., VII, pt. II, p. 383.

1895. *Sorex richardsoni* MILLER, North Amer. fauna, no. 10, p. 48. December 31, 1895.

TYPE LOCALITY. — Unknown; probably plains of Saskatchewan, Canada.

Sorex tundrensis Merriam.

1900. *Sorex tundrensis* MERRIAM, Proc. Washington acad. sci., II, p. 16. March 14, 1900.

TYPE LOCALITY. — St. Michaels, Norton Sound, Alaska.

* **Sorex sphagnicola** Coues.

1877. *Sorex sphagnicola* COUES, Bull. U. S. geol. and geogr. surv. terr., III, p. 650. May 15, 1877.

1885. *Sorex sphagnicola* TRUE, Proc. U. S. nat. mus., VII (1884), p. 606. 1885.

TYPE LOCALITY. — Vicinity of Fort Liard, northwestern British Columbia, Canada.

* **Sorex fumeus** Miller.

1885. *Sorex forsteri* TRUE, Proc. U. S. nat. mus., VII (1884), p. 606. 1885.

1895. *Sorex fumeus* MILLER, North Amer. fauna, no. 10, p. 50. December 31, 1895.

TYPE LOCALITY. — Peterboro, Madison County, New York.

Sorex vagrans Baird.

1857. *Sorex vagrans* BAIRD, Mamm. N. Amer., p. 15.

1891. *S[orex] vagrans* MERRIAM, North Amer. fauna, no. 5, p. 34. July 30, 1891.

TYPE LOCALITY. — Shoalwater Bay, Washington.

Sorex vagrans dobsoni (Merriam).

1891. *Sorex dobsoni* MERRIAM, North Amer. fauna, no. 5, p. 33. July 30, 1891.

1895. *Sorex vagrans dobsoni* MERRIAM, North Amer. fauna, no. 10, p. 68. December 31, 1895.

TYPE LOCALITY. — Saw Tooth or Alturas Lake, east base of Saw Tooth Mountains, central Idaho. Altitude, about 7200 feet.

Sorex vagrans monticola (Merriam).

1890. *Sorex monticolus* MERRIAM, North Amer. fauna, no. 3, p. 43. September 11, 1890.

1895. *Sorex vagrans monticola* MERRIAM, North Amer. fauna, no. 10, p. 69. December 31, 1895.

TYPE LOCALITY. — San Francisco Mountain, Coconino County, Arizona. Altitude, 11,500 feet.

Sorex setosus Elliot.

1899. *Sorex setosus* ELLIOT, Field Columbian mus., publication 32, zool. ser., I, p. 274. March, 1899.

TYPE LOCALITY. — Happy Lake, Olympic Mountains, Clallam County, Washington.

Sorex amoenus Merriam.

1895. *Sorex amoenus* MERRIAM, North Amer. fauna, no. 10, p. 69. December 31, 1895.

Type locality. — Mammoth Pass, head of Owen's River, east slope of the Sierra Nevada Mountains, California. Altitude, about 10,000 feet.

Sorex vancouverensis Merriam.

1895. *Sorex vancouverensis* Merriam, North Amer. fauna, no. 10, p. 70. December 31, 1895.

Type locality. — Goldstream, Vancouver Island, British Columbia, Canada.

Sorex orizabae Merriam.

1895. *Sorex orizabae* Merriam, North Amer. fauna, no. 10, p. 71. December 31, 1895.

Type locality. — Mount Orizaba, State of Puebla, Mexico. Altitude, 9500 feet.

Sorex nevadensis Merriam.

1895. *Sorex nevadensis* Merriam, North Amer. fauna, no. 10, p. 71. December 31, 1895.

Type locality. — Reese River, Lander County, Nevada.

Sorex obscurus Merriam.

1895. *Sorex obscurus* Merriam, North Amer. fauna, no. 10, p. 72. December 31, 1895.

Type locality. — Timber Creek, Salmon River Mountains, Idaho. Altitude, 8200 feet.

Sorex obscurus longicauda Merriam.

1895. *Sorex obscurus longicauda* Merriam, North Amer. fauna, no. 10, p. 74. December 31, 1895.

Type locality. — Wrangel, Alaska.

Regarded by Merriam (Proc. Washington acad. sci., ii, p. 16, March 14, 1900) as a distinct species.

Sorex obscurus ventralis Merriam.

1895. *Sorex obscurus ventralis* Merriam, North Amer. fauna, no. 10, p. 75. December 31, 1895.

Type locality. — Cerro San Felipe, State of Oaxaca, Mexico. Altitude, 10,000 feet.

Sorex glacialis Merriam.

1900. *Sorex glacialis* Merriam, Proc. Washington acad. sci., ii, p. 16. March 14, 1900.

Type locality.—Point Gustavus, on east side of entrance to Glacier Bay, Alaska.

Sorex alascensis (Merriam).

1895. *Sorex obscurus alascensis* Merriam, North Amer. fauna, no. 10, p. 76. December 31, 1895.

1900. *S[orex] alascensis* Merriam, Proc. Washington acad. sci., II, p. 18. March 14, 1900.

Type locality.—Yakutat Bay, Alaska.

Sorex alascensis shumaginensis Merriam.

1900. *Sorex alascensis shumaginensis* Merriam, Proc. Washington acad. sci., II, p. 18. March 14, 1900.

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

Sorex salvini Merriam.

1897. *Sorex salvini* Merriam, Proc. biol. soc. Washington, XI, p. 229. July 15, 1897.

Type locality.—Calel, Totonicapan, Guatemala. Altitude, 10,200 feet.

Sorex oreopolus Merriam.

1892. *Sorex oreopolus* Merriam, Proc. biol. soc. Washington, VII, p. 173. September 29, 1892.

Type locality.—North slope of Sierra Nevada of Colima, State of Jalisco, Mexico. Altitude, 10,000 feet.

Sorex bairdi Merriam.

1895. *Sorex bairdi* Merriam, North Amer. fauna, no. 10, p. 77. December 31, 1895.

Type locality.—Astoria, mouth of the Columbia River, Clatsop County, Oregon.

* **Sorex trowbridgii** Baird.

1857. *Sorex trowbridgii* Baird, Mamm. N. Amer., p. 13.

1885. *Sorex trowbridgei* True, Proc. U. S. nat. mus., VII (1884), p. 606. 1885.

Type locality.—Astoria, mouth of the Columbia River, Clatsop County, Oregon.

Sorex montereyensis Merriam.

1895. *Sorex montereyensis* Merriam, North Amer. fauna, no. 10, p. 79. December 31, 1895.

Type locality.—Monterey, Monterey County, California.

Sorex ornatus Merriam.

1895. *Sorex ornatus* Merriam, North Amer. fauna, no. 10, p. 79. December 31, 1895.

Type locality.— Head of San Emigdio Canyon, Mount Piños, Monterey County, California.

Sorex californicus Merriam.

1895. *Sorex californicus* Merriam, North Amer. fauna, no. 10, p. 80. December 31, 1895.

Type locality.— Walnut Creek, Contra Costa County, California.

Sorex shastensis Merriam.

1899. *Sorex shastensis* Merriam, North Amer. fauna, no. 16, p. 87. October 28, 1899.

Type locality.— Wagon Camp, Mount Shasta, Siskiyou County, California. Altitude, 5700 feet.

Sorex tenellus Merriam.

1895. *Sorex tenellus* Merriam, North Amer. fauna, no. 10, p. 81. December 31, 1895.

Type locality. — Summit of Alabama Hills, near Lone Pine, Owens Valley, Inyo County, California.

Sorex tenellus nanus Merriam.

1895. *Sorex tenellus nanus* Merriam, North Amer. fauna, no. 10, p. 81. December 31, 1895.

Type locality. — Estes Park, Larimer County, Colorado.

Sorex macrodon Merriam.

1895. *Sorex macrodon* Merriam, North Amer. fauna, no. 10, p. 82. December 31, 1895.

Type locality.— Orizaba, State of Vera Cruz, Mexico. Altitude, 4200 feet.

* **Sorex veraepacis** Alston.

1877. *Sorex verae-pacis* Alston, Proc. zool. soc. London, p. 445.

1885. *Sorex verae-pacis* True, Proc. U. S. nat. mus., vii (1884), p. 606. 1885.

Type locality. — Coban, Guatemala.

Sorex saussurei Merriam.

1892. *Sorex saussurei* Merriam, Proc. biol. soc. Washington, vii, p. 173. September 29, 1892.

Type locality.— North slope of Sierra Nevada of Colima, State of Jalisco, Mexico. Altitude, 8000 feet.

Sorex saussurei mutabilis Merriam.

1898. *Sorex saussurei mutabilis* Merriam, Science, n. s., viii, p. 782. December 2, 1898.

Type locality.— Reyes, State of Oaxaca, Mexico. Altitude, 10,200 feet.

Sorex sclateri Merriam.

1897. *Sorex sclateri* Merriam, Proc. biol. soc. Washington, xi, p. 228. July 15, 1897.

Type locality.— Tumbala, State of Chiapas, Mexico. Altitude, 5000 feet.

Sorex godmani Merriam.

1897. *Sorex godmani* Merriam, Proc. biol. soc. Washington, xi, p. 229. July 15, 1897.

Type locality.— Volcano Santa Maria, Quezaltenango, Guatemala. Altitude, 9000 feet.

Sorex stizodon Merriam.

1895. *Sorex stizodon* Merriam, North Amer. fauna, no. 10, p. 98. December 31, 1895.

Type locality. — San Cristobal, State of Chiapas, Mexico.

Sorex longirostris Bachman.

1837. *Sorex longirostris* Bachman, Journ. acad. nat. sci. Phila., vii, pt. ii, p. 370.

1895. *Sorex longirostris* Miller, North Amer. fauna, no. 10, p. 52. December 31, 1895.

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

Sorex fisheri Merriam.

1895. *Sorex fisheri* Merriam, North Amer. fauna, no. 10, p. 86. December 31, 1895.

Type locality.— Lake Drummond, Dismal Swamp, Norfolk County, Virginia.

* **Sorex pacificus** Coues.

1877. *Sorex pacificus* Coues, Bull. U. S. geol. and geogr. surv. terr., III, p. 650. May 15, 1877.

1885. *Sorex pacificus* True, Proc. U. S. nat. mus., VII (1884) p. 606. 1885.

Type locality. — Fort Umpqua, mouth of Umpqua River, Douglas County, Oregon.

Sorex pribilofensis Merriam.

1895. *Sorex pribilofensis* Merriam, North Amer. fauna, no. 10, p. 87. December 31, 1895.

Type locality. — St. Paul Island, Pribilof Islands, Bering Sea.

Sorex merriami Dobson.

1890. *Sorex merriami* Dobson, Monogr. insectivora, pt. III, fasc. I, pl. XXIII, fig. 6. May, 1890.

Type locality. — Little Bighorn River, about a mile and a half above Fort Custer, Crow Indian Reservation, Montana.

The possibility that this is an Asiatic shrew is suggested by Merriam (North Amer. fauna, no. 10, p. 89, December 31, 1895).

Subgenus Microsorex Coues.

1877. *Microsorex* Coues, Bull. U. S. geol. and geogr. surv. terr., III, p. 646. May 15, 1897. Type. — *Sorex hoyi* Baird.

* **Sorex hoyi** Baird.

1857. *Sorex hoyi* Baird, Mamm. N. Amer., p. 32.

1885. *Sorex hoyi* True, Proc. U. S. nat. mus., VII (1884), p. 606. 1885.

Type locality. — Racine, Racine County, Wisconsin.

Subgenus Neosorex Baird.

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

* **Sorex palustris** Richardson.

1828. *Sorex palustris* Richardson, Zool. journ., iii, p. 517.

1885. *Neosorex palustris* True, Proc. U. S. nat. mus., vii (1884), p. 606. 1885.

Type locality. — Marshy places from Hudson Bay to the Rocky Mountains.

* **Sorex navigator** (Baird).

1857. *Neosorex navigator* Baird, Mamm. N. Amer., p. 11.

1885. *Neosorex navigator* True, Proc. U. S. nat. mus., vii (1884), p. 606. 1885.

1900. [*Sorex*] *navigator* Merriam, Proc. Washington acad. sci., ii, p. 18. March 14, 1900.

Type locality. — Unknown; probably northern Idaho (see Merriam, North Amer. fauna, no. 10, p. 92, December 31, 1895).

Sorex navigator alaskanus Merriam.

1900. *Sorex navigator alaskanus* Merriam, Proc. Washington acad. sci., ii, p. 18. March 14, 1900.

Type locality. — Point Gustavus, on east side of entrance to Glacier Bay, Alaska.

Sorex albibarbis (Cope).

1862. *Neosorex albibarbis* Cope, Proc. acad. nat. sci. Phila., p. 188.

1892. *Sorex albibarbis* Merriam, Proc. biol. soc. Washington, vii, p. 25. April 13, 1892.

Type locality. — Profile Lake, Franconia Mountains, Grafton County, New Hampshire.

Sorex hydrodromus Dobson.

1889. *Sorex hydrodromus* Dobson, Ann. and mag. nat. hist., 6th ser., iv, p. 373. November, 1889.

Type locality. — Unalaska Island, Alaska.

Subgenus Atophyrax Merriam.

1884. *Atophyrax* Merriam, Trans. Linn. soc. New York, ii, p. 217. August, 1884. Type. — *Atophyrax bendirii* Merriam.

* **Sorex bendirii** (Merriam).

1884. *Atophyrax bendirii* Merriam, Trans. Linn. soc. New York, II, p. 217. August, 1884.

1885. *Atophyrax bendirei* True, Proc. U. S. nat. mus., VII (1884), p. 606. 1885.

1890. *Sorex bendirii* Dobson, Monogr. insectivora, pt. III, fasc. I, pl. XXIII, fig. 17. May, 1890.

Type locality. — Near Williamson River, 18 miles southeast of Fort Klamath, Klamath County, Oregon.

Sorex bendirii palmeri Merriam.

1895. *Sorex bendirii palmeri* Merriam, North Amer. fauna, no. 10, p. 97. December 31, 1895.

Type locality. — Astoria, Clatsop County, Oregon.

Sorex bendirii albiventer Merriam.

1895. *Sorex bendirii albiventer* Merriam, North Amer. fauna, no. 10, p. 97. December 31, 1895.

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

Genus **NOTIOSOREX** Coues.[1]

1877. *Notiosorex* Coues, Bull. U. S. geol. and geogr. surv. terr., III, p. 646. May 15, 1877. Type.— *Sorex* (*Notiosorex*) *crawfordi* Coues.

* **Notiosorex crawfordi** (Coues).

1877. *Sorex* (*Notiosorex*) *crawfordi* Coues, Bull. U. S. geol. and geogr. surv. terr., III, p. 651. May 15, 1877.

1885. *Sorex crawfordi* True, Proc. U. S. nat. mus., VII (1884), p. 606. 1885.

1895. *Notiosorex crawfordi* Merriam, North Amer. fauna, no. 10, p. 32. December 31, 1895.

Type locality. — Near old Fort Bliss, about two miles above El Paso, El Paso County, Texas.

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[1] Revised by Merriam, North Amer. fauna, no. 10, pp. 31–34. December 31, 1895.

Notiosorex crawfordi evotis (Coues).

1877. *Sorex* (*Notiosorex*) *evotis* Coues, Bull. U. S. geol. and geogr. surv. terr., III, p. 652. May 15, 1877.

1895. *Notiosorex crawfordi evotis* Merriam, North Amer. fauna, no. 10, p. 34. December 31, 1895.

Type locality. — Mazatlan, State of Sinaloa, Mexico.

Notiosorex gigas Merriam.

1897. *Notiosorex gigas* Merriam, Proc. biol. soc. Washington, XI, p. 227. July 15, 1897.

Type locality.— Mountains at Milpillas, near San Sebastian, State of Jalisco, Mexico.

Genus **BLARINA** Gray.[1]

1838. *Blarina* Gray, Proc. zool. soc. London, 1837, p. 124.

Type. — *Sorex talpoides* Gapper = *Sorex brevicauda* Say.

Subgenus Blarina Gray.

* **Blarina brevicauda** (Say).

1823. *Sorex brevicaudus* Say, Long's exped. Rocky Mts., I, p. 164.

1857. *Blarina brevicauda* Baird, Mamm. N. Amer., p. 42.

1885. *Blarina brevicauda* True, Proc. U. S. nat. mus., VII (1884), p. 606. 1885.

Type locality. — West bank of Missouri River, near Blair, formerly Engineer Cantonment, Washington County, Nebraska.

Blarina brevicauda carolinensis (Bachman).

1837. *Sorex carolinensis* Bachman, Journ. acad. nat. sci. Phila., VII, pt. II, p. 366.

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[1] Revised by Merriam, North Amer. fauna, no. 10, pp. 7–31. December 31, 1895.

1895. *Blarina brevicauda carolinensis* Merriam, North Amer. fauna, no. 10, p. 13. December 31, 1895.

Type locality. — Eastern South Carolina.

Blarina brevicauda peninsulae (Merriam).

1895. *Blarina carolinensis peninsulae* Merriam, North Amer. fauna, no. 10, p. 14. December 31, 1895.

1897. [*Blarina brevicauda*] *peninsulae* Trouessart, Catal. mamm., pt. i, p. 188.

Type locality. — Miami River, Dade County, Florida.

Blarina brevicauda hulophaga Elliot.

1899. *Blarina brevicauda hulophaga* Elliot, Field Columbian mus., publication 38, zool. ser., i, p. 287. May 24, 1899.

Type locality. — Dougherty, Washita River, Chicksaw Nation, Indian Territory.

Blarina telmalestes Merriam.

1895. *Blarina telmalestes* Merriam, North Amer. fauna, no. 10, p. 15. December 31, 1895.

Type locality. — Lake Drummond, Dismal Swamp, Norfolk County, Virginia.

Blarina costaricensis Allen.

1891. *Blarina costaricensis* Allen, Bull. Amer. mus. nat. hist., iii, p. 205. April 17, 1891.

Type locality. — La Carpintera, Costa Rica, or upper Mississippi Valley (see Merriam, North Amer. fauna, no. 10, p. 12, December 31, 1895).

Regarded by Merriam (North Amer. fauna, no. 10, p. 10, December 31, 1895) as identical with *B. brevicauda*, but this determination is questioned by Allen (Bull. Amer. mus. nat. hist., ix, p. 34, March 11, 1897).

Subgenus CRYPTOTIS Pomel.

1848. *Cryptotis* Pomel, Archiv. sci. phys. et nat. Genève, 4th ser., ix, p. 249. November, 1848. Type.—*Sorex cinereus* Bachman = *Sorex parvus* Say.

***Blarina parva** (Say).

1823. *Sorex parvus* Say, Long's exped. Rocky Mts., I, p. 163.

1885. *Blarina cinerea* and *Sorex parvus* True, Proc. U. S. nat. mus., VII (1884), p. 606. 1885.

1895. *Blarina parva* Merriam, North Amer. fauna, no. 10, p. 17. December 31, 1895.

Type locality. — West bank of Missouri River, near Blair, formerly Engineer Cantonment, Washington County, Nebraska.

Blarina floridana Merriam.

1895. *Blarina floridana* Merriam, North Amer. fauna, no. 10, p. 19. December 31, 1895.

Type locality. — Chester Shoal, 11 miles north of Cape Canaveral, Brevard County, Florida.

Blarina berlandieri Baird.

1857. *Blarina berlandieri* Baird, Mamm. N. Amer., p. 53.

1895. *Blarina berlandieri* Merriam, North Amer. fauna, no. 10, p. 20. December 31, 1895.

Type locality. — Matamoras, State of Tamaulipas, Mexico.

Blarina tropicalis Merriam.

1895. *Blarina tropicalis* Merriam, North Amer. fauna, no. 10, p. 21. December 31, 1895.

Type locality. — Coban, Guatemala. Altitude, about 4400 feet.

Blarina orophila Allen.

1895. *Blarina* (*Soriciscus*) *orophila* Allen, Bull. Amer. mus. nat. hist., VII, p. 340. November 8, 1895.

Type locality. — Volcano of Irazú, Costa Rica.

Blarina soricina Merriam.

1895. *Blarina soricina* Merriam, North Amer. fauna, no. 10, p. 22. December 31, 1895.

Type locality. — Tlalpam, ten miles south of the city of Mexico, Mexico. Altitude, 7600 feet.

Blarina obscura Merriam.

1895. *Blarina obscura* Merriam, North Amer. fauna, no. 10, p. 23. December 31, 1895.

Type locality. — Tulancingo, State of Hidalgo, Mexico. Altitude, 8500 feet.

* **Blarina mexicana** Coues.

1877. *Blarina* (*Soriciscus*) *mexicana* Coues, Bull. U. S. geol. and geogr. surv. terr., iii, p. 652. May 15, 1877.

1885. *Blarina mexicana* True, Proc. U. S. nat. mus., vii (1884), p. 606. 1885.

Type locality. — Jalapa, State of Vera Cruz, Mexico.

Blarina mexicana peregrina Merriam.

1895. *Blarina mexicana peregrina* Merriam, North Amer. fauna, no. 10, p. 24. December 31, 1895.

Type locality. — Mountains 15 miles west of Oaxaca, State of Oaxaca, Mexico. Altitude, 9500 feet.

Blarina mexicana goldmani Merriam.

1895. *Blarina mexicana goldmani* Merriam, North Amer. fauna, no. 10, p. 25. December 31, 1895.

Type locality. — Mountains near Chilpancingo, State of Guerrero, Mexico. Altitude, 10,000 feet.

Blarina mexicana machetes Merriam.

1895. *Blarina mexicana machetes* Merriam, North Amer. fauna, no. 10, p. 26. December 31, 1895.

Type locality. — Mountains near Ozolotepec, State of Oaxaca, Mexico. Altitude, 10,000 feet.

Blarina nelsoni Merriam.

1895. *Blarina nelsoni* Merriam, North Amer. fauna, no. 10, p. 26. December 31, 1895.

Type locality. — Volcano of Tuxtla, State of Vera Cruz, Mexico. Altitude, 4800 feet.

Blarina nigrescens Allen.

1895. *Blarina* (*Soriciscus*) *nigrescens* Allen, Bull. Amer. mus. nat. hist., vii, p. 339. November 8, 1895.

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

Blarina alticola Merriam.

1895. *Blarina alticola* Merriam, North Amer. fauna, no. 10, p. 27. December 31, 1895.

Type locality. — Mount Popocatepetl, State of Mexico, Mexico. Altitude, 11,500 feet.

Blarina fossor Merriam.

1895. *Blarina fossor* Merriam, North Amer. fauna, no. 10, p. 28. December 31, 1895.

Type locality. — Mount Zempoaltepec, State of Oaxaca, Mexico. Altitude, 10,500 feet.

Blarina magna Merriam.

1895. *Blarina magna* Merriam, North Amer. fauna, no. 10, p. 28. December 31, 1895.

Type locality. — Totontepec, State of Oaxaca, Mexico. Altitude, 6800 feet.

Family TALPIDAE.

Subfamily Talpinae.

Genus SCALOPS Illiger.[1]

1811. *Scalops* Illiger, Prodr. syst. mamm. et avium, p. 126.

Type. — *Sorex aquaticus* Linnaeus.

* **Scalops aquaticus** (Linnaeus).

1758. [*Sorex*] *aquaticus* Linnaeus, Syst. nat., x ed., i, p. 53.

1825. *Scalops aquaticus* F. Cuvier, Dents des mamm., p. 251.

1885. *Scalops aquaticus aquaticus* True, Proc. U. S. nat. mus., vii (1884), p. 606. 1885.

Type locality. — Eastern United States.

* **Scalops aquaticus machrinus** (Rafinesque).

1832. *Talpa machrina* Rafinesque, Atlantic journal, i, p. 61.

1885. *Scalops aquaticus argentatus* True, Proc. U. S. nat. mus., vii (1884), p. 606. 1885.

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[1] Revised by True, Proc. U. S. nat. mus., xix, pp. 19–47. December 21, 1896.

1896. *Scalops aquaticus machrinus* TRUE, Proc. U. S. nat. mus., XIX, p. 20. December 21, 1896.

TYPE LOCALITY. — Near Lexington, Fayette County, Kentucky.

Regarded by Elliot (Field Columbian mus., publication 37, zool. ser., I, p. 280, May 9, 1899) as a distinct species.

Scalops aquaticus intermedius (Elliot).

1899. *Scalops machrinus intermedius* ELLIOT, Field Columbian mus., publication 37, zool. ser., I, p. 280. May 9, 1899.

TYPE LOCALITY. — Alva, Woods County, Oklahoma Territory.

Scalops aquaticus aereus (Bangs).

1896. *Scalops texanus aereus* BANGS, Proc. biol. soc. Washington, X, p. 138. December 28, 1896.

TYPE LOCALITY. — Stilwell, Boston Mountains, Indian Territory.

Scalops aquaticus australis Chapman.

1893. *Scalops aquaticus australis* CHAPMAN, Bull. Amer. mus. nat. hist., V, p. 339. December 22, 1893.

TYPE LOCALITY. — Gainesville, Alachua County, Florida.

Scalops aquaticus texanus (Allen).

1891. *Scalops argentatus texanus* ALLEN, Bull. Amer. mus. nat. hist., III, p. 221. April 29, 1891.

1896. *Scalops aquaticus texanus* TRUE, Proc. U. S. nat. mus., XIX, p. 21. December 21, 1896.

TYPE LOCALITY. — Texas; "given by Dr. J. A. Allen as Presidio County, Texas, but believed to be Aransas County" (see True, Proc. U. S. nat. mus., XIX, p. 22, December 21, 1896).

Scalops anastasae Bangs.

1898. *Scalops anastasae* BANGS, Proc. Boston soc. nat. hist., XXVIII, p. 212. March, 1898.

TYPE LOCALITY. — Point Romo, Anastasia Island, St. John County, Florida.

Genus **SCAPANUS** Pomel.[1]

1848. *Scapanus* Pomel, Archiv. sci. phys. nat. Genève, 4th ser. ix, p. 247. Type.—By elimination, *Scalops townsendii* Bachman.

* **Scapanus townsendii** (Bachman).

1839. *Scalops townsendii* Bachman, Journ. acad. nat. sci., Phila., viii, pt. i, p. 58.

1848. *Scapanus tow[n]sendii* Pomel, Archiv. sci. phys. nat. Genève, 4th ser., ix, p. 247.

1885. *Scapanus townsendii* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.

Type locality.—Vicinity of Vancouver, Clarke County, Washington (see True, Proc. U. S. nat. mus., xix, p. 63, December 21, 1896).

Scapanus orarius True.

1896. *Scapanus orarius* True, Proc. U. S. nat. mus., xix, p. 52. December 21, 1896.

Type locality.—Shoalwater Bay, Pacific County, Washington.

Scapanus californicus (Ayres).

1855. *Scalops californicus* Ayres, Proc. California acad. nat. sci., i, p. 54.

1896. *Scapanus californicus* True, Proc. U. S. nat. mus., xix, p. 52. December 21, 1896.

Type locality.—San Francisco, California.

Scapanus californicus minusculus Bangs.

1899. *Scapanus californicus minusculus* Bangs, Proc. New England zool. club, i, p. 70. July 31, 1900.

Type locality.—Fyffe, El Dorado County, California.

Scapanus alpinus Merriam.

1897. *Scapanus alpinus* Merriam, Proc. biol. soc. Washington, xi, p. 102. April 26, 1897.

Type locality.—Crater Lake, Mount Mazama, Klamath County, Oregon. Altitude, 7000 feet.

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[1] Revised by True, Proc. U. S. nat. mus., xix, pp. 47–67. December 21, 1896.

Scapanus truei Merriam.

1897. *Scapanus truei* MERRIAM, Proc. biol. soc. Washington, XI, p. 102. April 26, 1897.

TYPE LOCALITY. — Lake City, Modoc County, California.

Scapanus anthonyi Allen.

1893. *Scapanus anthonyi* ALLEN, Bull. Amer. mus. nat. hist., V, p. 200. August 18, 1893.

TYPE LOCALITY. — San Pedro Martir Mountains, Lower California, Mexico. Altitude, 7000 feet.

Genus **PARASCALOPS** True.[1]

1894. *Parascalops* TRUE, Diagnoses of new North American mammals, p. 2. April 26, 1894. (Reprint: Proc. U. S. nat. mus., XVII, p. 242. November 15, 1894.) Type. — *Scalops breweri* BACHMAN.

***Parascalops breweri** (Bachman).

1844. *Scalops breweri* BACHMAN, Boston journ. nat. hist., IV, p. 32.

1885. *Scapanus breweri* TRUE, Proc. U. S. nat. mus., VII (1884), p. 606. 1885.

1895. *Parascalops breweri* TRUE, Science, n. s., I, p. 101. January 25, 1895.

TYPE LOCALITY. — Unknown; type supposed by Bachman to have been taken on the island of Marthas Vineyard, Massachusetts, a locality where the animal probably does not occur.

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[1] Revised by True, Proc U. S. nat. mus., XIX, pp. 67–77. December 21, 1896.

Genus **CONDYLURA** Illiger.[1]

1811. *Condylura* Illiger, Prodr. syst. mamm. et avium, p. 125. Type.— *Sorex cristatus* Linnaeus.

* **Condylura cristata** (Linnaeus).

1758. [*Sorex*] *cristatus* Linnaeus, Syst. nat., x ed., i, p. 53.
1819. *Condylura cristata* Desmarest, Journ. de phys., lxxxix, p. 230.
1885. *Condylura cristata* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.
Type locality.— Pennsylvania.

Subfamily Mygalinae.

Genus **NEUROTRICHUS** Günther.[2]

1880. *Neurotrichus* Günther, Proc. zool. soc. London, p. 441. Type.— *Urotrichus gibbsii* Baird.

* **Neurotrichus gibbsii** (Baird).

1857. *Urotrichus gibbsii* Baird, Mamm. N. Amer., p. 76.
1880. *Neurotrichus gibbsi* Günther, Proc. zool. soc. London, pl. xlii.
1885. *Neurotrichus gibbsii* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.
Type locality.— White River Pass, north of Mount Rainier, Pierce County, Washington.

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[1] Revised by True, Proc. U. S. nat. mus., xix, pp. 77–98. December 21, 1896.

[2] Revised by True, Proc. U. S. nat. mus., xix, pp. 98–106. December 21, 1896.

Neurotrichus gibbsii hyacinthinus Bangs.

1897. *Neurotrichus gibbsi hyacinthinus* Bangs, Amer. nat., xxxi, p. 240. March, 1897.

Type locality. —Nicasio, Marin County, California.

Neurotrichus gibbsii major Merriam.

1899. *Neurotrichus gibbsi major* Merriam, North Amer. fauna, no. 16, p. 88. October 28, 1899.

Type locality. — Carberry Ranch, between Mount Shasta and Mount Lassen, Shasta County, California. Altitude, 4100 feet.

Family SOLENODONTIDAE.

Genus SOLENODON Brandt.

1833. *Solenodon* Brandt, Mém. acad. imp. sci., St. Pétersbourg, 6th ser., ii, p. 459. Type. — *Solenodon paradoxus* Brandt.

* **Solenodon paradoxus** Brandt.

1833. [*Solenodon*] *paradoxus* Brandt, Mém. acad. imp. sci., St. Pétersbourg, 6th ser., ii, p. 459.

1885. *Solenodon paradoxus* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.

Type locality. — Hayti.

* **Solenodon cubanus** Peters.

1863. *Solenodon cubanus* Peters, Abhandl. k. preuss. Akad. Wissensch. Berlin, p. 2.

1885. *Solenodon cubanus* True, Proc. U. S. nat. mus., vii (1884), p. 607. 1885.

Type locality. — Cuba.

Order CHIROPTERA.

Suborder MICROCHIROPTERA.

Family **VESPERTILIONIDAE**.

Subfamily VESPERTILIONINAE.

Genus **MYOTIS** Kaup.[1]

1829. *Myotis* KAUP, Skizzirte Entw.-Gesch. u. natürl. Syst. der europ. Thierw., I, p. 106. Type. — *Vespertilio myotis* BECHSTEIN.

* **Myotis velifer** (J. A. Allen).
1885. *Vespertilio albescens* TRUE, Proc. U. S. nat. mus., VII (1884), p. 603. 1885. (Part.)
1890. *Vespertilio velifer* J. A. ALLEN, Bull. Amer. mus. nat. hist., III, p. 177. December 10, 1890.
1897. *Myotis velifer* MILLER, North Amer. fauna, no. 13, p. 56. October 16, 1897.
TYPE LOCALITY. — Santa Cruz del Valle, near Guadalajara, State of Jalisco, Mexico.

Myotis peninsularis Miller.
1898. *Myotis peninsularis* MILLER, Ann. and mag. nat. hist., 7th ser., II, p. 124. August, 1898.
TYPE LOCALITY. — San José del Cabo, Lower California, Mexico.

* **Myotis lucifugus** (Le Conte).
1831. *V[espertilio] lucifugus* LE CONTE, McMurtrie's Cuvier, Animal kingdom, I, p. 431.
1885. *Vespertilio lucifugus* and *Vespertilio carolii* TRUE, Proc. U. S. nat. mus., VII (1884), p. 603. 1885.

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[1] Revised by Miller, North Amer. fauna, no. 13, pp. 55-85. October 16, 1897.

1897. *Myotis lucifugus* MILLER, North Amer. fauna, no. 13, p. 59. October 16, 1897.

TYPE LOCALITY. — Georgia; probably the Le Conte plantation, near Riceboro, Liberty County.

Myotis lucifugus alascensis Miller.

1897. *Myotis lucifugus alascensis* MILLER, North Amer. fauna, no. 13, p. 63. October 16, 1897.

TYPE LOCALITY. — Sitka, Alaska.

Myotis lucifugus longicrus (True).

1886. *Vespertilio longicrus* TRUE, Science, VIII, p. 588. December 24, 1886.

1897. *Myotis lucifugus longicrus* MILLER, North Amer. fauna, no. 13, p. 64. October 16, 1897.

TYPE LOCALITY. — Puget Sound, Washington.

Myotis yumanensis (H. Allen).

1864. *Vespertilio yumanensis* H. ALLEN, Monogr. bats N. Amer., p. 58, June, 1864.

1897. *Myotis yumanensis* MILLER, North Amer. fauna, no. 13, p. 66. October 16, 1897.

TYPE LOCALITY. — Old Fort Yuma, San Diego County, California.

Myotis yumanensis saturatus Miller.

1897. *Myotis yumanensis saturatus* MILLER, North Amer. fauna, no. 13, p. 68. October 16, 1897.

TYPE LOCALITY. — Hamilton, Skagit County, Washington.

* **Myotis californicus** (Audubon and Bachman).

1842. *Vespertilio californicus* AUDUBON and BACHMAN, Journ. acad. nat. sci. Phila., VIII, pt. II, p. 285.

1885. *Vespertilio nitidus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 602. 1885.

1897. *Myotis californicus* MILLER, North Amer. fauna, no. 13, p. 69. October 16, 1897.

TYPE LOCALITY. — California.

Myotis californicus pallidus Stephens.

1900. *Myotis californicus pallidus* STEPHENS, Proc. biol. soc. Washington, XIII, p. 153. June 13, 1900.

TYPE LOCALITY. — Vallecito, San Diego County, California.

Myotis californicus caurinus Miller.

1897. *Myotis californicus caurinus* Miller, North Amer. fauna, no. 13, p. 72. October 16, 1897.

Type locality. — Massett, Graham Island, Queen Charlotte Islands, British Columbia, Canada.

Myotis californicus ciliolabrum (Merriam).

1886. *Vespertilio ciliolabrum* Merriam, Proc. biol. soc. Washington, iv, p. 2. December 17, 1886.

1897. *Myotis californicus ciliolabrum* Miller, North Amer. fauna, no. 13, p. 72. October 16, 1897.

Type locality. — Near Banner, Trego County, Kansas, in bluff on Hackberry Creek about one mile from Castle Rock.

Myotis californicus mexicanus (Saussure).

1860. *V[espertilio] mexicanus* Saussure, Revue et magasin de zoologie, 2d ser., xii, p. 282. July, 1860.

1897. *Myotis californicus mexicanus* Miller, North Amer. fauna, no. 13, p. 73. October 16, 1897.

Type locality. — Exact locality unknown, probably somewhere in Vera Cruz, Puebla, or Oaxaca, Mexico.

* **Myotis nigricans** (Wied).

1826. *V[espertilio] nigricans* Wied, Beiträge zur Naturgesch. Brasilien, ii, p. 266.

1885. *Vespertilio nigricans* True, Proc. U. S. nat. mus., vii (1884), p. 602. 1885. (Part.)

1897. *Myotis nigricans* Miller, North Amer. fauna, no. 13, p. 74. October 16, 1897.

Type locality. — Fazenda de Aga, near the Iritiba River, southeastern Brazil.

* **Myotis subulatus** (Say).

1823. *V[espertilio] subulatus* Say, Long's exped. Rocky Mts., ii, p. 65.

1885. *Vespertilio subulatus* True, Proc. U. S. nat. mus., vii (1884), p. 603. 1885.

1897. *Myotis subulatus* Miller, North Amer. fauna, no. 13, p. 75. October 16, 1897.

Type locality. — Arkansas River, near La Junta, Otero County, Colorado.

Myotis subulatus keenii (Merriam).

1895. *Vespertilio subulatus keenii* Merriam, Amer. nat., xxix, p. 860. September, 1895.

1897. *Myotis subulatus keenii* Miller, North Amer. fauna, no. 13, p. 77. October 16, 1897.

Type locality. — Massett, Graham Island, Queen Charlotte Islands, British Columbia, Canada.

* **Myotis evotis** (H. Allen).

1864. *Vespertilio evotis* H. Allen, Monogr. bats N. Amer., p. 48. June, 1864.

1885. *Vespertilio evotis* True, Proc. U. S. nat. mus., vii (1884), p. 602. 1885.

1897. *Myotis evotis* Miller, North Amer. fauna, no. 13, p. 77. October 16, 1897.

Type locality. — Monterey, Monterey County, California.

Myotis thysanodes Miller.

1897. *Myotis thysanodes* Miller, North Amer. fauna, no. 13, p. 80. October 16, 1897.

Type locality. — Old Fort Tejon, in mountains south of Kern Lake, Kern County, California.

Genus **LASIONYCTERIS** Peters.[1]

1866. *Lasionycteris* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin (1865), p. 648. Type. — *Vespertilio noctivagans* Le Conte.

* **Lasionycteris noctivagans** (Le Conte).

1831. *V[espertilio] noctivagans* Le Conte, McMurtries' Cuvier, Animal kingdom, i, p. 431.

1885. *Vesperugo noctivagans* True, Proc. U. S. nat. mus., vii (1884), p. 602. 1885.

1894. *Lasionycteris noctivagans* H. Allen, Monogr. bats N. Amer., p. 105. (1893). March 14, 1894.

Type locality. — Eastern United States.

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[1] Revised by Miller, North Amer. fauna, no. 13, pp. 85-87. October 16, 1897.

Genus **PIPISTRELLUS** Kaup.[1]

1829. *Pipistrellus* KAUP, Skizzirte Entw.-Gesch. u. natürl. Syst. der europ. Thierw., I, p. 98. Type.— *Vespertilio pipistrellus* SCHREBER.

* **Pipistrellus hesperus** (H. Allen).

1864. *Scotophilus hesperus* H. ALLEN, Monogr. bats N. Amer., p. 43. June, 1864.

1885. *Vesperugo hesperus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 602. 1885.

1897. *Pipistrellus hesperus* MILLER, North Amer. fauna, no. 13, p. 88. October 16, 1897.

TYPE LOCALITY. — Old Fort Yuma, San Diego County, California.

Pipistrellus hesperus australis Miller.

1897. *Pipistrellus hesperus australis* MILLER, North Amer. fauna, no. 13, p. 90. October 16, 1897.

TYPE LOCALITY. — Barranca Ibarra, State of Jalisco, Mexico.

* **Pipistrellus subflavus** (F. Cuvier).

1832. *V[espertilio] subflavus* F. CUVIER, Nouv. ann. mus. d'hist. nat., Paris, I, p. 17.

1885. *Vesperugo georgianus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 602. 1885.

1897. *Pipistrellus subflavus* MILLER, North Amer. fauna, no. 13, p. 90. October 16, 1897.

TYPE LOCALITY. — Eastern United States, probably Georgia.

Pipistrellus subflavus obscurus Miller.

1897. *Pipistrellus subflavus obscurus* MILLER, North Amer. fauna, no. 13, p. 93. October 16, 1897.

TYPE LOCALITY. — Lake George, Warren County, New York.

Pipistrellus veraecrucis (Ward).

1891. *Vesperugo veraecrucis* WARD, Amer. nat., XXV, p. 745. August, 1891.

1897. *Pipistrellus veraecrucis* MILLER, North Amer. fauna, no. 13, p. 93. October 16, 1897.

TYPE LOCALITY. — Las Vigas, Jalapa, State of Vera Cruz, Mexico.

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[1] Revised by Miller. North Amer. fauna, no. 13, pp. 87–95. October 16, 1897.

Genus **EPTESICUS** Rafinesque.[1]

1820. *Eptesicus* Rafinesque, Annals of nature, p. 2. Type.—*Eptesicus melanops* Rafinesque = *Vespertilio fuscus* Beauvois. For use of this name in place of *Vespertilio* Linnaeus (Syst. nat., x ed., i, p. 31, 1758), see Méhely, Magyarország denevéreinek monographiája (Monographia chiropterorum Hungariae), pp. 206, 338, 1900.

* **Eptesicus fuscus** (Beauvois).

1796. *Vespertila* (sic) *fuscus* Beauvois, Catal. Peale's museum, Philadelphia, p. 14.

1885. *Vesperugo serotinus* True, Proc. U. S. nat. mus., vii (1884), p. 602. 1885. (Part.)

1900. *Eptesicus fuscus* Méhely, Magyarország denevéreinek monographiája (Monographia chiropterorum Hungariae), p. 208.

Type locality. — Philadelphia, Pennsylvania.

Eptesicus fuscus miradorensis (H. Allen).

1866. *S*[*cotophilus*] *miradorensis* H. Allen, Proc. acad. nat. sci. Phila., p. 287.

1897. *Vespertilio fuscus miradorensis* Miller, North Amer. fauna, no. 13, p. 99. October 16, 1897.

Type locality. — Mirador, State of Vera Cruz, Mexico.

Eptesicus fuscus propinquus (Peters).

1872. *Vesperus propinquus* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 262.

1897. *Vespertilio fuscus propinquus* Miller, North Amer. fauna, no. 13, p. 100. October 16, 1897.

Type locality. — Santa Isabel, Guatemala.

Eptesicus fuscus bahamensis (Miller).

1897. *Vespertilio fuscus bahamensis* Miller, North Amer. fauna, no. 13, p. 101. October 16, 1897.

Type locality. — Nassau, New Providence, Bahamas.

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[1] Revised by Miller, North Amer. fauna, no. 13, pp. 95–104. October 16, 1897.

Eptesicus fuscus cubensis (Gray).

1839. *Scotophilus cubensis* Gray, Ann. nat. hist., iv, p. 7. September, 1839.

1892. *Vesperugo fuscus cubensis* Chapman, Bull. Amer. mus. nat. hist., iv, p. 316. December 29, 1892.

Type locality. — Cuba.

Eptesicus fuscus peninsulae (Thomas).

1898. *Vespertilio fuscus peninsulae* Thomas, Ann. and mag. nat. hist., 7th ser., i, p. 43. January, 1898.

Type locality. — Sierra Laguna, Lower California, Mexico.

Eptesicus gaumeri (J. A. Allen).

1897. *Adelonycteris gaumeri* J. A. Allen, Bull. Amer. mus. nat. hist., ix, p. 231. September 28, 1897.

Type locality. — Izamal, Yucatan.

Eptesicus albigularis (Peters).

1872. *Vesperus* (*Marsipolaemus*) *albigularis* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 260.

1897. *Vespertilio albigularis* Miller, North Amer. fauna, no. 13, p. 104. October 16, 1897.

Type locality. — The type was supposed to have been taken in Mexico.

Regarded by Méhely (Magyarország denevéreinek monographiája, pp. 207, 339, 1900) as identical with the European *Vespertilio murinus*.

Genus **LASIURUS** Gray.[1]

1831. *Lasiurus* Gray, Zool. miscell., no. 1, p. 38. Type. — The name was based on the American hairy-tailed bats, of which *Lasiurus borealis* may be regarded as typical.

* **Lasiurus borealis** (Müller).

1776. *Vespertilio borealis* Müller, Natursyst., Suppl., p. 21.

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[1] Revised by Miller, North Amer. fauna, no. 13. pp. 105–115. October 16, 1897.

1885. *Atalapha noveboracensis* True, Proc. U. S. nat. mus., vii (1884), p. 602. 1885.

1897. *Lasiurus borealis* Miller, North Amer. fauna, no. 13, p. 105. October 16, 1897.

Type locality. — New York.

Lasiurus borealis seminolus (Rhoads).

1895. *Atalapha borealis seminola* Rhoads, Proc. acad. nat. sci. Phila., p. 32. March 19, 1895.

1897. *Lasiurus borealis seminolus* Miller, North Amer. fauna, no. 13, p. 109. October 16, 1897.

Type locality. — Tarpon Springs, Hillsboro County, Florida.

Lasiurus borealis pfeifferi (Gundlach).

1861. *Atalapha pfeifferi* Gundlach, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 152.

1897. *Lasiurus borealis pfeifferi* Miller, North Amer. fauna, no. 13, p. 110. October 16, 1897.

Type locality. — Cuba.

Regarded by J. A. Allen (Proc. biol. soc. Washington, xiii, p. 165, October 31, 1900) as a distinct species.

Lasiurus borealis teliotis (H. Allen).

1891. *Atalapha teliotis* H. Allen, Proc. Amer. philos. soc., xxix, p. 5. April 10, 1891.

1897. *Lasiurus borealis teliotis* Miller, North Amer. fauna, no. 13, p. 110. October 16, 1897.

Type locality. — Unknown, probably some part of California.

Lasiurus borealis mexicanus (Saussure).

1861. *A[talapha] mexicana* Saussure, Revue et magasin de zoologie, 2d ser., xiii, p. 97. March, 1861.

1897. *Lasiurus borealis mexicanus* Miller, North Amer. fauna, no. 13, p. 111. October 16, 1897.

Type locality. — Probably in Vera Cruz, Puebla, or Oaxaca, Mexico.

* **Lasiurus cinereus** (Beauvois).

1796. *Vespertilio cinereus* Beauvois, Catal. Peale's museum, Philadelphia, p. 15.

1864. *Lasiurus cinereus* H. ALLEN, Monogr. bats N. Amer., p. 21. June, 1864.
1885. *Atalapha cinerea* TRUE, Proc. U. S. nat. mus., VII (1884), p. 602. 1885.
1897. *Lasiurus cinereus* MILLER, North Amer. fauna, no. 13, p. 112. October 16, 1897.
TYPE LOCALITY. — Philadelphia, Pennsylvania.

Genus **DASYPTERUS** Peters.[1]

1871. *Dasypterus* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin (1870), p. 912. Type. — *Lasiurus intermedius* H. ALLEN.

* **Dasypterus intermedius** (H. Allen).
1862. *Lasiurus intermedius* H. ALLEN, Proc. acad. nat. sci. Phila., p. 246.
1885. *Atalapha intermedia* TRUE, Proc. U. S. nat. mus., VII (1884), p. 602. 1885.
1894. *Dasypterus intermedius* H. ALLEN, Monogr. bats N. Amer., p. 137. (1893) March 14, 1894.
TYPE LOCALITY. — Matamoras, State of Tamaulipas, Mexico.

Dasypterus ega xanthinus Thomas.
1897. *Dasypterus ega xanthinus* THOMAS, Ann. and mag. nat. hist., 6th ser., XX, p. 544. December, 1897.
TYPE LOCALITY. — Sierra Laguna, Lower California, Mexico.

Genus **NYCTICEIUS** Rafinesque.[2]

1819. *Nycticeius* RAFINESQUE, Journ. de physique, LXXXVIII, p. 417. June, 1819. Type. — By elimination, *Vespertilio humeralis* RAFINESQUE.

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[1] Revised by Miller, North Amer. fauna, no. 13, pp. 115–118. October 16, 1897.
[2] Revised by Miller, North Amer. fauna, no. 13, pp. 118–121. October 16, 1897.

* **Nycticeius humeralis** (Rafinesque).

1818. *Vespertilio humeralis* Rafinesque, American monthly magazine, III, p. 445. October, 1818.

1819. *N*[*ycticeius*] *humeralis* Rafinesque, Journ. de physique, LXXXVIII, p. 417. June, 1819.

1885. *Nycticejus crepuscularis* True, Proc. U. S. nat. mus., VII (1884), p. 602. 1885.

Type locality. — Kentucky.

Nycticeius humeralis cubanus (Gundlach).

1861. *Vesperus cubanus* Gundlach, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 150.

1897. *Nycticeius humeralis cubanus* Miller, North Amer. fauna, no. 13, p. 120. October 16, 1897.

Type locality. — Near Cardenas, Cuba.

Genus **RHOGEESSA** H. Allen.[1]

1866. *Rhogeessa* H. Allen, Proc. acad. nat. sci. Phila., p. 285.

Type. — *Rhogeessa tumida* H. Allen.

* **Rhogeessa tumida** H. Allen.

1866. *Rhogeessa tumida* H. Allen, Proc. acad. nat. sci. Phila., p. 286.

1885. *Vesperugo parvulus* True, Proc. U. S. nat. mus., VII (1884), p. 602. 1885.

1897. *Rhogeessa tumida* Miller, North Amer. fauna, no. 13, p. 123. October 16, 1897.

Type locality. — Mirador, State of Vera Cruz, Mexico.

Rhogeessa parvula H. Allen.

1866. *Rhogeessa parvula* H. Allen, Proc. acad. nat. sci. Phila., p. 285.

1897. *Rhogeessa parvula* Miller, North Amer. fauna, no. 13, p. 125. October 16, 1897.

Type locality.— Tres Marias Islands, State of Jalisco, Mexico.

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[1] Revised by Miller, North Amer. fauna, no. 13, pp. 122–129. October 16, 1897.

Rhogeessa gracilis Miller.

1897. *Rhogeessa gracilis* Miller, North Amer. fauna, no. 13, p. 126. October 16, 1897.

Type locality. — Piaxtla, State of Puebla, Mexico.

Rhogeessa alleni Thomas.

1892. *Rhogeessa alleni* Thomas, Ann. and mag. nat. hist., 6th ser., x, p. 477. December, 1892.

Type locality. — Santa Rosalia, near Autlan, State of Jalisco, Mexico.

Subfamily Plecotinae.

Genus **EUDERMA** H. Allen.[1]

1892. *Euderma* H. Allen, Proc. acad. nat. sci. Phila. (1891), p. 467. January 19, 1892. Type.— *Histiotus maçulatus* J. A. Allen.

Euderma maculatum (J. A. Allen).

1891. *Histiotus maculatus* J. A. Allen, Bull. Amer. mus. nat. hist., iii, p. 195. February 20, 1891.

1894. *Euderma maculata* H. Allen, Monogr. bats N. Amer., p. 61. (1893) March 14, 1894.

Type locality.— Near Piru, Ventura County, California.

Genus **CORYNORHINUS** H. Allen.[2]

1865. *Corynorhinus* H. Allen, Proc. acad. nat. sci. Phila., p. 173. Type. — *Plecotus macrotis* Le Conte.

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[1] Revised by Miller, North Amer. fauna, no. 13, pp. 46–49. October 16, 1897.

[2] Revised by Miller, North Amer. fauna, no. 13, pp. 49–54. October 16, 1897.

Corynorhinus macrotis (Le Conte).

1831. *Plec*[*otus*] *macrotis* Le Conte, McMurtries' Cuvier, Animal kingdom, I, p. 431.

1865. *C*[*orynorhinus*] *macrotis* H. Allen, Proc. acad. nat. sci. Phila., p. 174.

Type locality. — Georgia; probably the Le Conte plantation, near Riceboro, Liberty County.

Inadvertently omitted from True's list.

Corynorhinus macrotis pallescens Miller.

1897. *Corynorhinus macrotis pallescens* Miller, North Amer. fauna, no. 13, p. 52. October 16, 1897.

Type locality.— Keam Canyon, Navajo County, Arizona.

Corynorhinus macrotis townsendii (Cooper).

1848. *Plecotus townsendii* Cooper, Ann. lyc. nat. hist. New York, IV, p. 73.

1897. *Corynorhinus macrotis townsendii* Miller, North Amer. fauna, no. 13, p. 53. October 16, 1897.

Type locality. — Columbia River, Oregon.

Subfamily ANTROZOINAE.

Genus **ANTROZOUS** H. Allen.[1]

1862. *Antrozous* H. Allen, Proc. acad. nat. sci. Phila., p. 248.

Type. — *Vespertilio pallidus* Le Conte.

* **Antrozous pallidus** (Le Conte).

1856. *V*[*espertilio*] *pallidus* Le Conte, Proc. acad. nat. sci. Phila., VII, p. 437.

1864. *Antrozous pallidus* H. Allen, Monogr. bats N. Amer., p. 68. June, 1864.

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[1] Revised by Miller, North Amer. fauna, no. 13, pp. 42–46. October 16, 1897.

1885. *Antrozous pallidus* True, Proc. U. S. nat. mus., vii (1884), p. 602. 1885. (Part.)

Type locality. — El Paso, El Paso County, Texas.

Antrozous pallidus pacificus Merriam.

1897. *Antrozous pallidus pacificus* Merriam, Proc. biol. soc. Washington, xi, p. 180. July 1, 1897.

Type locality. — Old Fort Tejon, in mountains south of Kern Lake, Kern County, California.

Family **NOCTILIONIDAE**.

For use of this name in place of *Emballonuridae*, see Palmer, Proc. biol. soc. Washington, xii, p. 109–110, April 30, 1898.

Subfamily EMBALLONURINAE.

Genus **RHYNCHONYCTERIS** Peters.

1867. *Rhynchonycteris* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 477. Type. — *Vespertilio naso* Wied.

* **Rhynchonycteris naso** (Wied).

1821. *Vespertilio naso* Wied, Schinz's Thierreich, i, p. 179.

1867. *Rhynchonycteris naso* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 487.

1885. *Rhynchonycteris naso* True, Proc. U. S. nat. mus., vii (1884), p. 603. 1885.

Type locality. — East coast of Brazil.

Genus **SACCOPTERYX** Illiger.

1811. *Saccopteryx* ILLIGER, Prodr. syst. mamm. et avium, p. 121. Type. — *Vespertilio lepturus* SCHREBER.

Subgenus SACCOPTERYX Illiger.

* **Saccopteryx bilineata** (Temminck).

1838. *Urocryptus bilineatus* TEMMINCK, Van der Hoevens tijdsch. voor natuurl. gesch. en physiol., v, p. 33.

1867. *Saccopteryx bilineata* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 471.

1885. *Saccopteryx bilineata* TRUE, Proc. U. S. nat. mus., VII (1884), p. 603. 1885.

TYPE LOCALITY. — Surinam.

Subgenus BALANTIOPTERYX Peters.

1867. *Balantiopteryx* PETERS, Monatsber. k. preuss. akad. Wissensch. Berlin, p. 476. Type. — *Balantiopteryx plicata* PETERS.

* **Saccopteryx plicata** (Peters).

1867. *Balantiopteryx plicata* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 476.

1878. *Saccopteryx plicata* DOBSON, Catal. chiropt. Brit. mus., p. 376.

1885. *Saccopteryx plicata* TRUE, Proc. U. S. nat. mus., VII (1884), p. 603. 1885.

TYPE LOCALITY. — Puento Arenas, Costa Rica.

Saccopteryx infusca Thomas.

1897. *Saccopteryx infusca* THOMAS, Ann. and mag. nat. hist., 6th ser., XX, p. 546. December, 1897.

TYPE LOCALITY. — Cachavi, northern Ecuador.

Genus **PEROPTERYX** Peters.

1867. *Peropteryx* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 472. Type. — *Vespertilio canina* WIED.

Recognized as a genus distinct from *Saccopteryx* by Miller, Bull. Amer. mus. nat. hist., XII, p. 178, October 20, 1899.

* **Peropteryx canina** (Wied).

1821. *Vespertilio caninus* WIED, Schinz's Thierreich, I, p. 179.

1867. *Peropteryx canina* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 472.

1885. *Saccopteryx canina* TRUE, Proc. U. S. nat. mus., VII (1884), p. 602. 1885.

1899. *Peropteryx canina* MILLER, Bull. Amer. mus. nat. hist., XII, p. 178. October 20, 1899.

TYPE LOCALITY. — East coast of Brazil.

Genus **DICLIDURUS** Wied.

1819. *Diclidurus* WIED, Isis, p. 1629. Type. — *Diclidurus albus* WIED.

* **Diclidurus albus** Wied.

1819. *Diclidurus albus* WIED, Isis, p. 1630.

1885. *Diclidurus albus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 603. 1885.

TYPE LOCALITY.— East coast of Brazil, at mouth of Rio Pardo.

Subfamily NOCTILIONINAE.

Genus **NOCTILIO** Linnaeus.

1766. *Noctilio* LINNAEUS, Syst. nat., XII ed., I, p. 88. Type. — *Noctilio americanus* LINNAEUS = *Vespertilio leporinus* LINNAEUS.

* **Noctilio leporinus mastivus** (Dahl).

1797. *Vespertilio mastivus* Dahl, Skrifter af naturhist. Selskabet, Kjöbenhavn, iv, p. 132.

1885. *Noctilio leporinus mastivus* True, Proc. U. S. nat. mus., vii (1884), p. 603. 1885.

Type locality. — Island of St. Croix, West Indies.

Subfamily Molossinae.

Genus **MOLOSSUS** E. Geoffroy.

1805. *Molossus* E. Geoffroy, Ann. mus. d'hist. nat., Paris, vi, p. 151. Type.— By elimination, *Molossus rufus* E. Geoffroy.

* **Molossus rufus** E. Geoffroy.

1805. *Molossus rufus* E. Geoffroy, Ann. mus. d'hist. nat., Paris, vi, p. 155.

1885. *Molossus rufus* True, Proc. U. S. nat. mus., vii (1884), p. 603. 1885.

Type locality. — Paraguay.

Molossus rufus obscurus (E. Geoffroy).

1805. *Molossus obscurus* E. Geoffroy, Ann. mus. d'hist. nat., Paris, vi, p. 155.

1897. [*Molossus rufus*] *obscurus* Trouessart, Catal. mamm., pt. i, p. 143.

Type locality. — Paraguay.

Regarded by Miller (Proc. biol. soc. Washington, xiii, p. 162, October 31, 1900) as a distinct species.

Genus **PROMOPS** Gervais.

1855. *Promops* Gervais, Expéd. du Comte de Castelnau, zool., mamm., p. 58. Type. — *Promops ursinus* Gervais = *Molossus nasutus* Spix.

* **Promops abrasus** (Temminck).

1827. *Dysopes abrasus* Temminck, Monogr. mamm., I, p. 232.

1885. *Molossus abrasus* True, Proc. U. S. nat. mus., VII (1884), p. 603. 1885.

1900. *P[romops] abrasus* J. A. Allen, Bull. Amer. mus. nat. hist., XIII, p. 92. May 12, 1900.

Type locality. — Interior of Brazil.

Promops californicus (Merriam).

1890. *Molossus californicus* Merriam, North Amer. fauna, no. 4, p. 31. October 8, 1890.

Type locality. — Alhambra, Los Angeles County, California.

Regarded by H. Allen (Monogr. bats N. Amer., p. 175, 1894) as a form of *Promops perotis*.

Promops nanus Miller.

1900. *Promops nanus* Miller, Ann. and mag. nat. hist., 7th ser., VI, p. 470. November, 1900.

Type locality. — Bogava, Chiriqui, Panama. Altitude, 800 feet.

* **Promops nasutus** (Spix).

1823. *Molossus nasutus* Spix, Simiar. et vespert. Brasil., p. 60.

1885. *Molossus nasutus* True, Proc. U. S. nat. mus., VII (1884), p. 603. 1885.

1900. *Promops nasutus* J. A. Allen, Bull. Amer. mus. nat. hist., XIII, p. 93. May 12, 1900.

Type locality. — Near the Rio Sao Francisco, Brazil.

Genus **NYCTINOMUS** E. Geoffroy.

1818. *Nyctinomus* E. Geoffroy, Description de l'Égypte, II, mammifères, p. 114. Type. — *Nyctinomus aegyptiacus* E. Geoffroy.

Nyctinomus brasiliensis I. Geoffroy.

1824. *Nyctinomus brasiliensis* I. Geoffroy, Ann. sci. nat., I, p. 343.

Type locality. — Brazil.

Nyctinomus brasiliensis californicus H. Allen.

1894. *Nyctinomus brasiliensis californicus* H. Allen, Monogr. bats N. Amer., p. 166. (1893) March 14, 1894.

Type locality. — California.

* **Nyctinomus cynocephalus** (Le Conte).

1831. *Nyct[icea] cynocephala* Le Conte, McMurtries' Cuvier, Animal kingdom, i, p. 432.

1885. *Nyctinomus brasiliensis* True, Proc. U. S. nat. mus., vii (1884), p. 603. 1885. (Part.)

1898. *Nyctinomus cynocephalus* Miller, Proc. Boston soc. nat. hist., xxviii, p. 218. March, 1898.

Type locality. — Georgia; probably the Le Conte plantation, near Riceboro, Liberty County.

Nyctinomus depressus Ward.

1891. *Nyctinomus depressus* Ward, Amer. nat., xxv, p. 747. August, 1891.

Type locality. — Tacubaya, Federal District, Mexico.

Nyctinomus femorosaccus Merriam.

1889. *Nyctinomus femorosaccus* Merriam, North Amer. fauna, no. 2, p. 23. October 30, 1889.

Type locality. — Agua Caliente, Colorado Desert, California.

* **Nyctinomus gracilis** (Wagner).

1843. *Dysopes gracilis* Wagner, Wiegmann's Arch. f. Naturg., ix, bd. i, p. 368.

1865. *Nyctinomus gracilis* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 573.

1885. *Nyctinomus gracilis* True, Proc. U. S. nat. mus., vii (1884), p. 603. 1885.

Type locality. — Cuyaba, Matto Grosso, Brazil.

* **Nyctinomus macrotis** Gray.

1840. *Nyctinomus macrotis* Gray, Ann. nat. hist., iv, p. 5. September, 1839.

1885. *Nyctinomus macrotis* True, Proc. U. S. nat. mus., vii (1884), p. 603. 1885.

Type locality. — Interior of Cuba.

Nyctinomus minutus Miller.

1899. *Nyctinomus minutus* Miller, Bull. Amer. mus. nat. hist., xii, p. 173. October 20, 1899.

Type locality. — Trinidad, Cuba.

Nyctinomus mohavensis Merriam.

1889. *Nyctinomus mohavensis* Merriam, North Amer. fauna, no. 2, p. 25. October 30, 1889.

Type locality. — Fort Mohave, Mohave County, Arizona.

Nyctinomus nevadensis (H. Allen).

1894. *Nyctinomus macrotis nevadensis* H. Allen, Monogr. bats N. Amer., p. 171. (1893) March 14, 1894.

1895. *Nyctinomus nevadensis* J. A. Allen, Bull. Amer. mus. nat. hist., vi, p. 326. November 7, 1894.

Type locality. — California (see J. A. Allen, Bull. Amer. mus. nat. hist., vi, p. 326, footnote, November 7, 1894).

Nyctinomus orthotis H. Allen.

1889. *Nyctinomus orthotis* H. Allen, Proc. Amer. philos. soc., xxvi, p. 561. December 18, 1889.

Type locality. — Spanishtown, Jamaica.

Family **NATALIDAE**.[1]

Genus **NATALUS** Gray.

1838. *Natalus* Gray, Mag. zool. and bot., ii, p. 496. December, 1838. Type.—*Natalus stramineus* Gray.

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[1] For history and characters see Miller, Bull. Amer. mus. nat. hist., xii, pp. 245–253. December 23, 1899.

Subgenus NATALUS Gray.

* **Natalus lepidus** (Gervais).

1838. *Vespertilio lepidus* GERVAIS, in Ramon de la Sagra, Hist. de l'île de Cuba, mamm., p. 22.

1878. *Natalus lepidus* DOBSON, Catal. chiropt. Brit. mus., p. 344.

1885. *Natalus lepidus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 603. 1885.

TYPE LOCALITY. — Cuba.

* **Natalus stramineus** Gray.

1838. *Natalus stramineus* GRAY, Mag. zool. and bot., II, p. 496. December, 1838.

1885. *Natalus stramineus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 603. 1885.

TYPE LOCALITY. — Unknown.

Subgenus CHILONATALUS Miller.

1898. *Chilonatalus* MILLER, Proc. acad. nat. sci. Phila., p. 326. July 12, 1898. Type. — *Natalus micropus* DOBSON.

Natalus brevimanus Miller.

1898. *Natalus* (*Chilonatalus*) *brevimanus* MILLER, Proc. acad. nat. sci. Phila., p. 328. July 12, 1898.

TYPE LOCALITY. — Old Providence Island, Caribbean Sea.

Natalus micropus Dobson.

1880. *Natalus micropus* DOBSON, Proc. zool. soc. London, p. 443.

TYPE LOCALITY. — Environs of Kingston, Jamaica.

Inadvertently omitted from True's list.

Genus **THYROPTERA** Spix.

1823. *Thyroptera* SPIX, Simiar. et vespert. Brasil., p. 61. Type. — *Thyroptera tricolor* SPIX.

Thyroptera discifera (Lichtenstein and Peters).

1854. *Hyonycteris discifera* LICHTENSTEIN and PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 336.

1896. *Thyroptera discifera* MILLER, Proc. biol. soc. Washington, x, p. 109. July 22, 1896.

TYPE LOCALITY. — Puerto Caballos, District of Cortez, Honduras.

Family PHYLLOSTOMATIDAE.

Subfamily CHILONYCTERINAE.

Genus CHILONYCTERIS Gray.

1839. *Chilonycteris* GRAY, Ann. nat. hist., IV, p. 4. September 1839. Type. — *Chilonycteris macleayii* GRAY.

* **Chilonycteris macleayii** Gray.

1839. *Chilonycteris macleayii* GRAY, Ann. nat. hist., IV, p. 5. September, 1839.

1885. *Chilonycteris macleayi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 603. 1885.

TYPE LOCALITY. — Cuba.

* **Chilonycteris parnellii** (Gray).

1843. *Phyllodia parnellii* GRAY, Proc. zool. soc. London, p. 50.

1878. *Chilonycteris parnellii* DOBSON, Catal. chiropt. Brit. mus., p. 452.

1885. *Chilonycteris parnellii* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.

TYPE LOCALITY. — Jamaica.

* **Chilonycteris personata** Wagner.

1843. *Chilonycteris personata* WAGNER, Wiegmann's Arch. f. Naturg., IX, bd. I, p. 367.

1885. *Chilonycteris personata* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.

TYPE LOCALITY. — Matto Grosso, Brazil.

* **Chilonycteris rubiginosa** Wagner.

1843. *Chilonycteris rubiginosa* WAGNER, Wiegmann's Arch. f. Naturg., IX, bd. I, p. 367.

1885. *Chilonycteris rubiginosa* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.

TYPE LOCALITY. — Caicara, Brazil.

Genus PTERONOTUS Gray.

1838. *Pteronotus* GRAY, Mag. zool. and bot., II, p. 500. December, 1838. Type. — *Pteronotus davyi* GRAY.

Recognized as a genus distinct from *Chilonycteris* by J. A. Allen, Bull. Amer. mus. nat. hist., III, p. 178, December 10, 1890.

* **Pteronotus davyi** Gray.

1838. *Pteronotus davyi* GRAY, Mag. zool. and bot., II, p. 500. December, 1838.

1885. *Chilonycteris davyi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.

1896. *Pteronotus davyi* J. A. ALLEN, Bull. Amer. mus. nat. hist., III, p. 178. December 10, 1890.

TYPE LOCALITY. — Island of Trinidad.

Pteronotus davyi fulvus (Thomas).

1892. *Chilonycteris davyi fulvus* THOMAS, Ann. and mag. nat. hist., 6th ser., X, p. 410. November, 1892.

TYPE LOCALITY. — Las Peñas, State of Jalisco, Mexico.

Regarded by Allen (Bull. Amer. mus. nat. hist., VI, p. 248, August 3, 1894) as a color phase of *Pteronotus davyi*.

Genus **MORMOOPS** Leach.

1822. *Mormoops* LEACH, Trans. Linn. soc., XIII, p. 76. Type.— *Mormoops blainvillii* LEACH.

* **Mormoops blainvillii** Leach.

1822. *Mormoops blainvillii* LEACH, Trans. Linn. soc., XIII, p. 77.
1885. *Mormops blainvillei* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.
TYPE LOCALITY. — Jamaica.

* **Mormoops megalophylla** Peters.

1864. *Mormops megalophylla* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 381.
1885. *Mormops megalophylla* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.
TYPE LOCALITY. — Mexico.

Subfamily PHYLLOSTOMATINAE.

Genus **LONCHORHINA** Tomes.

1863. *Lonchorhina* TOMES, Proc. zool. soc. London, p. 81. Type.— *Lonchorhina aurita* TOMES.

* **Lonchorhina aurita** Tomes.

1863. *Lonchorhina aurita* TOMES, Proc. zool. soc. London, p. 83.
1885. *Lonchorina aurita* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.
TYPE LOCALITY. — West Indies.

Genus **OTOPTERUS** Flower and Lydekker.

1891. *Otopterus* FLOWER and LYDEKKER, Introduction to the study of mammals, p. 673. Type. — *Macrotus waterhousii* GRAY.

According to H. Allen (Monogr. bats N. Amer., p. 33, March 14, 1894) this genus should stand as *Macrotus* GRAY (Proc. zool. soc. London, 1843, p. 21, type, *M. waterhousii* GRAY).

* **Otopterus bocourtianus** (Dobson).

1876. *Macrotus bocourtianus* DOBSON, Ann. and mag. nat. hist., 4th ser., XVIII, p. 436. November, 1876.

1885. *Macrotus bocourtianus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.

TYPE LOCALITY. — Vera Paz, Guatemala.

Otopterus bulleri (H. Allen).

1890. *Macrotus bulleri* H. ALLEN, Proc. Amer. philos. soc., XXVIII, p. 73. May 10, 1890.

1898. *Otopterus bulleri* MERRIAM, Proc. biol. soc. Washington, XII, p. 18. January 27, 1898.

TYPE LOCALITY. — Bolaños, State of Jalisco, Mexico.

Regarded by Merriam (Proc. biol. soc. Washington, XII, p. 18, January 27, 1898) as identical with *O. mexicanus*.

* **Otopterus californicus** (Baird).

1858. *Macrotus californicus* BAIRD, Proc. acad. nat. sci. Phila., p. 116.

1885. *Macrotus waterhousii* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885. (Part.)

1894. *Macrotus californicus* H. ALLEN, Monogr. bats N. Amer., p. 34. (1893) March 14, 1894.

TYPE LOCALITY. — Old Fort Yuma, San Diego County, California.

Otopterus mexicanus (Saussure).

1860. *Macrotus mexicanus* SAUSSURE, Revue et magasin de zoologie, 2d ser., XII, p. 486. November, 1860.

1898. *Otopterus mexicanus* MERRIAM, Proc. biol. soc. Washington, XII, p. 18. January 27, 1898.

Type locality. — Yautepec, near Cuautla, State of Morelos, Mexico.

Otopterus waterhousii (Gray).

1843. *Macrotus waterhousii* Gray, Proc. zool. soc. London, p. 21.

1891. *Otopterus waterhousei* Flower and Lydekker, Introduction to the study of mammals, p. 673.

1894. *M[acrotus] waterhousii* H. Allen, Monogr. bats N. Amer., p. 40. (1893) March 14, 1894.

Type locality. — Hayti.

Genus **VAMPYRUS** Leach.

1822. *Vampyrus* Leach, Trans. Linn. soc., xiii, p. 79. Type. — *Vespertilio spectrum* Linnaeus.

* **Vampyrus spectrum** (Linnaeus).

1758. [*Vespertilio*] *spectrum* Linnaeus, Syst. nat., x ed., i, p. 31.

1822. *Vampyrus spectrum* Leach, Trans. Linn. soc., xiii, p. 80.

1885. *Vampyrus spectrum* True, Proc. U. S. nat. mus., vii (1884), p. 604. 1885.

Type locality. — South America.

Genus **CHROTOPTERUS** Peters.

1865. *Chrotopterus* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 505. Type — *Vampyrus auritus* Peters.

Recognized as a genus distinct from *Vampyrus* by J. A. Allen, Bull. Amer. mus. nat. hist., xiii, p. 91, May 12, 1900.

* **Chrotopterus auritus** (Peters).

1856. *Vampyrus auritus* Peters, Abhandl. k. preuss. Akad. Wissensch. Berlin, p. 415.

1865. *Chrotopterus auritus* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 505.

1885. *Vampyrus auritus* True, Proc. U. S. nat. mus., vii (1884), p. 604. 1885.

1900. *Chrotopterus auritus* Allen, Bull. Amer. mus. nat. hist., xiii, p. 91. May 12, 1900.

Type locality. — Mexico.

Genus **MICRONYCTERIS** Gray.

1866. *Micronycteris* Gray, Proc. zool. soc. London, p. 113. Type. — *Phyllophora megalotis* Gray.

For use of this name in place of *Schizostoma* Gervais (Expéd. du Comte de Castelnau, zool., mamm., p. 49, 1855) see Flower and Lydekker, Introduction to the study of mammals, p. 673, 1891.

* **Micronycteris behnii** (Peters).

1865. *Schizostoma behnii* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 505.

1885. *Schizostoma behnii* True, Proc. U. S. nat. mus., vii (1884), p. 604. 1885.

1898. *M[icronycteris] behnii* Miller, Proc. acad. nat. sci. Phila., p. 330. July 12, 1898.

Type locality. — Cuyaba, Matto Grosso, Brazil.

* **Micronycteris hirsutus** Peters.

1869. *Schizostoma hirsutum* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 396.

1885. *Schizostoma hirsutus* True, Proc. U. S. nat. mus., vii (1884), p. 604. 1885.

1898. *M[icronycteris] hirsuta* Miller, Proc. acad. nat. sci. Phila., p. 330. July 12, 1898.

Type locality.—Unknown. The second specimen was taken at Pozo Azul, Costa Rica (see Thomas, Ann. and mag. nat. hist., 7th ser., ii, p. 318, October, 1898).

* **Micronycteris megalotis** (Gray).

1842. *Phyllophora megalotis* Gray, Ann. and mag. nat. hist., x, p. 257. December, 1842.

1885. *Schizostoma megalotis* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885. (Part.)

1898. *M*[*icronycteris*] *megalotis* MILLER, Proc. acad. nat. sci. Phila., p. 330. July 12, 1898.

TYPE LOCALITY. — Brazil.

Micronycteris megalotis mexicanus Miller.

1898. *Micronycteris megalotis mexicanus* MILLER, Proc. acad. nat. sci. Phila., p. 329. July 12, 1898.

TYPE LOCALITY. — Plantinar, State of Jalisco, Mexico.

Micronycteris microtis Miller.

1898. *Micronycteris microtis* MILLER, Proc. acad. nat. sci. Phila., p. 328. July 12, 1898.

TYPE LOCALITY.— Greytown, Nicaragua.

Genus **GLYPHONYCTERIS** Thomas.

1896. *Glyphonycteris* THOMAS, Ann. and mag. nat. hist., 6th ser., XVIII, p. 302. October, 1896. Type. — *Glyphonycteris sylvestris* THOMAS.

Glyphonycteris sylvestris Thomas.

1896. *Glyphonycteris sylvestris* THOMAS, Ann. and mag. nat. hist., 6th ser., XVIII, p. 303. October, 1896.

TYPE LOCALITY. — Imravalles, Costa Rica.

Genus **TRACHYOPS** Gray.

1847. *Trachyops* GRAY, Proc. zool. soc. London, p. 14. Type.— *Trachyops fuliginosus* GRAY = *Vampyrus cirrhosus* SPIX.

* **Trachyops cirrhosus** (Spix).

1823. *Vampyrus cirrhosus* SPIX, Simiar. et vespert. Brasil., p. 64.

1878. *Trachyops cirrhosus* Dobson, Catal. chiropt. Brit. mus., p. 481.

1885. *Trachyops cirrhosus* True, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.

Type locality. — Brazil.

Genus **PHYLLOSTOMUS** Lacépède.

1799. *Phyllostomus* Lacépède, Tableau des divisions, sous-divisions, ordres et genres des mammifères, p. 16 (Published as supplement to Discours d'ouverture et de clôture du cours d'histoire naturelle, et tableaux méthodiques des mammifères et des oiseaux). Type. — *Vespertilio hastatus* Pallas.

* **Phyllostomus hastatus** (Pallas).

1767. *V[espertilio] hastatus* Pallas, Spicilegia zoologica, fasc. III, p. 7.

1799. *Phyllostomus hastatus* Lacépède, Tableaux des divisions, sous-divisions, ordres et genres des mammifères, p. 16 (Published as supplement to Discours d'ouverture et de clôture du cours d' histoire naturelle, et tableaux méthodiques des mammifères et des oiseaux).

1885. *Phyllostoma hastatum* True, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.

Type locality. — Unknown.

Genus **MIMON** Gray.

1847. *Mimon* Gray, Proc. zool. soc. London, p. 14. Type. — *Phyllostoma bennettii* Gray.

* **Mimon bennettii** (Gray).

1838. *Phyllostoma bennettii* Gray, Mag. zool. and bot., II, p. 488. December, 1838.

1847. *M[imon] bennettii* Gray, Proc. zool. soc. London, p. 14.
1885. *Mimon bennettii* True, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.
Type locality. — South America.

Genus **HEMIDERMA** Gervais.

1855. *Hemiderma* Gervais, Expéd. du Comte de Castelnau, zool., mamm., p. 43. Type. — *Phyllostoma brevicaudum* Wied.

For use of this name in place of *Carollia* Gray (Mag. zool. and bot., II, p. 488, December, 1838, see Flower and Lydekker, Introduction to the study of mammals, p. 674, 1891.

* **Hemiderma brevicaudum** (Wied).
1821. *Phyllost[oma] bernicaudum* Wied, Schinz's Thierreich, I, p. 164. (Obvious misprint for *brevicaudum.*)
1855. *Hemiderma brevicaudum* Gervais, Expéd. du Comte de Castelnau, zool., mamm., p. 43.
1885. *Carollia brevicauda* True, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.
1891. *Hemiderma brevicauda* Flower and Lydekker, Introduction to the study of mammals, p. 674.
Type locality. — Unknown.

Hemiderma castaneum (H. Allen).
1890. *Carollia castanea* H. Allen, Proc. Amer. philos. soc., XVIII, p. 19. February 25, 1890.
Type locality. — Costa Rica.

Subfamily GLOSSOPHAGINAE.[1]

Genus **GLOSSOPHAGA** E. Geoffroy.

1818. *Glossophaga* E. GEOFFROY, Mém. mus. d'hist. nat., Paris, IV, p. 418. Type.— *Vespertilio soricinus* PALLAS.

Glossophaga mutica Merriam.

1898. *Glossophaga mutica* MERRIAM, Proc. biol. soc. Washington, XII, p. 18. January 27, 1898.

TYPE LOCALITY.— Maria Madre Island, Tres Marias Islands, State of Jalisco, Mexico.

* **Glossophaga soricina** (Pallas).

1766. *Vespertilio soricinus* PALLAS, Miscell. zool., p. 48.

1818. *Glossophaga soricina* E. GEOFFROY, Mém. mus. d'hist. nat., Paris, IV, p. 418.

1885. *Glossophaga soricina* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.

TYPE LOCALITY.— Unknown.

Genus **CHOERONYCTERIS** Tschudi.

1844. *Choeronycteris* TSCHUDI, Fauna peruana, p. 70. Type.— *Choeronycteris mexicana* TSCHUDI.

* **Choeronycteris mexicana** Tschudi.

1844. *Choeronycteris mexicana* TSCHUDI, Fauna peruana, p. 72.

1885. *Choeronycteris mexicana* TRUE, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.

TYPE LOCALITY.— Mexico.

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[1] For review of this family see H. Allen, Trans. Amer. philos. soc., n. s., XIX, pp. 237–266. June, 1898.

* **Choeronycteris minor** Peters.

1868. *Choeronycteris minor* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 366.

1885. *Choeronycteris minor* True, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.

Type locality. — Surinam.

Genus **MONOPHYLLUS** Leach.[1]

1822. *Monophyllus* Leach, Trans. Linn. soc., XIII, p. 75. Type. — *Monophyllus redmani* Leach.

* **Monophyllus redmani** Leach.

1822. *Monophyllus redmani* Leach, Trans. Linn. soc., XIII, p. 76.

1885. *Monophyllus redmani* True, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.

Type locality. — Jamaica.

Monophyllus portoricensis Miller.

1900. *Monophyllus portoricensis* Miller, Proc. Washington acad. sci., II, p. 34. March 30, 1900.

Type locality. — Cave near Bayamon, Porto Rico.

Monophyllus plethodon Miller.

1900. *Monophyllus plethodon* Miller, Proc. Washington acad. sci., II, p. 35. March 30, 1900.

Type locality. — St. Michaels Parish, Barbadoes.

Monophyllus clinedaphus Miller.

1900. *Monophyllus clinedaphus* Miller, Proc. Washington acad. sci., II, p. 36. March 30, 1900.

Type locality. — Unknown.

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[1] Revised by Miller, Proc. Washington acad. sci., II, pp. 31-38. March 30, 1900.

Genus **LEPTONYCTERIS** Flower and Lydekker.

1891. *Leptonycteris* Flower and Lydekker, Introduction to the study of mammals, p. 674. Type.—*Ischnoglossa nivalis* Saussure.

* **Leptonycteris nivalis** (Saussure).

1860. *I[schnoglossa] nivalis* Saussure, Revue et magasin de zoologie, 2d ser., xii, p. 492. November, 1860.

1885. *Ischnoglossa nivalis* True, Proc. U. S. nat. mus., vii (1884), p. 605. 1885.

1900. *Leptonycteris nivalis* Miller, Proc. biol. soc. Washington, xiii, p. 126. April 6, 1900.

Type locality.—Near the snow line on Mount Orizaba, Mexico.

Genus **ANOURA** Gray.

1838. *Anoura* Gray, Mag. zool. and bot., ii, p. 490. December, 1838. Type.—*Anoura geoffroyi* Gray.

* **Anoura geoffroyi** Gray.

1838. *Anoura geoffroyi* Gray, Mag. zool. and bot., ii, p. 490. December, 1838.

1885. *Glossonycteris lasiopyga* True, Proc. U. S. nat. mus., vii (1884), p. 605. 1885.

1893. *Anura geoffroyi* Thomas, Proc. zool. soc. London, p. 335.

Type locality.—Brazil.

Genus **LICHONYCTERIS** Thomas.

1895. *Lichonycteris* Thomas, Ann. and mag. nat. hist., 6th ser., xvi, p. 55. July, 1895. Type.—*Lichonycteris obscurus* Thomas.

Lichonycteris obscurus Thomas.
1895. *Lichonycteris obscurus* THOMAS, Ann. and mag. nat. hist., 6th ser., XVI, p. 56. July, 1895.
TYPE LOCALITY. — Managua, Nicaragua.

Genus **PHYLLONYCTERIS** Gundlach.

1861. *Phyllonycteris* GUNDLACH, Monatsber. k. preuss. Akad. Wissensch. Berlin (1860), p. 817. Type.—*Phyllonycteris poeyi* GUNDLACH.

Phyllonycteris bombifrons Miller.
1899. *Phyllonycteris bombifrons* MILLER, Proc. biol. soc. Washington, XIII, p. 36. May 29, 1899.
TYPE LOCALITY. — Cave near Bayamon, Porto Rico.

Phyllonycteris planifrons Miller.
1899. *Phyllonycteris planifrons* MILLER, Proc. biol. soc. Washington, XIII, p. 34. May 29, 1899.
TYPE LOCALITY. — Nassau, New Providence, Bahamas.

* **Phyllonycteris poeyi** Gundlach.
1861. *Ph[yllonycteris] poeyi* GUNDLACH, Monatsber. k. preuss Akad. Wissensch. Berlin (1860), p. 817.
1885. *Phyllonycteris poeyi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 604. 1885.
TYPE LOCALITY. — Cuba.

* **Phyllonycteris sezekorni** Gundlach.
1861. *Phyllonycteris sezekorni* GUNDLACH, Monatsber. k. preuss. Akad. Wissensch. Berlin (1860), p. 818.
1885. *Phyllonycteris sezekorni* TRUE, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.
TYPE LOCALITY. — Cuba.

Genus **REITHRONYCTERIS** Miller.

1898. *Reithronycteris* Miller, Proc. acad. nat. sci. Phila., p. 333. July 12, 1898. Type.—*Reithronycteris aphylla* Miller.

Reithronycteris aphylla Miller.

1898. *Reithronycteris aphylla* Miller, Proc. acad. nat. sci. Phila., p. 334. July 12, 1898.

Type locality. — Jamaica.

Genus **BRACHYPHYLLA** Gray.

1833. *Brachyphylla* Gray, Proc. zool. soc. London, p. 122. Type.—*Brachyphylla cavernarum* Gray.

* **Brachyphylla cavernarum** Gray.

1833. *Brachyphylla cavernarum* Gray, Proc. zool. soc. London, p. 123.

1885. *Brachyphyllum cavernarum* True, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.

Type locality. — Island of St. Vincent, West Indies.

Subfamily Stenodermatinae.

Genus **ARTIBEUS** Leach.

1822. *Artibeus* Leach, Trans. Linn. soc., XIII, p. 75. Type. — *Artibeus jamaicensis* Leach = *Vespertilio perspicillatus* Linnaeus.

Artibeus coryi J. A. Allen.

1890. *Artibeus coryi* J. A. Allen, Bull. Amer. mus. nat. hist., III, p. 173. November 14, 1890.

Type locality. — St. Andrews Island, Caribbean Sea.

* **Artibeus intermedius** J. A. Allen.

1885. *Artibeus perspicillatus* True, Proc. U. S. nat. mus., VII (1884), p. 605. 1885. (Part.)

1897. *Artibeus intermedius* J. A. Allen, Bull. Amer. mus. nat. hist., IX, p. 33. March 11, 1897.

Type locality. — San José, Costa Rica.

Artibeus perspicillatus (Linnaeus).

1758. [*Vespertilio*] *perspicillatus* Linnaeus, Syst. nat., x ed., I, p. 31.

1838. *Arctibeus perspicillatus* Gray, Mag. zool. and bot., II, p. 487. December, 1838.

Type locality. — Jamaica (see Allen and Chapman, Bull. Amer. mus. nat. hist., IX, p. 3, February 23, 1897).

Genus **URODERMA** Peters.

1865. *Uroderma* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 588. Type. — *Phyllostoma personatum* Peters (nec Wagner) = *Uroderma bilobatum* Peters.

Recognized as a genus distinct from *Artibeus* by J. A. Allen, Bull. Amer. mus. nat. hist., XIII, p. 89, May 12, 1900.

Uroderma planirostre (Spix).

1823. *Phyllostoma planirostre* Spix, Simiar. et vespert. Brasil., p. 66.

Type locality. — Suburbs of Bahia, Brazil.

This species, though not mentioned by True, was recorded by Dobson (Catal. chiropt. Brit. mus., p. 517, 1878) from the island of Grenada, West Indies, and from Acapulco, State Guerrero, Mexico.

Genus **DERMANURA** Gervais.

1855. *Dermanura* Gervais, Expéd. du Comte de Castelnau, zool., mamm., p. 36. Type. — *Dermanura cinereum* Gervais.

Recognized as a genus distinct from *Artibeus* by Cope, Amer. nat., XXIII, p. 130, February, 1889.

* **Dermanura cinereum** Gervais.

1855. *Dermanura cinereum* GERVAIS, Expéd. du Comte de Castelnau, zool., mamm., p. 36.

1885. *Artibeus cinereus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.

TYPE LOCALITY. — Brazil.

Dermanura eva Cope.

1889. *Dermanura eva* COPE, Amer. nat., XXIII, p. 130. February, 1889.

TYPE LOCALITY. — Island of St. Martins, West Indies.

Genus **VAMPYROPS** Peters.

1865. *Vampyrops* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 356. Included *Phyllostoma lineatum* E. GEOFFROY and *Artibeus vittatus* PETERS.

* **Vampyrops lineatus** (E. Geoffroy).

1810. *Phyllostoma lineatum* E. GEOFFROY, Ann. mus. d'hist. nat., Paris, p. 180.

1866. *V[ampyrops] lineatus* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 392.

1885. *Vampyrops lineatus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.

TYPE LOCALITY. — Paraguay.

* **Vampyrops vittatus** (Peters).

1859. *Artibeus vittatus* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 225.

1865. *V[ampyrops] vittatus* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 356.

1885. *Vampyrops vittatus* True, Proc. U. S. nat. mus., vii (1884), p. 605. 1885.

Type locality. — Puerto Cabello, Venezuela.

Genus **STENODERMA** E. Geoffroy.

1818. *Stenoderma* E. Geoffroy, Description de l'Égypte, mammifères, ii, p. 114. Type.— *Stenoderma rufum* E. Geoffroy.

Subgenus Stenoderma E. Geoffroy.

Stenoderma montserratense Thomas.

1894. *Stenoderma montserratense* Thomas, Proc. zool. soc. London, p. 133.

Type locality. — Island of Montserrat, West Indies.

Stenoderma nichollsi Thomas.

1891. *Stenoderma nichollsi* Thomas, Ann. and mag. nat. hist., 6th ser., vii, p. 529. June, 1891.

Type locality. — Island of Dominica, West Indies.

Subgenus Peltorhinus Peters.

1876. *Peltorhinus* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 433. Type. —*Artibeus achradophilus* Gosse.

* **Stenoderma achradophilum** (Gosse).

1851. *Artibeus achradophilus* Gosse, A naturalist's sojourn in Jamaica, p. 271.

1878. *Stenoderma achradophilum* Dobson, Catal. chiropt. Brit. mus., p. 527.

1885. *Stenoderma achradophilum* TRUE, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.

TYPE LOCALITY. — Content, Jamaica.

Subgenus PHYLLOPS Peters.

1865. *Phyllops* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 356. Type.—*Phyllostoma albomaculatum* GUNDLACH = *Arctibeus falcatus* GRAY.

* **Stenoderma falcatum** (Gray).

1839. *Arctibeus falcatus* GRAY, Ann. nat. hist., IV, p. 1. September, 1839.

1878. *Stenoderma falcatum* DOBSON, Catal. chiropt. Brit. mus., p. 529.

1885. *Stenoderma falcatum* TRUE, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.

TYPE LOCALITY. — Cuba.

Genus **ECTOPHYLLA** H. Allen.

1892. *Ectophylla* H. ALLEN, Proc. U. S. nat. mus., XV, p. 441. Type. — *Ectophylla alba* H. ALLEN.

Ectophylla alba H. Allen.

1892. *Ectophylla alba* H. ALLEN, Proc. U. S. nat. mus., XV, p. 442. October 26, 1892.

TYPE LOCALITY. — Believed to be the vicinity of the Segovia River, Eastern Honduras.

Genus **CHIRODERMA** Peters.

1860. *Chiroderma* PETERS, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 747. Type. — *Chiroderma villosum* PETERS.

* **Chiroderma salvini** Dobson.

1878. *Chiroderma salvini* Dobson, Catal. chiropt. Brit. mus., p. 532.

1885. *Chiroderma salvini* True, Proc. U. S. nat. mus., vii (1884), p. 605. 1885.

Type locality. — Costa Rica.

Genus **PYGODERMA** Peters.

1865. *Pygoderma* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 357. Type.—*Phyllostoma bilabiatum* Wagner.

* **Pygoderma bilabiatum** (Wagner).

1843. *Phyllostoma bilabiatum* Wagner, Wiegmann's Arch. f. Naturg., ix, bd. i, p. 366.

1878. *Pygoderma bilabiatum* Dobson, Catal. chiropt. Brit. mus., p. 536.

1885. *Pygoderma bilabiatum* True, Proc. U. S. nat. mus., vii (1884), p. 605. 1885.

Type locality. — Ipanema, Sao Paulo, Brazil.

Genus **STURNIRA** Gray.

1842. *Sturnira* Gray, Ann. and mag. nat. hist., x, p. 257. December, 1842. Type.—*Sturnira spectrum* Gray = *Phyllostoma lilium* E. Geoffroy.

* **Sturnira lilium** (E. Geoffroy).

1810. *Phyllostoma lilium* E. Geoffroy, Ann. mus. d'hist. nat., Paris, xv, p. 181.

1855. *Sturnira lilium* Gervais, Expéd. du Comte de Castelnau, zool., mamm., p. 39.

1885. *Sturnira lilium* True, Proc. U. S. nat. mus., vii (1884), p. 605. 1885.

Type locality. — Paraguay.

Genus **CENTURIO** Gray.

1842. *Centurio* Gray, Ann. and mag. nat. hist., x, p. 259. December, 1842. Type. — *Centurio senex* Gray.

* **Centurio mcmurtrii** H. Allen.

1861. *C[enturio] mcmurtrii* H. Allen, Proc. acad. nat. sci. Phila., p. 360.

1885. *Centurio mcmurtrii* True, Proc. U. S. nat. mus., vii (1884), p. 605. 1885.

Type locality. — Mirador, State of Vera Cruz, Mexico.

Centurio minor Ward.

1891. *Centurio minor* Ward, Amer. nat., xxv, p. 750. August, 1891.

Type locality. — Cerro de los Pajaros, Las Vigas, State of Vera Cruz, Mexico.

* **Centurio senex** Gray.

1842. *Centurio senex* Gray, Ann. and mag. nat. hist., x, p. 259. December, 1842.

1885. *Centurio senex* True, Proc. U. S. nat. mus., vii (1884), p. 605. 1885.

Type locality. — Unknown.

Subfamily DESMODONTINAE.

Genus **DESMODUS** Wied.

1826. *Desmodus* WIED, Beiträge zur Naturgesch. Brasilien, II, p. 231. Type.—*Desmodus rufus* WIED = *Phyllostoma rotundum* E. GEOFFROY.

* **Desmodus rotundus** (E. Geoffroy).
1810. *Phyllostoma rotundum* E. GEOFFROY, Ann. mus. d'hist. nat., Paris, XV, p. 181.
1885. *Desmodus rufus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.
1900. *Desmodus rotundus* THOMAS, Ann. mus. civ. stor. nat. Genova, 2d ser., XX, p. 547.
TYPE LOCALITY. — Paraguay.

Genus **DIPHYLLA** Spix.

1823. *Diphylla* SPIX, Simiar. et vespert. Brasil., p. 68. Type. — *Diphylla ecaudata* SPIX.

The name *Haematonycteris* was proposed by H. Allen (Proc. U. S. nat. mus., XVIII, p. 777, October 27, 1896) for the *Diphylla* of Dobson (Catal. chiropt. Brit. mus., p. 550, 1878), should it prove to be distinct from that of Spix.

* **Diphylla ecaudata** Spix.
1823. *Diphylla ecaudata* SPIX, Simiar. et vespert. Brasil., p. 68.
1885. *Diphylla ecaudata* TRUE, Proc. U. S. nat. mus., VII (1884), p. 605. 1885.
TYPE LOCALITY. — Brazil.

Order PRIMATES.

Suborder ANTHROPOIDEA.

Family HAPALIDAE.

Genus **MIDAS** E. Geoffroy.

1812. *Midas* E. GEOFFROY, Ann. mus. d'hist. nat., Paris, XIX, p. 120. Type.— *Simia midas* LINNAEUS.

* **Midas geoffroyi** (Pucheran).

1845. *Hapale geoffroyi* PUCHERAN, Rev. zool., VIII, p. 336. September, 1845.
1871. *Midas geoffroii* SCLATER, Proc. zool. soc. London, p. 478.
1885. *Midas geoffroyi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.
TYPE LOCALITY. — Unknown.

Family CEBIDAE.

Subfamily ALOUATTINAE.

Genus **ALOUATTA** Lacépède.

1799. *Alouatta* LACÉPÈDE, Tableau des divisions, sous-divisions, ordres et genres des mammifères, p. 4 (Published as supplement to Discours d'ouverture et de clôture du cours d'histoire naturelle, et tableaux méthodiques des mammifères et des oiseaux). Type.— *Simia belzebul* LINNAEUS.

* **Alouatta villosa** (Gray).

1845. *Mycetes villosus* GRAY, Ann. and mag. nat. hist., XVI, p. 220. October, 1845.

1885. *Mycetes villosus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.

1894. *Alouatta villosa* FORBES, A hand-book of the primates, I, p. 199.

TYPE LOCALITY. — Brazil.

* **Alouatta palliata** (Gray).

1848. *Mycetes palliatus* GRAY, Proc. zool. soc. London, p. 138.

1863. *Aluatta palliata* SLACK, Proc. acad. nat. sci. Phila., (1862), p. 519.

1885. *Mycetes palliatus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.

1897. [*Alouata*] *palliata* TROUESSART, Catal. mamm., pt. I, p. 34.

TYPE LOCALITY. — Caracas, Venezuela.

Subfamily NYCTIPITHECINAE.

This name is untenable since *Nyctipithecus* has been replaced by *Aotus*.

Genus **SAIMIRI** Voigt.

1831. *Saimiri* VOIGT, Cuvier's Thierreich, I, p. 95. Type. — *Simia sciurea* LINNAEUS.

For use of this name in place of *Chrysothrix* (Kaup, Thierreich, I, p. 50) see Palmer, Proc. biol. soc. Washington, XI, p. 174, June 9, 1897.

* **Saimiri oerstedii** (Reinhardt).

1872. *Chrysothrix oerstedii* REINHARDT, Vidensk. Middelelser, p. 157.

1885. *Chrysothrix oerstedi* True, Proc. U. S. nat. mus., vii (1884), p. 611. 1885.

Type locality. — Cartago, Costa Rica.

Genus **AOTUS** Humboldt.

1811. *Aotus* Humboldt, Recueil d'obs. de zool. et d'anat. comp., i, p. 358. Type. — *Simia trivirgata* Humboldt.

For use of this name in place of *Nyctipithecus* (Spix, Simiar. et vespert. Brasil., p. 24, 1823) see Palmer, Science, n. s., x, p. 493, October 6, 1899.

* **Aotus rufipes** (Sclater).

1872. *Nyctipithecus rufipes* Sclater, Proc. zool. soc. London, p. 3.

1885. *Nyctipithecus rufipes* True, Proc. U. S. nat. mus., vii (1884), p. 611. 1885.

Type locality.— San Juan del Norte, Nicaragua.

* **Aotus vociferans** (Spix).

1823. *Nyctipithecus vociferans* Spix, Simiar. et vespert. Brasil., p. 25.

1885. *Nyctipithecus vociferans* True, Proc. U. S. nat. mus., vii (1884), p. 611. 1885.

Type locality. — Tabatinga, Upper Amazon, Brazil.

Subfamily Cebinae.

Genus **ATELES** E. Geoffroy.

1806. *Ateles* E. Geoffroy, Ann. mus. d'hist. nat., Paris, vii, p. 262. Type. — *Simia paniscus* Linnaeus.

* **Ateles ater** F. Cuvier.

1823. *A[teles] ater* F. CUVIER, Hist. nat. mammifères, III, livr. XXXIX. March, 1823.

1885. *Ateles ater* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.

TYPE LOCALITY. — Cayenne, French Guiana.

* **Ateles geoffroyi** Kuhl.

1820. *Ateles geoffroy* (sic) KUHL, Beiträge z. Zoologie, p. 26.

1885. *Ateles geoffroyi* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.

TYPE LOCALITY. — Unknown.

* **Ateles rufiventris** Sclater.

1872. *Ateles rufiventris* SCLATER, Proc. zool. soc. London, p. 688.

1885. *Ateles rufiventris* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.

TYPE LOCALITY. — Rio Atrato, northern Colombia.

* **Ateles vellerosus** Gray.

1865. *Ateles vellerosus* GRAY, Proc. zool. soc. London, p. 733.

1885. *Ateles vellerosus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.

TYPE LOCALITY. — Supposed to be somewhere in Brazil, but this is clearly an error (see Alston, Biol. Centr.-Amer., mammals, p. 10, 1879).

Genus **CEBUS** Erxleben.

1777. *Cebus* ERXLEBEN, Syst. regni anim., I, p. 44. Included *Simia capucina* LINNAEUS and *Simia fatuellus* LINNAEUS.

* **Cebus hypoleucus** (Humboldt).

1811. *Simia hypoleuca* HUMBOLDT, Recueil d'obs. de zool. et d'anat. comp., I, p. 337.

1861. *Cebus hypoleucus* SCLATER, Nat. hist. rev., p. 509.

1885. *Cebus hypoleucus* TRUE, Proc. U. S. nat. mus., VII (1884), p. 611. 1885.

TYPE LOCALITY.— Rio Sinu, Bolivar, Colombia.

APPENDIX.

The following names have been applied to members of recently revised genera since the publication of True's list, but are now regarded as untenable.

Cariacus clavatus True.[1]

1888. *Cariacus clavatus* TRUE, Proc. U. S. nat. mus., XI, p. 417.

Preoccupied by *Cervus clavatus* HAMILTON SMITH (Griffith's Cuvier, Animal kingdom, v, p. 315, 1827) and replaced by *Odocoileus truei* MERRIAM (p. 17).

Sciurus wagneri Allen.

1898. *Sciurus wagneri* ALLEN, Bull. Amer. mus. nat. hist., X, p. 453. November 10, 1898.

A name proposed as a substitute for the preoccupied *S. albipes* WAGNER and *S. varius* WAGNER, but regarded by Nelson (Proc. Washington acad. sci., I, p. 46, May 9, 1899) as a synonym of *S. poliopus* (p. 26).

Sciurus poliopus quercinus Nelson.

1898. *Sciurus poliopus quercinus* NELSON, Proc. biol. soc. Washington, XII, p. 150. June 30, 1898.

Preoccupied by *Sciurus quercinus* ERXLEBEN (Syst. regni anim., I, p. 432, 1777) and replaced by *S. poliopus hernandezi* NELSON (p. 26).

Sciurus fossor anthonyi Mearns.

1897. *Sciurus fossor anthonyi* MEARNS, Preliminary diagnoses of new mammals of the genera Sciurus, Castor, Neotoma, and Sigmodon, from the Mexican border of the United States, p. 1. March 5, 1897. (Reprint: Proc. U. S. nat. mus., XX, p. 501. January 19, 1898.)

TYPE LOCALITY. — Campbell's Ranch, Laguna, San Diego County, California.

Regarded by Nelson (Proc. Washington acad. sci., I, p. 83, May 9, 1898) as identical with *S. griseus* (p. 30).

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[1] This name was inadvertently omitted on page 17, where it properly belongs.

Sciurus aberti concolor True.

1894. *Sciurus aberti concolor* True, Diagnoses of new North American mammals, p. 1. April 26, 1894. (Reprint: Proc. U. S. nat. mus., xvii, p. 241. November 15, 1894.)

Preoccupied by *Sciurus concolor* Blyth (Journ. Asiat. soc. Bengal, xxiv, p. 474, 1855) and replaced by *S. aberti ferreus* True (p. 31).

Sciurus hudsonicus orarius Bangs.

1897. *Sciurus hudsonicus orarius* Bangs, Proc. biol. soc. Washington, xi, p. 281. December 30, 1897.

Type locality. — Philo, Mendocino County, California.

Regarded by Allen (Bull. Amer. mus. nat. hist., x, p. 276, July 22, 1898) as identical with *S. douglasii mollipilosus* (p. 34).

Sciurus niger melanonotus Thomas.

1890. *Sciurus niger melanonotus* Thomas, Proc. zool. soc. London, p. 73.

Type locality. — Las Vigas, State of Vera Cruz, Mexico.

Regarded by Nelson (Proc. Washington acad. sci., i, p. 88, May 9, 1899) as identical with *S. oculatus* (p. 35).

Sciurus alstoni Allen.

1889. *Sciurus alstoni* Allen, Bull. Amer. mus. nat. hist., ii, p. 167. October 21, 1889.

Preoccupied by *Sciurus alstoni* Anderson (Zool. results Yunnan Exp., i, p. 252, 1878) and replaced by *S. nayaritensis* Allen (p. 35).

Reithrodontomys aztecus Allen.

1893. *Reithrodontomys aztecus* Allen, Bull. Amer. mus. nat. hist., v, p. 79. April 28, 1893.

Type locality. — La Plata, San Juan County, New Mexico.

Regarded by Allen (Bull. Amer. mus. nat. hist., vii, p. 125, May 21, 1895) as identical with *R. megalotis* (p. 98).

Phenacomys truei Allen.

1894. *Phenacomys truei* Allen, Bull. Amer. mus. nat. hist., vi, p. 331. November 7, 1894.

Type locality. — Black Hills, now Laramie Mountains, Wyoming.

Regarded by Miller (Proc. biol. soc. Washington, XI, p. 80, April 21, 1897) as identical with *P. orophilus* (p. 111).

Phenacomys oramontis Rhoads.

1895. *Phenacomys oramontis* Rhoads, Amer. nat., XXIX, p. 941. October, 1895.

Type locality. — Mount Baker Range, British Columbia, Canada. Altitude, 6000 feet.

Regarded by Miller (Proc. biol. soc. Washington, XI, p. 80, April 21, 1897) as identical with *P. orophilus* (p. 111).

Phenacomys ungava Merriam.

1889. *Phenacomys ungava* Merriam, North Amer. fauna, no. 2, p. 35. October 30, 1889.

Type locality. — Godbout, Quebec, Canada.

Regarded by Miller (Proc. biol. soc. Washington, XI, p. 80, April 21, 1897) as identical with *P. celatus* (p. 112).

Evotomys fuscodorsalis Allen.

1894. *Evotomys fuscodorsalis* Allen, Bull. Amer. mus. nat. hist., VI, p. 103. April 14, 1894.

Type locality. — Trousers Lake, New Brunswick, Canada.

Regarded by Bailey (Proc. biol. soc. Washington, XI, p. 122, May 13, 1897) as a color phase of *E. gapperi* (p. 113).

Evotomys pygmaeus Rhoads.

1894. *Evotomys pygmaeus* Rhoads, Proc. acad. nat. sci. Phila., p. 284. October 23, 1894.

Type locality. — Mouth of the Nisqually River, Pierce County, Washington.

Regarded by Bailey (Proc. biol. soc. Washington, XI, p. 122, May 13, 1897), as identical with *E. occidentalis* (p. 115).

Subgenus Tetramerodon Rhoads.

1894. *Tetramerodon* Rhoads, Proc. acad. nat. sci. Phila., p. 282. October 23, 1894. Type. — *Arvicola tetramerus* Rhoads.

Regarded by Miller (North Amer. fauna, no. 12, pp. 18–19, 62, July 23, 1896) as identical with the subgenus *Microtus* (p. 116).

Arvicola insperatus Allen.

1894. *Arvicola insperatus* Allen, Bull. Amer. mus. nat. hist., vi, p. 347. December 7, 1894.

Type locality. — Custer, Black Hills, Custer County, South Dakota.

Regarded by Bailey (North Amer. fauna, no. 17, p. 20, June 6, 1900) as identical with *Microtus pennsylvanicus modestus* (p. 117).

Arvicola microcephalus Rhoads.

1894. *Arvicola* (*Mynomes*) *microcephalus* Rhoads, Proc. acad. nat. sci. Phila., p. 286. October 23, 1894.

Type locality. — Lac la Hache, British Columbia, Canada.

Regarded by Bailey (North Amer. fauna, no. 17, p. 22, June 6, 1900) as identical with *Microtus drummondii* (p. 117).

Microtus stonei Allen.

1899. *Microtus stonei* Allen, Bull. Amer. mus. nat. hist., xii, p. 5, March 4, 1899.

Type locality. — Liard River, British Columbia, Canada.

Regarded by Bailey (North Amer. fauna, no. 17, p. 22, June 6, 1900) as identical with *M. drummondii* (p. 117).

Microtus insularis Bailey.

1898. *Microtus insularis* Bailey, Proc. biol. soc. Washington, xii, p. 86. April 30, 1898.

Preoccupied by *Lemmus insularis* Nilsson (Öfver. k. vet. akad. förh., Stockholm, i, p. 33, 1844) and replaced by *Microtus nesophilus* Bailey (p. 118).

Microtus vellerosus Allen.

1899. *Microtus vellerosus* Allen, Bull. Amer. mus. nat. hist., xii, p. 7. March 4, 1899.

Type locality. — Liard River, British Columbia, Canada.

Regarded by Bailey (North Amer. fauna, no. 17, p. 48, June 6, 1900) as identical with *M. mordax* (p. 122).

Microtus cautus Allen.

1899. *Microtus cautus* Allen, Bull. Amer. mus. nat. hist., xii, p. 7. March 4, 1899.

Type locality. — Hells Gate, Liard River, British Columbia, Canada.

Regarded by Bailey (North Amer. fauna, no. 17, p. 48, June 6, 1900) as identical with *M. mordax* (p. 122).

Genus **AULACOMYS** Rhoads.

1894. *Aulacomys* Rhoads, Amer. nat., xxviii, p. 182. February, 1894. Type. — *Aulacomys arvicoloides* Rhoads.

Regarded by Miller (North Amer. fauna, no. 12, pp. 18, 66, July 23, 1896) as identical with the subgenus *Arvicola* (p. 124).

Microtus principalis Rhoads.

1895. *Microtus principalis* Rhoads, Amer. nat., xxix, p. 940. October, 1895.

Type locality. — Mount Baker Range, British Columbia, Canada. Altitude, 6000 feet.

Regarded by Bailey (North Amer. fauna, no. 17, p. 62, June 6, 1900) as identical with *Microtus richardsoni arvicoloides* (p. 125).

Microtus pumilus Elliot.

1899. *Microtus* (*Lagurus*) *pumilus* Elliot, Field Columbian mus., publication 30, zool. ser., i, p. 226. February 1, 1899.

Type locality. — Happy Lake, Olympic Mountains, Clallam County, Washington. Altitude, about 5000 feet.

Regarded by Bailey (North Amer. fauna, no. 17, p. 68, June 6, 1900) as an immature *Phenacomys*.

Microtus morosus Elliot.

1899. *Microtus morosus* Elliot, Field Columbian mus., publication 30, zool. ser., i, p. 227. February 1, 1899.

Type locality. — Boulder Lake, Olympic Mountains, Clallam County, Washington. Altitude, about 5000 feet.

Regarded by Bailey (North Amer. fauna, no. 17, p. 70, June 6, 1900) as identical with *M. oregoni* (p. 127).

Synaptomys stonei Rhoads.

1893. *Synaptomys stonei* Rhoads, Amer. nat., xxvii, p. 53. January, 1893.

Type locality. — Mays Landing, Atlantic County, New Jersey.

Regarded by Merriam (Proc. biol. soc. Washington, x, p. 58, March 19, 1896) as identical with *S. cooperi* (p. 132).

Geomys nelsoni Merriam.

1892. *Geomys nelsoni* Merriam, Proc. biol. soc. Washington, vii, p. 164. September 29, 1892.

TYPE LOCALITY. — North slope of Sierra Nevada of Colima, State of Jalisco, Mexico. Altitude, 6500 feet.

Regarded by Merriam (North Amer. fauna, no. 8, p. 147, January 31, 1895) as identical with *Pappogeomys bulleri* (p. 138).

Perognathus copei Rhoads.

1893. *Perognathus copei* RHOADS, Proc. acad. nat. sci. Phila., p. 404. January 30, 1894.

TYPE LOCALITY. — Near Mobeetie, Wheeler County, Texas.

Regarded by Osgood (North Amer. fauna, no. 18, p. 20, September 20, 1900) as identical with *P. flavescens* (p. 156).

Perognathus mearnsi Allen.

1896. *Perognathus mearnsi* ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 237. November 21, 1896.

TYPE LOCALITY. — Watson's Ranch, 15 miles southwest of San Antonio, Bexar County, Texas.

Regarded by Osgood (North Amer. fauna, no. 18, p. 21, September 20, 1900) as identical with *P. merriami* (p. 156).

Perognathus inornatus Merriam.

1889. *Perognathus inornatus* MERRIAM, North Amer. fauna, no. 1, p. 15. October 25, 1889.

TYPE LOCALITY. — Fresno, Fresno County, California.

Regarded by Osgood (North Amer. fauna, no. 18, p. 33, September 20, 1900) as identical with *P. longimembris* (p. 158).

Perognathus olivaceus amoenus Merriam.

1889. *Perognathus olivaceus amoenus* MERRIAM, North Amer. fauna, no. 1, p. 16. October 25, 1889.

TYPE LOCALITY. — Nephi, Juab County, Utah.

Regarded by Osgood (North Amer. fauna, no. 18, p. 37, September 20, 1900) as identical with *P. parvus olivaceus* (p. 159).

Perognathus paradoxus spilotus Merriam.

1889. *Perognathus paradoxus spilotus* MERRIAM, North Amer. fauna, no. 1, p. 25. October 25, 1889.

TYPE LOCALITY. — Gainesville, Cook County, Texas.

Regarded by Osgood (North Amer. fauna, no. 18, p. 42, September 20, 1900) as identical with *P. hispidus* (p. 160).

Perognathus latirostris Rhoads.

1894. *Perognathus latirostris* Rhoads, Amer. nat., xxviii, p. 185. February, 1894.

Type locality. — "Rocky Mountains."

Regarded by Osgood (North Amer. fauna, no. 18, p. 44, September 20, 1900) as identical with *P. hispidus paradoxus* (p. 160).

Perognathus conditi Allen.

1894. *Perognathus conditi* Allen, Bull. Amer. mus. nat. hist., vi, p. 318. November 7, 1894.

Type locality. — San Bernardino Ranch, Cochise County, Arizona.

Regarded by Osgood (North Amer. fauna, no. 18, p. 44, September 20, 1900) as identical with *P. hispidus paradoxus* (p. 160).

Perognathus obscurus Merriam.

1889. *Perognathus obscurus* Merriam, North Amer. fauna, no. 1, p. 20. October 25, 1889.

Type locality. — Camp Apache, Grant County, New Mexico.

Regarded by Osgood (North Amer. fauna, no. 18, p. 52, September 20, 1900) as identical with *P. intermedius* (p. 162).

Perognathus armatus Merriam.

1889. *Perognathus armatus* Merriam, North Amer. fauna, no. 1, p. 27. October 25, 1889.

Type locality. — Mount Diablo, central California.

Regarded by Osgood (North Amer. fauna, no. 18, p. 58, September 20, 1900) as identical with *P. californicus* (p. 163).

Zapus hudsonius hardyi Batchelder.

1899. *Zapus hudsonius hardyi* Batchelder, Proc. New England zool. club, i, p. 5.

Type locality. — Mount Desert Island, Hancock County, Maine.

Regarded by Preble (North Amer. fauna, no. 15, pp. 10, 15, August 8, 1899) as identical with *Z. hudsonius* (p. 166).

Zapus imperator Elliot.

1899. *Zapus imperator* Elliot, Field Columbian mus., publication 30, zool. ser., i, p. 228. February 1, 1899.

Type locality.—Sieg's Ranch, Elwah River, Clallam County, Washington.

Regarded by Preble (North Amer. fauna, no. 15, p. 26, August 8, 1899) as identical with *Z. trinotatus* (p. 167).

Sorex idahoensis Merriam.

1891. *Sorex idahoensis* MERRIAM, North Amer. fauna, no. 5, p. 32. July 30, 1891.

TYPE LOCALITY. — Timber Creek, Salmon River Mountains, Idaho.

Regarded by Merriam (North Amer. fauna, no. 8, p. 60, December 31, 1895) as identical with *S. personatus* (p. 235).

Sorex vagrans similis Merriam.

1891. *Sorex vagrans similis* MERRIAM, North Amer. fauna, no. 5, p. 34. July 30, 1891.

Preoccupied by *Sorex similis* HENSEL (Zeitschr. der deutsch. geolog. Gesellsch., VII, p. 459, 1855) and replaced by *S. obscurus* MERRIAM (p. 238).

Sorex saussurei caudatus Merriam.

1895. *Sorex saussurei caudatus* MERRIAM, North Amer. fauna, no. 10, p. 84. December 31, 1895.

Preoccupied by *Sorex caudatus* HORSFIELD (Cat. mamm. mus. East-India Company, p. 135, 1851, ex Hodgson, Ann. and mag. nat. hist., 2d ser., III, p. 203, March, 1849, *nomen nudum*) and replaced by *S. saussurei mutabilis* MERRIAM (p. 241).

Scapanus dilatus True.

1894. *Scapanus dilatus* TRUE, Diagnoses of new North American mammals, p. 2. April 26, 1894. (Reprint: Proc. U. S. nat. mus., XVII, p. 242. November 15, 1894.)

TYPE LOCALITY. — Fort Klamath, Klamath County, Oregon.

Regarded by True (Proc. U. S. nat. mus., XIX, p. 52, December 12, 1896) as identical with *S. californicus* (p. 251).

Vespertilio incautus J. A. Allen.

1896. *Vespertilio incautus* J. A. ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 239. November 21, 1896.

TYPE LOCALITY. — San Antonio, Bexar County, Texas.

Regarded by Miller (North Amer. fauna, no. 13, p. 56, October 16, 1897) as identical with *Myotis velifer* (p. 255).

Vespertilio lucifugus austroriparius Rhoads.

1897. *Vespertilio lucifugus austroriparius* RHOADS, Proc. acad. nat. sci. Phila., p. 227. May 22, 1897.

TYPE LOCALITY. — Tarpon Springs, Hillsboro County, Florida.

Regarded by Miller (North Amer. fauna, no. 13, p. 60, October 16, 1897) as identical with *Myotis lucifugus* (p. 255).

Vespertilio melanorhinus Merriam.

1890. *Vespertilio melanorhinus* MERRIAM, North Amer. fauna, no. 3, p. 46. September 11, 1890.

TYPE LOCALITY. — Little Spring, north base of San Francisco Mountain, Coconino County, Arizona.

Regarded by Miller (North Amer. fauna, no. 13, p. 69, October 16, 1897) as identical with *Myotis californicus* (p. 256).

Vespertilio nitidus henshawii H. Allen.

1894. *V[espertilio] nitidus henshawii* H. ALLEN, Monogr. bats North Amer., p. 103. (1893) March 14, 1894.

TYPE LOCALITY. — Near Wingate, Bernalillo County, New Mexico.

Regarded by Miller (North Amer. fauna, no. 13, p. 69, October 16, 1897) as identical with *Myotis californicus* (p. 256).

Vespertilio gryphus septentrionalis Trouessart.

1897. [*Vespertilio gryphus*] *septentrionalis* TROUESSART, Catal. mamm., pt. I, p. 131.

TYPE LOCALITY. —Eastern United States; name based on the "northern form of *Vespertilio gryphus*" of H. Allen, Monogr. bats North Amer., p. 80, (1893) March 14, 1894.

Regarded by Miller (North Amer. fauna, no. 13, p. 75, October 16, 1897) as identical with *Myotis subulatus* (p. 257).

Vespertilio chrysonotus J. A. Allen.

1896. *Vespertilio chrysonotus* J. A. ALLEN, Bull. Amer. mus. nat. hist., VIII, p. 240. November 21, 1896.

TYPE LOCALITY. — Kinney Ranch, Sweetwater County, Wyoming.

Regarded by Miller (North Amer. fauna, no. 13, p. 77, October 16, 1897) as identical with *Myotis evotis* (p. 258).

Vesperugo merriami Dobson.

1886. *Vesperugo merriami* Dobson, Ann. and mag. nat. hist., 5th ser., xviii, p. 124. August, 1886.

Type locality.— Supposed to have been Locust Grove, Lewis County, New York, but in fact Red Bluff, Tehama County, California.

Regarded by True, (Proc. U. S. nat. mus., x, p. 515, August 6, 1888) and Miller (North Amer. fauna, no. 13, p. 31, October 16, 1897) as identical with *Pipistrellus hesperus* (p. 259).

ERRATA.

Page 6, line 7 from bottom, for "Cat. mus. p. 42" read Catal. des mamm. du mus. national d'hist. nat., p. 142.

" 14, between lines 6 and 7 from bottom, insert:

1895. *Dorcelaphus virginianus macrourus* Allen, Bull. Amer. mus. nat. hist., vii, p. 263. August 21, 1895.

" 16, line 11 from bottom, for "1828" read 1829.

" 16, between lines 5 and 6 from bottom, insert:

1894. *Cariacus virginianus mexicanus* Rhoads, Amer. nat., xxviii, p. 525. June, 1894.

" 18, line 11 from bottom, for "*rooseveldti*" read *roosevelti*.

" 18, line 16 from bottom, for "(Smith)" read (Hamilton Smith).

" 20, between lines 7 and 8 from top, insert:

1896. *Rangifer groenlandicus* Allen, Bull. Amer. mus. nat. hist., viii, p. 234. November 21, 1896.

" 25, line 10 from top, for "mammiféres" read mammifères.

" 36, line 10 from top, for "Yavapi" read Yavapai.

" 52, line 19 from top, for "*Spermophilus*" read *S*[*permophilus*].

" 52, line 21 from top, for "*S*[*permophilus*]" read *Spermophilus*.

Page 56, after last line, insert:

1833. *Spermophilus macrourus* Bennett, Proc. zool. soc. London, I, p. 41.

1889. *Spermophilus grammurus macrourus* Allen, Bull. Amer. mus. nat. hist., II, p. 170. October 21, 1889.

" 72, line 4 from top, omit comma after word Mountains.

" 93, line 22 from bottom, for "*Oryxomys*" read *Oryzomys*.

" 94, between lines 8 and 9 from top, insert:

1891. *Oryzomys palustris* Allen, Bull. Amer. mus. nat. hist., III, p. 215. April 17, 1891.

" 94, line 2 from bottom, for "177" read 178.

" 96, line 13 from top, for "Popocatapetl" read Popocatepetl.

" 100, line 3 from top, for "Card." read Carol.

" 104, lines 10 and 15 from bottom, for "30" read 27.

" 117, line 6 from bottom, for "*Nynomes*" read *Mynomes*.

" 166, lines 8 and 9 from top, for "Bull. U. S. geol. surv. terr., 2d ser., I," read Bull. U. S. geol. and geogr. surv. terr., I.

" 173, line 3 from top, for "I" read III.

" 221, line 18 from top, for "Skizziete" read Skizzirte.

" 227, lines 7 and 8 from bottom, for "Prodr. meth. mamm." read Prodr. syst. mamm. et avium.

" 243, between lines 4 and 5 from top, insert:

1890. *Sorex palustris* Dobson, Monogr. insectivora, pt. III, fasc. I, pl. XXIII, fig. 18.

" 272, line 5 from bottom, for "1840" read 1839.

" 283, line 9 from top, insert parenthesis after 1838.

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Page references of minor importance in italics.

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THE MEDFORD DIKE AREA.

By Alfred W. G. Wilson.

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No. 2. — THE MEDFORD DIKE AREA.

BY ALFRED W. G. WILSON.

That portion of the rim of the Boston Basin which may be designated the Medford Dike Area, comprises a narrow belt extending north-eastward along the line of the Medford diabase dike from Medford city, on the Mystic river, for a distance of about two miles. The present paper presents the results of a detailed field study of a portion of the complex series of igneous rocks which form the northern rim of the Basin. The primary object of the work was to prepare a detailed map of the northern end of the large dike of diabase which occurs in Medford and in Somerville, Mass. The work necessarily required the examination of a narrow belt upon either side of the great dike. Evidence for the interpretation of the relations of some of the rocks is either incomplete or wanting within the area. The facts for a final interpretation will probably be determined when the detailed studies now being carried on in the Middlesex Fells, under the direction of Dr. T. A. Jaggar, Jr., are completed. The latter part of this paper presents some studies of the topographic features of the area.

Areal, Petrographic, and Dynamic Geology.

Rhyolite breccia. — The most southern member of the series of rocks, outcropping in this area on both sides of Pasture hill, is a rhyolitic breccia. On freshly fractured surfaces the colors of this breccia vary from dull gray to pale grayish pink or greenish. In thin section, the breccia shows traces of flow structure in the ground mass between the fragments. At one locality, west of Hillside avenue, a large irregular mass of soft, dark, almost black, shale-like rock occurs, included within the rhyolite. Under the microscope the nature of this inclusion is indeterminate, except that it carries a large amount of hematite.

Sedimentary rocks. — North of the breccia, on the west side of the Medford diabase dike at the foot of Pasture hill, is a bed of conglomerate apparently dipping 30° N. and striking approximately east and west. The deposit is, in this locality, about fifty feet in thickness, and contains well rounded pebbles of quartzite and of rhyolite. The source of these pebbles is uncertain. It seems very probable that the quartzite pebbles were derived from the quartzites now exposed in the northern part of the Middlesex Fells. The quartzites of the immediate vicinity are younger than the conglomerate. The original rhyolite from which the rhyolite pebbles were derived was porphyritic, with phenocrysts of probably both orthoclase and plagioclase feldspar. The subsequent alteration, chiefly to kaolin, has been so great that the type of the phenocrysts can only be determined from the outlines of the crystals. The nature of the much decayed cement of the conglomerate is very obscure.

East of the dike and in a position which would seem to bring it stratigraphically under the conglomerate, were the latter exposed east of the diabase dike, is a large outcrop of grayish pink arkose. Microscopically, this rock consists of very finely fragmental quartz grains with, apparently, an admixture of felsitic material. Epidote, zoisite, hematite, and magnetite are present in small amount. The base of the arkose is indeterminable. Some two hundred and fifty feet north of this outcrop is a small exposure of dull white quartzite whose relationship to the arkose is uncertain. Its position suggests that it is separated from the arkose by a bed of conglomerate similar to that exposed further west, an inference which is strengthened by the known relative positions of similar series in West Medford.

So far as the present available evidence goes, the breccia may tentatively be considered as of volcanic origin, and probably later than the sediments. The breccia seems to have been preceded, in the order indicated, by the formation of the arkose, the conglomerate, and the quartzite of the area. The source of the material is at present uncertain. The exposures of sediments in the area are too small to permit of the determination of their structural relations. The absence of pebbles of granite in the conglomerate, and the fact that the whole stratified series seems to dip towards the igneous rocks, would appear to indicate that the stratified rocks are older than the granite to the north. So far as has been determined, there is no definite evidence offered in this area as to the relative ages of the two. Diller ('81, p. 173) states, however, that in an adjacent area the granite is found overlying the upturned edges of the stratified series.

Granites.— A number of igneous intrusions, older than the breccia already noted, succeeded the formation of the sedimentary series, coming in, probably, after these had been folded. The earliest of these intrusions, in the area under consideration, is that of a hornblende granite.

As shown on the map, granites occur in two portions of the area, immediately north of the stratified series north of Hall road, and also at the north end. For the most part, these granites are moderately coarse-grained in texture, white to pink in color, mottled with green, due to the presence of much epidote as a secondary mineral from the alteration of plagioclase and of hornblende. The quartz is light in color, translucent, and relatively abundant. The orthoclase feldspar, in the hand specimens, varies from pink to white, the salmon colored or pink variety being especially abundant in the granite from the more southern of the two areas. The plagioclase feldspar for the most part has a low maximum extinction angle (about 15°) on the twinning lamellae, so that in composition it lies between the oligoclase and albite types. Much of it is altered to muscovite. and the contorted twin lamellae in many cases give evidence of strain. The prevailing color of the plagioclase is white, though frequently it is stained greenish by secondary epidote. The hornblende, when present, is of a light green color, but for the most part it has undergone alteration.

In the specimens examined, necessarily taken from near the surface, the feldspars, especially orthoclase, and the hornblende were almost invariably altered. The chief secondary products from the alteration of both feldspars are kaolin and muscovite (the former in rather larger proportion), chlorite from the hornblende, and epidote from the plagioclase feldspar. The usual accessory minerals, titanite, magnetite, hematite, and zircon are present in small amounts. The epidote, in an amount great enough to give the granite a pale greenish tint, often occurs in distinct streaks or veins several inches in width, and has a mottled greenish-white appearance. Locally pink feldspar and white quartz are arranged in bands. More frequently we find dark, almost black, fine-grained portions of the mass carrying a large amount of biotite, some magnetite, and a correspondingly marked reduction in the amount of feldspar. In one instance a drusy cavity within this darker segregation contained glassy crystals of quartz and crystals of pale blue fluorite. In another locality west of Owen's walk in the Fells, an inclusion of aplitic granite, containing quartz, orthoclase, plagioclase, and a small amount of microcline, occurs in a dike of the oldest series, described below as probably lamprophyric phases of the granite magma. The source of this inclusion has not been located.

Through the granite at the north end of the area was intruded a series of dike-like masses of basic rock whose general trend is north and south. What may have been the original constitution of these masses is now obscure; at present they must be classed with the schistose rocks. The most southern of these (see map) are hornblende schists, consisting of much quartz and hornblende with a more or less distinct banded structure, the hornblende prisms being arranged in rows parallel to the bounding walls of the dike. Small amounts of biotite, plagioclase, and magnetite are present, together with secondary chlorite and epidote. The largest member of the series, represented on the map at the north end, and west of Forest street, shows, even in small hand specimens, alternate plicated bands of white quartz and dark biotite, the latter in larger amounts. The thin section shows that the rock consists almost wholly of quartz in small angular anhedra, and small plates of biotite. Both the hornblende and the biotite schists carry fragments of the granite. These latter, beyond the usual secondary minerals and the warped twinning lamellae of the plagioclase, show no essential changes. It is inferred that these schistose bands are altered lamprophyric phases of the granite, intruded from beneath after the partial solidification of the more acid rock. The irregular boundary walls, and the fact that the joint planes cut both granite and schists, would appear to indicate that the jointing of the granite was subsequent to the intrusion of these basic masses.

Felsites. — The middle portion of the area is occupied by a series of rocks which, taken collectively, may be called felsite (acid porphyries). They are, for the most part, pink in color, and show a cryptocrystalline structure on a freshly fractured surface. Microscopically, the rocks of the larger portion of this part of the area show the intergrowth of quartz and feldspar characteristic of microgranitic structure. In some cases, the rock appears to consist almost wholly of this quartz-feldspar ground mass, but occasionally irregular grains of quartz appear and phenocrysts of feldspar, both orthoclase and albite (quartz granophyr). On the one hand, this granophyr grades into granite porphyries in which the ground mass becomes relatively diminished in amount, and the phenocrysts larger and more numerous. These granite porphyries are somewhat darker in color than the granophyr, owing to the presence of epidote and chlorite. The alteration of the plagioclase feldspar has resulted in the production of a considerable amount of calcite, as shown both in thin section and by effervescence with dilute acid. The largest mass of granite porphyry occurs to the west of the large diabase dike, just south of the northern granite area. In the field, this rock so much resembles the granite, that, were it not for the fact that the schistose dikes which occur in the granite are cut off by it, one would be inclined to think it contemporaneous and identical with the latter.

Towards the middle of the area, especially at the south crest of Pine hill, forming part of the top of the hill, and extending northeastward approximately parallel with the line of contact of the felsites and the granite, the magma cooled more rapidly, producing a true rhyolite with a characteristic sub-conchoidal fracture, wavy or sub-vitreous lustre, and prevailing greenish-gray color, weathering nearly white. This rhyolite is in places quite porphyritic. A few quartz phenocrysts occur and larger numbers of orthoclase and plagioclase crystals, usually idiomorphic, less often fragmentary, the plagioclase being particularly abundant. Both the feldspars have undergone secondary changes. At the southwestern foot of Pine hill, inclusions of white quartzite were found included in the granophyr. At the northeast end of Pine hill along the line of contact with the granite, is a belt of breccia in which fragments of granite, rhyolite, and some undetermined rocks occur.

Diabase dikes. — These acid eruptives were followed by a period of strain and fracture, as shown by their jointed condition. The diabase dikes are later intrusions not so much jointed. The evidence of strain appears in the distorted twinning lamellae of the plagioclase of the granite, and in the wavy extinction of the quartz phenocrysts in the granophyr. This may also have been the time of conversion of the lamprophyric dikes into the present schists. Succeeding this period of stress or contemporaneous with it, a large number of diabase dikes were intruded. Of these dikes there is positive evidence of at least five periods, and possibly of a sixth period, of intrusion. These intrusions may have succeeded one another very rapidly, though the contacts of intersection are well marked. Three series, and a possible fourth, were intruded before the Medford diabase dike, and one small dike was intruded subsequent to it. In mapping the dikes older than the Medford diabase, no attempt has been made to indicate, by means of a color scheme, their relative ages. Where this has been positively determined in a few localities it has been indicated by showing the intersections of the dikes concerned. In other localities than those where the relationship is indicated by truncation, it will be necessary to correlate the dikes on lithological grounds. Sometimes this distinction may be made macroscopically, but in most cases it is necessary to refer the specimen to the microscope.

The two older members of this series are phanerocrystalline in texture, while the two younger may be described as aphanitic. All but the youngest carry visible amounts of pyrrhotite, the youngest of the three having the least. The oldest dikes contain a pink augite, of unusually low index of refraction, in small aggregations, and a brown hornblende; in some cases there is a parallel growth of the two silicates filling the interspaces between idiomorphic plagioclase crystals. There is also an abundance of chlorite, secondary from augite and hornblende, and a considerable quantity of ilmenite with titanite as an alteration product. The next youngest member of the series is tinted a greenish-gray color by the presence, in considerable amount, of a pale green augite (almost colorless in thin section), probably diopside; hornblende seems to be entirely absent, while chlorite, epidote, and a considerable amount of calcite are present as secondary products. The third member of the series is fine-grained and black, and exhibits, in thin section, an intersertal structure, whereas that of the two older is ophitic. The augite is violet in color; magnetite occurs in considerable quantity, also calcite, chlorite, and actinolite, the last-named in the form of secondary needles mingled with the chlorite.

In several localities there are dikes which cut some one or more of the three preceding members of this series. They are dense, fine-grained, black in color, apparently free from sulphides, and exhibit a hyalopilitic structure with rods and small masses of augite in a glassy matrix. These are olivine-free basaltic dikes. Magnetite is present in considerable amounts. Some of the dikes carry a considerable quantity of brown biotite, together with the augite, plagioclase, magnetite, and secondary and accessory minerals.

The next intrusion of the region was that of the Medford dike (described by Hobbs and others), a hornblende-biotite-augite diabase, very coarse and much disintegrated. The lenticular quartz inclusions have already been described by Dr. Jaggar ('98, p. 207). There occurs on the west flank of Pine hill a large inclusion of a coarse granular quartzite, readily friable, and almost pure white, the individual grains of quartz being about one sixteenth of an inch in diameter. There is also a large fragment (approximately two hundred and sixteen cubic feet) of sandstone exposed in a small excavation just south of the Big Quarry. This still retains obscure traces of bedding planes, and, in addition to the large amount of clastic quartz, carries a few rounded grains of pale green augite and a very small amount of secondary pyrite. At Pasture hill, Medford, in about the middle of the dike, some large inclusions have recently been disclosed by quarrying. They are very much jointed so that it is difficult to obtain a freshly fractured surface, but they are probably fragments of one of the earlier diabase dikes, one of which, about one hundred and fifty feet in width, is cut through at this place.

In the area studied, there is a single dike of fine-grained diabase cutting both the Medford diabase and the adjacent granite. The chief components are augite, plagioclase, magnetite, and secondary chlorite.

In the Middlesex Fells, along a line at right angles to the axis of the dike, the horizontal displacement accompanying the intrusion of the Medford diabase varies to a maximum of about two hundred and fifty feet. The older dikes on the east side are all offset towards the north, the maximum horizontal offset parallel to the axis of the Medford diabase dike being about one hundred and seventy-five feet. As the simple gaping of the crooked fracture occupied by the big dike would not offset the older dikes more than twenty-five feet, it is probable that there has been movement in more than one direction. Just what the amount and direction of throw is, cannot at present be stated. Possibly this displacement is one of the causes of the production of the joint planes in the older diabase dikes, although the Medford dike is itself jointed, in part by contraction while cooling and solidifying.

Summary. — (1) There are series of stratified rocks in this locality older than all the volcanics. In addition to evidence already cited, proof of older sedimentary rocks is afforded by the occurrence of quartzite and bedded sandstone inclusions in the Medford diabase, and smaller inclusions of quartzite in the rhyolites; these occur in localities fully three quarters of a mile from the nearest known sedimentaries. (2) The order of eruption of the volcanics was: — first, granite; second, a series of basic rocks, lamprophyric phases of the granite, now metamorphosed to hornblende-biotite schists; third, felsitic rock showing three phases, the greater part now appearing as granophyr, locally porphyritic and grading on the one hand into granite porphyry in which the micrograpitic ground mass disappears, and on the other into rhyolite and rhyolite porphyries. The line of contact between this granophyr and the granite of the southern area is not well marked, and it is possible that this latter granite is contemporaneous with the granophyr. It has not been possible to determine whether the rhyolite breccia of the south end of the area is contemporaneous with these latter volcanics. (3) Without question the metamorphism of the older basic masses in the granite, and possibly the production of joint systems in the granites and felsites, preceded the intrusion of the diabase dikes. (4) Since the intrusion of the dikes, some stresses have been exerted, as these dikes are also jointed and in places slickensided.

Glaciation and Topography.

During the interval from the time of the last intrusion until the eginning of Pleistocene glaciation, the rocks must have undergone many changes. At the time of the first ice transgression, the area was probably covered with a deep residual soil cover, the product of disintegration and decay. In a region where glaciation has left *in situ* only a small amount of residual material from rock decomposition, the extensive disintegration of the Medford diabase dike could not fail to attract the attention of even the earlier geologists. We find the first most detailed description of this phenomenon in an article, published in 1818, by J. F. and S. L. Dana (**'18**, p. 201). Later, Professor W. O. Crosby refers (**'90**, p. 236) to the decomposition of the rock and the probable time of disintegration; Dr. G. P. Merrill (**'96**, p. 349) adopts and enlarges Professor Crosby's views; Professor G. H. Barton also published a paper on the subject of "Bowlders formed *in situ*" in which he refers to the disintegration of the diabase (**'92**, p. 405).

The present topography of the dike and of the adjacent country is very instructive. At the Medford end, proceeding north, there is a gradual rise from the flood-plain of the Mystic river, just above tide level, to the summit of Pasture hill, one hundred and twenty-five feet higher, in a horizontal distance of about three hundred yards. As one crosses the summit, on his right he will find that the hill falls off almost abruptly towards Governor's avenue, the grade being little less than that normally assumed by the talus slope of coarse-grained debris at the foot of a cliff; on the left the fall is very slight towards several ridges of felsitic rock, trending towards the northwest. For a portion of the length of the hill, at the northern end, a depression occurs on the diabase between Pasture hill and these ridges. (Fig. 1, III.)

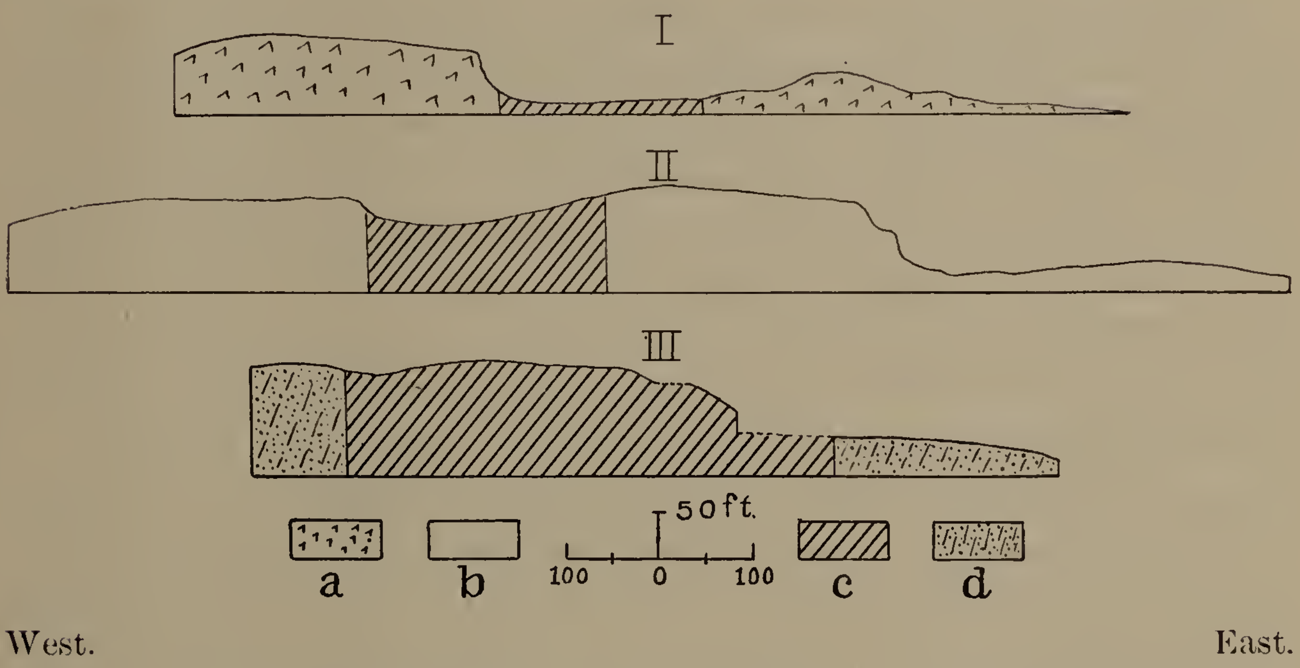

Fig. 1. Sections transverse to the diabase dike. I. From about one hundred yards north of where Owen's walk turns to join Forest street. II. From just north of the lower quarry on the west flank of Pine hill. III. From Pasture hill, Medford.

I and II, datum line one hundred feet above mean tide level; III, datum line at mean tide level.

a. granite, b. felsite, c. diabase, d. felsitic breccia.

The descent on the northern slope of the hill, about ten degrees, is, relative to the ascent on the south, quite gentle, until the Hall road, fifty feet above mean tide level, is reached. Here the land again rises very abruptly thirty-five feet, the grade along Cedar Cliff road, twenty-eight degrees, being steeper than that on the eastern side of Pasture hill. Ascending this slope, we find on the left a granite ridge, with here and there vertical faces towards the east and gentle slopes and soil-covered surfaces on the west, marking the western boundary of the dike; on the right, the land at first slopes very abruptly to about the level of Hall road, but further north the grade gradually becomes less steep.

Proceeding from here northeastward along the line of the dike, the surface is gently undulating with obscure ridges trending southeast, and almost completely soil-covered. To the east, granitic ridges stand out above the general level of the dike, and valleys between them are depressed below this level. At the boundary of the Middlesex Fells there is a depression on the east, a quick rise to the level of the diabase, and then a second abrupt rise marking the western boundary of the dike, and from here a gentle downward slope.

Passing up Owen's walk, which runs along the middle of the dike, with Pine hill on the right and a much lower ridge on the left, the dissimilarity of the slopes on right and left is very conspicuous. On the right the slope to the summit of Pine hill is gradual, while on the left there is a nearly perpendicular wall of varying height, and a steep talus slope at its base. Pine hill rises two hundred and fifty feet above sea level, with its summit one hundred and seventy feet above the valley on the east. The eastern face of the hill is, for the greater part of its length, a cliff varying in height up to about seventy feet, with an exceedingly steep talus slope made up of fairly large angular blocks at its base, grading into finer materials as the distance from the base of the cliff increases. The eastern or opposite side of the valley presents a much more evenly graded slope than is found on the western flank of Pine hill. This eastern valley is also much wider and deeper than the "dike" valley, and extends northeastward about two miles.

North of the elbow of Owen's walk, where it bends to join Forest street, the ridge on the left presents to the eastward an almost vertical face nearly sixty feet in height (Fig. 1, I). After crossing the width of the diabase there is a slight elevation and then a gradual descent into the valley which lies to the east of Pine hill.

The diabase dike at its extreme northern end, beyond Pine hill, becomes narrowed to a width of fifty feet, and is marked on both sides by vertical walls of granite here six or eight feet in height, ending in an area now occupied by a swamp which marks the granite-felsite contact.

Direction of the ice movement. — The topography has been described thus in detail, because there is a distinct relation between the topography and the glaciation. The topography of the valley to the west of Pine hill, which marks the location of the diabase dike, first drew the writer's attention to the glaciation. The asymmetry of this valley is very noticeable, the eastern slope being relatively gentle, while the western is marked by nearly vertical walls produced by the plucking action of the ice. (Fig. 1, I–II.) The general slopes are such as to indicate that the motion was not transverse to Pine hill ridge, nor yet parallel to it, but rather obliquely across it, trending toward the south. These first observations as to the direction of the ice movement in the valley were subsequently confirmed by the finding of glacial striae in two localities near the summit of Pine hill.

Mr. Warren Upham states ('92, p. 32) that the prevailing course of the glacial striae in Somerville is between S. 20° E. and S. 30° E. At the Powder House dike, a southward extension of the Medford diabase into the slates of the basin, the average direction of the striae is about S. 34° E., being nearly transverse to the ridge. In the city of Medford, at the summit of Pasture hill there is one large exposure with an area of over four hundred square feet of almost fresh rock, quite hard and well glaciated, the striae running S. 36° E. Further north, where the hill falls away, the striae vary slightly to S. 39° E., the direction evidently being controlled by the topography. At the Cedar Cliff road there are a number of well marked striae striking S. 37° E. From this point northward until the Fells boundary is reached, no well marked striations could be found, the diabase being for the most part soil-covered, or, where uncovered, the striae are too obscure to be noted. The same remark applies to the striae on the glaciated surfaces of the granitic and felsitic areas. A short distance north of the Fells boundary and before Pine hill is reached, striae trending S. 22° E. are found by the roadside. At Pine hill just at the brink of the Big Quarry the striae trend S. 21° E., the exposed surface upon which they appear dipping twenty-two degrees towards the northwest, so that the ice was evidently ascending. On the summit of the hill and a little further to the north, striae trending S. 26° E. occur on a small dike cutting the felsite. On the west shore of Wright's pond they trend S. 28° E., and five hundred yards further north some obscure grooves trend about S. 22° E.

The direction of the ice movement is also indicated by the occurrence of a number of boulders of the diabase upon the summit of Pine hill and in certain minor valleys or depressions between large outcrops of felsitic rock. According to Mr. T. H. Barnes, recently city engineer, similar boulders have been found in Medford, in several localities east of the dike, during excavation for sewers or water service.

Denudation and erosion by the ice sheet. — Perhaps the most interesting indication of the direction of movement of the ice sheet is that furnished by the topography. In two localities this is most strikingly marked; at Pine hill in the Middlesex Fells, and at Pasture hill in Medford. Pine hill is, with the exception of a small and low portion of its northern end, a felsitic ridge cut across transversely by a large number of diabase dikes. The felsites are often very much broken up by several groups of intersecting joint planes. To the west lies the Medford dike, beyond which is more of the felsitic rock and then granite; the next hill to the east is a mass of granite. The ice sheet in its passage over the granite, felsite, and diabase has undoubtedly largely produced the topography as we see it to-day, due allowance being made for post-glacial changes of relatively small amount, such as the formation of talus slopes. The paucity of parting planes in the granite as compared with their abundance in the felsite has enabled the former to resist the glacial drag, while the latter everywhere along the line of the eastern contact has been pulled away, forming the present nearly vertical cliffs.

The diabase dike within the felsitic rock was apparently even more easily torn out of its position by the ice. From the asymmetrical topography of the valley and the disintegration of the diabase one would be inclined to infer that the rock had been weakened by decay during preglacial or possibly interglacial time.

The diabase, in many places throughout its length, has undergone extensive disintegration, giving rise to loose sand and gravel of a deep brown color, in which lie rounded boulders of all sizes, produced by concentric weathering. These boulders show more or less concentric structure from without inward until a solid core of unaltered diabase is reached. The depth to which the decay has penetrated varies greatly; at Pasture hill in Medford it is in places as much as thirty feet, with almost complete disintegration of the diabase; at Pine hill the quarry openings indicate that the weathering has penetrated chiefly along joint cracks and to a depth much less than at Pasture hill. The difference in the amount of decay may be in part accounted for by the fact, that, where undisintegrated rock has been exposed at Pasture hill by the removal of the overlying cover, it shows evidence of much jointing and slickensiding, phenomena which are almost absent in the great dike at Pine hill; such joints render the rock more permeable to atmospheric agents.

Age of the disintegration of the diabase. — The question at once arises, is the disintegrated diabase, as found to-day, residual material of preglacial or interglacial weathering, or has this great amount of disintegration taken place since the last glacial epoch? To answer this question it will be necessary to consider in detail a number of facts as we find them to-day; but first the opinions, as expressed in published papers, of three former workers in this field will be quoted. In a paper on "The Kaolin in Blandford, Mass.", Professor W. O. Crosby states: — "That the lithologic decay in this region [Blandford] during post-glacial time has been almost *nil* is proved by the fact that the removal of the drift exposes everywhere, and on almost all kinds of rocks, a hard unaltered glaciated surface. I am well persuaded that even the decomposed dikes of diabase which are observed in many parts of New England, and which are a feature of particular interest in the geology of the Boston Basin, simply witness in general, to the substantial results accomplished by the quiet and unobtrusive atmospheric agents during the long pre-glacial epochs, and owe their preservation to the narrow fissures which they occupy in harder and more durable rocks. This general conclusion appears to be justified by the fact that the great majority of the dikes present hard glaciated outcrops; and there is only now and then one which was so deeply decomposed that the ice was unable wholly to remove the products of decay. It is undoubtedly true, however, that the more coarsely crystalline diabase forming the great dike in Medford, Somerville, etc., like some of the granites, is subject to rapid disintegration by frost action, and this process is now going on. We may thus readily explain the formation in post-glacial, and even in quite recent times, of the considerable bodies of coarse diabase sand known in this vicinity as Medford gravel and used for walks and carriage roads." ('90, p. 236.) Mr. Geo. P. Merrill in discussing this subject says: — "The dike occurs in a region of extensive glaciation. . . . . That the disintegration and decay into which the rock has fallen is subsequent to the glaciation, and is not an isolated case of protection from erosion, as might at first be thought, is shown by the presence of glacial striae still traceable over the surface of portions of the decomposed dike and the deposit of till overlying it. . . . . It is, of course, possible that the decomposition had set in prior to the period of glaciation. That the process had not gone on extensively, however, is evident from the fact that the material was still sufficiently firm to receive the glacial markings. We are apparently safe in assuming that this disintegration and decay, or *degeneration*, as I have called the combined process, and which extends to a depth of thirty feet, or perhaps fifty feet or more along joint planes, is mainly postglacial. That the degeneration has here gone on more extensively, than in other dikes of the vicinity is due, as the writer believes, to its coarse and somewhat granular structure, and also to the character of the alteration which had gone on prior to and contemporaneous with degeneration." ('96, p. 358, 359.) Professor G. H. Barton states: — "In a few cases striae are to be seen crossing surfaces of unchanged rock, and also of the decomposed rock in immediate contact, in such a manner as to indicate that the now completely decomposed rock was unchanged when the striae were formed. This would lead to the conclusion that the decomposition has taken place during post-glacial time. This view is strengthened by the fact that portions of the rock exposed as outcrops have remained unchanged, while immediately adjacent portions which have been covered by the soil are highly decomposed. This last feature indicates that organic action is a strong factor in the production of the rock decomposition." ('92, p. 405.)

Statement and consideration of criteria.—As already intimated, glacial striae are found in a number of localities, particularly at the southern end of the diabase dike. A careful examination of all the localities shows that for the most part these striae are on relatively fresh rock. Wherever the surface of the rock has been exposed to the atmosphere for a long period the striae have generally been obliterated, although the alteration zone, as judged by the eye, in many examples rarely penetrates more than one inch in depth, with no evidence of disintegration such as is found elsewhere over large areas. In one instance, a small lenticular inclusion of quartz stood about one quarter of an inch above the diabase surface, and assuming that the ice had planed the quartz off level with the rest (as it has done in two other noted cases of larger masses of quartz in an exposure with a well striated surface), this would give a partial indication of the amount which may be removed from the surface in the absence of a soil cover. In this connection it should be remarked that the glaciated surfaces of the felsitic rock and of the granite have also undergone alteration and loss to such an extent as to obliterate or obscure practically all striae if such were ever present. In those places where the striae were observed on the diabase there is evidence that there has been a covering of soil to preserve them. In the case of the large area at Pasture hill about three feet of soil have been removed from above it, and at one time a large elm was growing over the place. In the exceptional cases referred to, the glacial striae are now distinct on comparatively soft rock. This soft rock in every case, as far as observed, lies in the lee of hard and distinctly fresh rock relative to the direction of ice movement, both being striated in one case; in other cases the hard rock has been removed, presumably for building purposes. If during glacial times there had existed a mantle of disintegrated rock extending upward to an unknown distance, and beneath this cover masses of partially disintegrated rock surrounding cores of still fresh rock (Fig. 2), such as are now found, the ice sheet in passing over would remove much of the superficial cover. In cutting across the partially disintegrated rocks at the lower level (Fig. 3), it would necessarily reveal hard materials in close contact with relatively softer rock, but still hard enough to receive striations. It seems probable

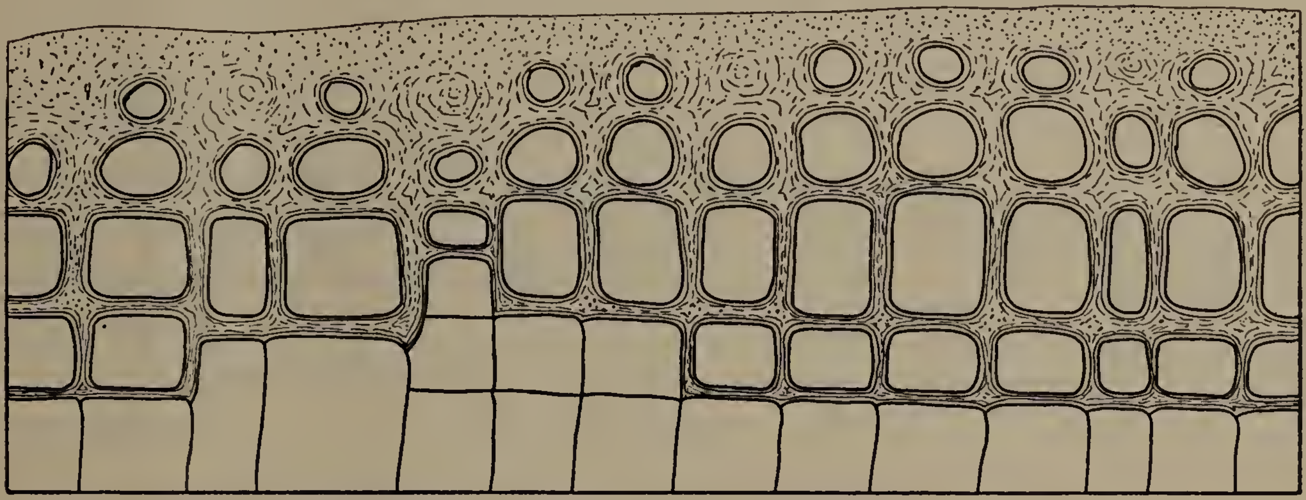

Fig. 2.

that the juxtaposition of the two, as seen to-day, must have been produced in some such way as this.

In a large number of areas examined on the north side of Pasture hill under conditions particularly favorable for such an examination, on account of the extensive quarrying and building now going on, nowhere has a glaciated area preserving the striae on distinctly disintegrated materials been found, although it is quite possible that they do exist. Many of the undecomposed and glaciated rocks show joint fractures, so that if we accept the post-glacial disintegration hypothesis we have to suppose that disintegration has taken place in one locality to a depth of "even fifty feet" and in another immediately adjacent locality not at all, there being no evidence that the rocks, which evidently are of uniform texture, are not of uniform composition.

When the ice passed over the dike and dragged portions of the partially disintegrated diabase with it in its onward course, it would naturally take up material of all kinds. Some of the boulders would be of quite fresh rock, others already well decayed. When these boulders were deposited by the subsequent melting of the ice they would be exposed to disintegrating agencies similar to those acting on the diabase outcrop. Reference has been made to boulders on the summit of Pine hill and in the sandy soils of the Mystic river valley to the eastward of the dike. Of the four largest on Pine hill none are disintegrated; two, however, which are quite angular, and close to the parent dike, show, at least externally, signs of decomposition and disintegration; the other two are well rounded and still quite hard, so much so, that it was with considerable difficulty that a specimen could be broken off. Of those buried in the soils of the basin, on the authority of Mr. Barnes and others who have seen them, it may be stated that except for a zone of two inches or less in depth, the rock is in appearance no more altered than is the fresh

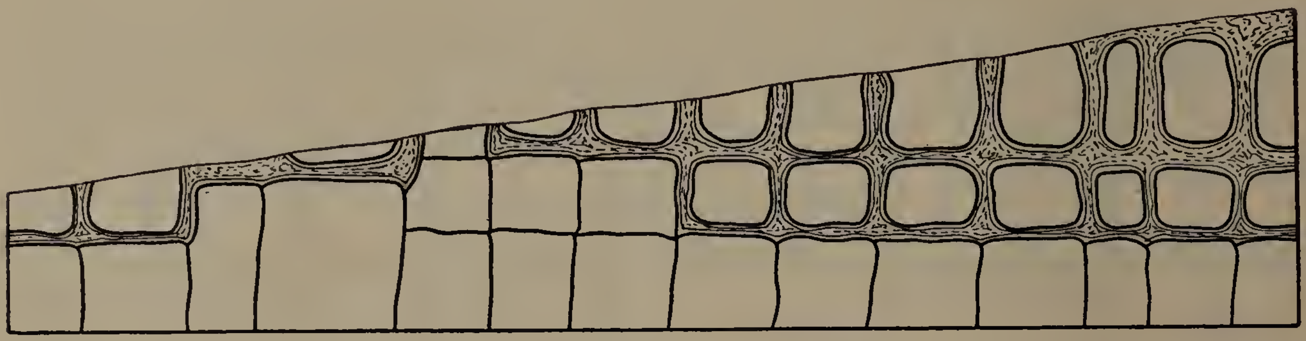

Fig. 3.

material of the interior of the decomposition spheres of the dike itself. Now, these boulders must have been plucked from the parent dike and in their transportation were more or less freed from all disintegrated material. When subsequently left upon the summit of Pine hill, or buried in the soil, they must all, in one place or the other, have been exposed to meteorological conditions similar to those of different localities along the parent dike. In fact, as regards those buried in the soil, the conditions seem even more favorable for disintegration than would be found on the summit of Pine hill below the frost line, where the soil waters would drain off very rapidly.

At the present time, the area of most extensive disintegration of the diabase dike is found on Pasture hill. This disintegration, however, is confined to the higher portions of the hill. The eastern contact of the diabase with the rhyolite breccia lies a little to the east of Governor's avenue. From the records (including a photograph) in the city engineer's office at Medford, it has been ascertained that the diabase at the eastern foot of Pasture hill, and hence underlying Governor's avenue, shows very little alteration and only a very small amount of decay along the joint planes, the joint blocks being yet distinctly rectangular in cross section. Now if the disintegration of the main mass of the hill has taken place within postglacial times, one would naturally expect to find similar decay in the locality described, which occurs at a lower elevation and is yet above the level of permanent ground water, and hence under more favorable conditions for action by humic acids and other substances in solution in the soil waters. Moreover, it seems strange that disintegration, which has affected the western four-fifths of the width of the dike so greatly, should affect the eastern side so little. The greater disintegration at Pasture hill than at Pine hill has already been explained as probably favored by the greater amount of jointing and slickensiding which is here quite evident.

In the outline of the topography of the dike, attention has been called to the prevalence of steeply graded slopes or nearly vertical cliffs facing towards the southeast, or in the direction of the ice movement as shown by the glacial striae, with gentler slopes to the northwest. In passing over the land that now forms Pasture hill, the ice sheet was forced upward by the harder felsitic ridges to the west. When the softer material of the hill itself was reached, the ice continued across it, removing the upper portions, grinding down the harder masses, which now appear here and there with glaciated surfaces, overriding the softer parts, as the glaciers of the present day in Norway and in the Alps and elsewhere locally override gravel and clay beds. To the eastward, either the area was at the time nearly as low as it is now or the softer rocks in the area permitted of its being lowered much more rapidly than at Pasture hill. The plucking action of the ice, acting on the disintegrated rock, has removed large masses both of diabase and other rocks. In some places, as at the Hall road valley, material has been removed from the full width of the dike; in other places, only from portions of the eastern side. In every case the field relations show that the amount of residual material now present, whether disintegrated or not, is dependent upon its position with reference to protection from ice action by harder material, with the single exception of the outcrop of the diabase at the Powder House in Somerville, which is much less disintegrated.

At Pine hill the plucking action of the ice has formed the deep valley to the west, removing portions of the dike, chiefly from the western side, so that now the eastern contact wall is found upon the side of the hill at least thirty feet higher than on the western side. The jointed condition of the felsitic rock has lent itself particularly to the plucking action of the ice, to such an extent that the entire eastern side of the contact with the granite, so far as traced, is marked by a valley with a very steep and in many places vertical western wall.

Powder House area. — At the Powder House in Somerville, where a southward extension of this dike outcrops above the soft and much jointed slate, glacial striae are present upon the outcrop. For a little over half the extent of the ridge the *stoss* side is little altered. Small amounts of disintegrated material are to be found lodged in the crevices. The disintegration along the joint planes is small. Along the remaining portion of the ridge to the south, the rock, so far as surface evidence goes, is quite disintegrated. This ridge, then, is regarded as a mass of the rock which was not decomposed at the time of the passage of the ice, and hence it was able to resist the ice action. Immediately to the north, where disintegration had gone deeper, the dike was swept away to the general level of the adjacent country, but here the harder rock has resisted the action, causing the ice to override the ridge and the somewhat softer portions partially in its lee. The ice must have overridden also the portion of the ridge to the south which is now disintegrated and which presents a much longer slope to the northwest. Here, if we suppose disintegration to be post-glacial, we should have again to postulate differential decomposition since the rock at both ends of this ridge, as far as observable, is quite decayed. It would perhaps be well to note in this connection that at the foot of the rock exposure, just southwest of the Powder House, there is evidence of glaciation, so that the outcrop as seen to-day stood out above the general level of the slates and bore the brunt of at least the last ice advance. The steep and unglaciated wall further to the north was probably produced by a plucking action of the ice which, splitting on the ridge, would have a slight lateral motion.

Summary and conclusions. — There are a number of areas of the diabase showing glacial striae on rocks which are jointed, and which are quite hard and practically fresh within an inch of the surface; the disintegrated rock occupies in every case protected areas, and in places where the disintegration is greatest, it lacks that uniformity of distribution which one would expect, had it taken place since the present topographic forms were developed; the boulders which have been carried away from the dike, and the dike itself in other localities, although found in positions favorable either to atmospheric action or to the action of ground waters, are alike undisintegrated. On the basis of these facts as studied in the field even in much more detail than can be given here, it seems probable that the disintegration of the diabase took place, for the most part, before the last ice advance. The amount of post-glacial disintegration is best indicated by the amount of disintegration seen on the still obscurely glaciated surfaces in the bottom of the dike valley at the western base of Pine hill, between the edges of the quarries and the eastern contact wall.

Relationship between topographic form and country rock. — It is interesting to note the close relationship existing between the character of the rocks and the topographic forms produced by glacial action. At the northern end of the dike the more or less disintegrated diabase is flanked by a much harder granite. Glacial scouring has swept the dike away for a considerable depth, and a nearly vertical cliff of granite is left standing to mark the western contact. Further south where the same dike rock lies in a much jointed felsitic rock, while both are affected, it is the jointed rock which has suffered the less, and the dike forms the bottom of a valley. Proceeding still farther south to Pasture hill in Medford, we find rocks of nearly equal resistance, a felsitic breccia and the diabase. Here the steep wall is formed by the diabase. In the softer slates of the basin to the south, at the Powder House area, the diabase is the stronger of the two rocks, standing out well above the softer slates, and acting even as a buffer to protect those which lie in its lee.

Summary and conclusions. — The study of the glaciation and the topography of the area have led to the following general conclusions: (1) The general direction of the ice movement in this portion of the margin of the Boston Basin has been between S. 22° E. and S. 40° E., changing more to the eastward as one proceeds south. (2) In the production of topographic forms by glacial ice, the disintegration of the diabase and the jointed structure of the felsitic rocks have been important controlling agents. (3) A series of topographic forms shows the diabase to be progressively more salient from north to south in rocks which are successively less resistant; viz., granite, jointed felsite, felsite breccia, and calcareous slate. (4) The disintegration of the diabase took place before the last ice advance, and the decomposed material found to-day is for the most part merely residual. (5) The glaciated areas are regarded as portions where decay had not penetrated so deeply as in other parts, and these were consequently first exposed to the ice and served in a measure to protect from erosion the soft rock near them.

In conclusion, the writer desires to express his thanks to Mr. John Woodbury, secretary of the Metropolitan Park Commission, for a topographic map of the Middlesex Fells; to Mr. T. Howard Barnes, city engineer of Medford, for maps and information from the records of the city engineer's office at Medford; to Mr. E. W. Bailey, city engineer of Somerville, for a contour map of the Powder House area (Tufts Park), Somerville; and to Mr. J. B. Woodworth, Dr. A. S. Eakle, and Dr. T. A. Jaggar, Jr., for criticism and advice while this paper was in preparation.

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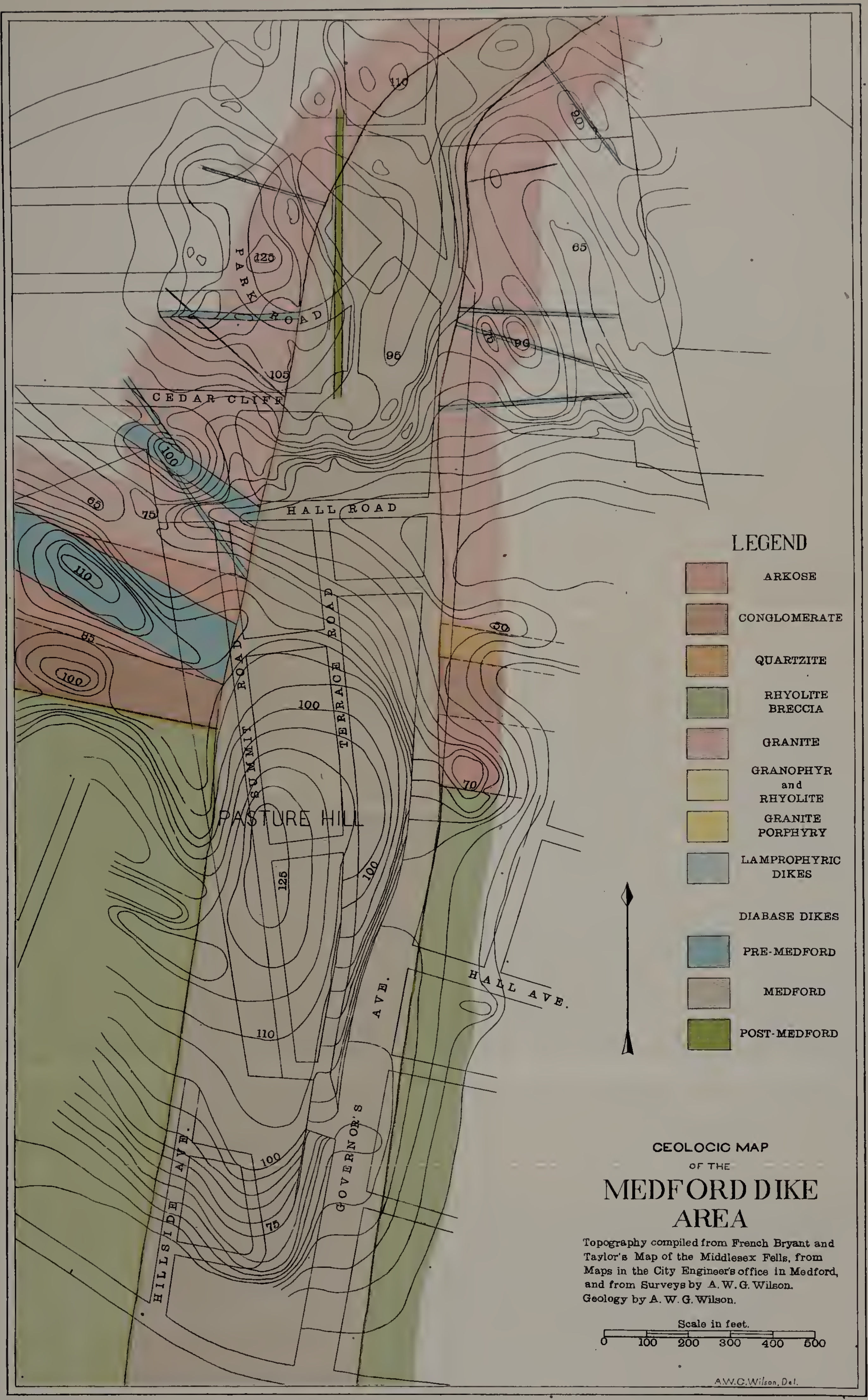
Printed, December. 1901.

PLATE I.



GEOLOGIC MAP OF THE MEDFORD DIKE AREA

Topography compiled from French Bryant and Taylor's Map of the Middlesex Fells, from Maps in the City Engineer's office in Medford, and from Surveys by A. W. G. Wilson. Geology by A. W. G. Wilson.

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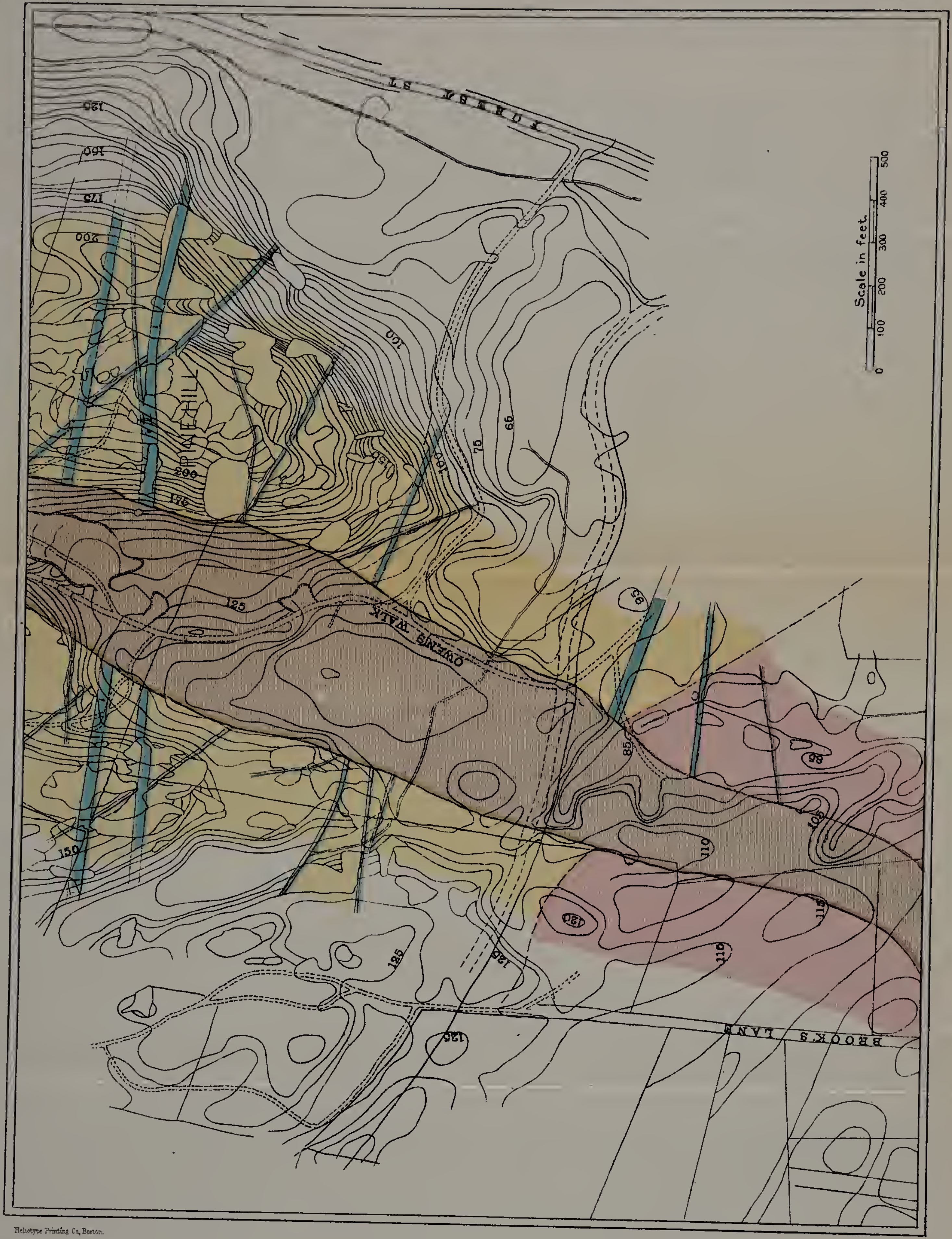

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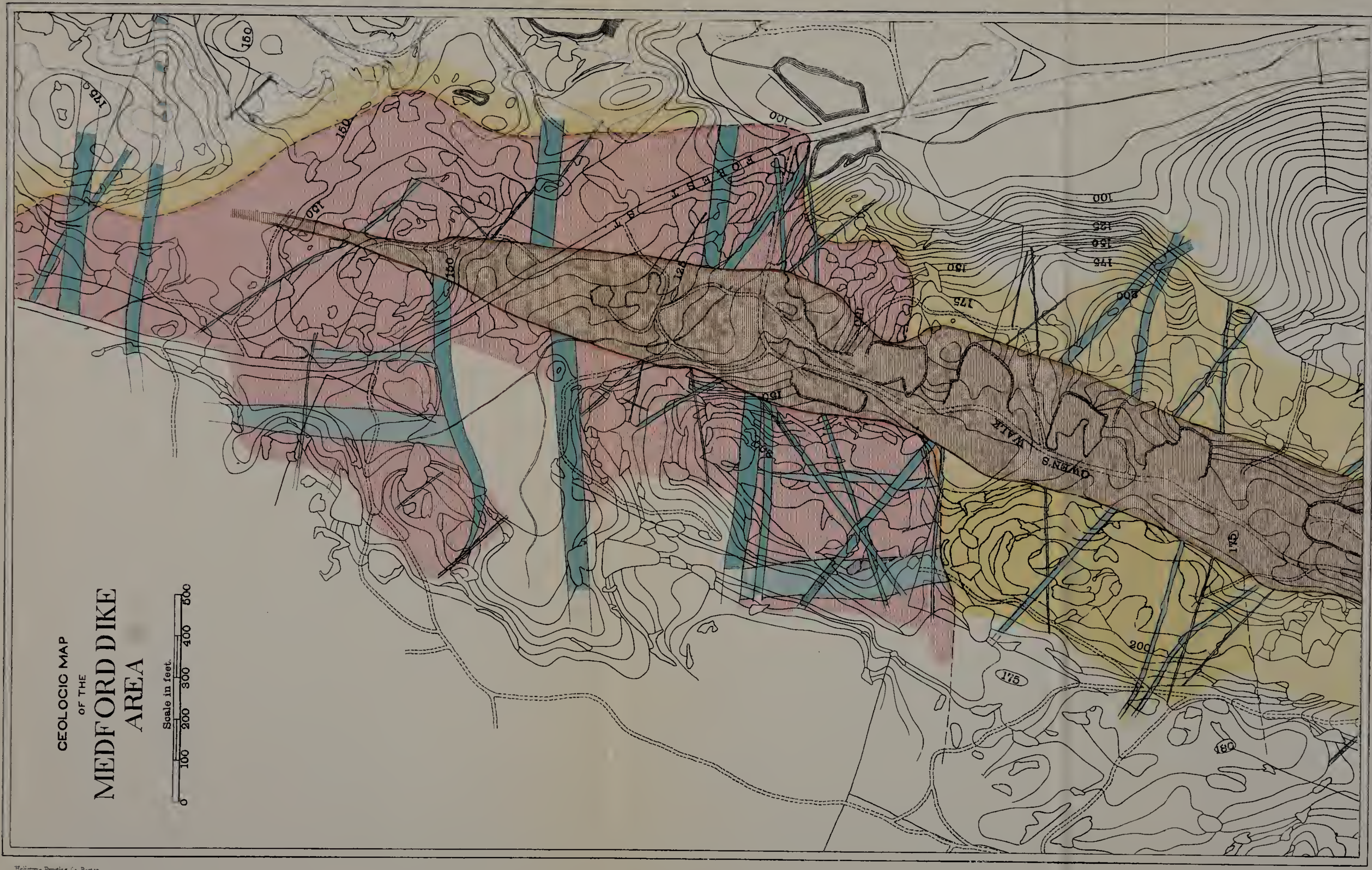

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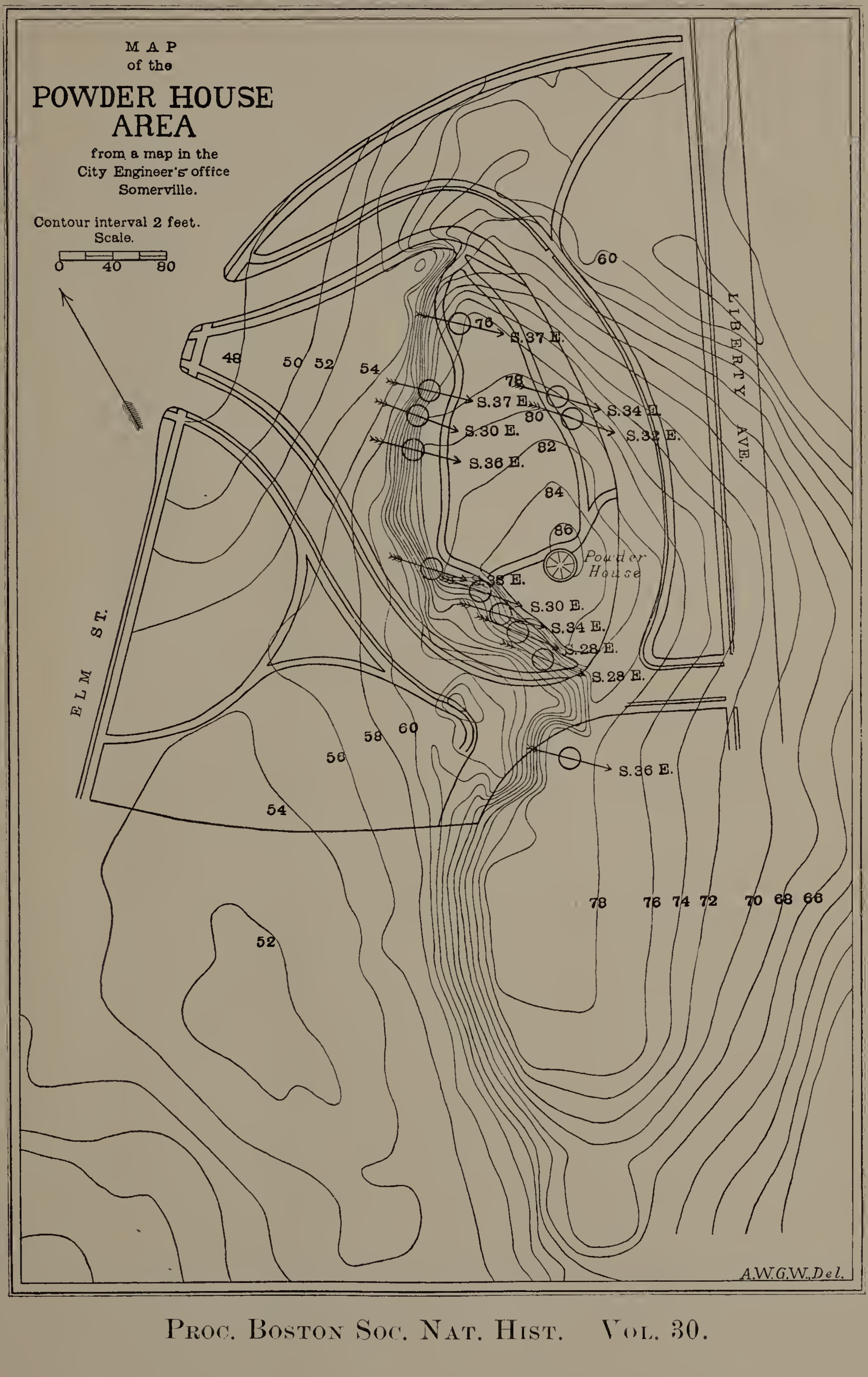
MAP
of the
POWDER HOUSE
AREA
from a map in the
City Engineer's office
Somerville.
Contour interval 2 feet.
Scale.
0 40 80
60
LIBERTY AVE.
76
S.37 E.
48
50
52
54
78
S.37 E.
S.34 E.
80
S.30 E.
S.32 E.
82
S.36 E.
84
86
Powder House
S.38 E.
S.30 E.
S.34 E.
S.28 E.
S.28 E.
ELM ST.
58
60
56
S.36 E.
54
78
76
74
72
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THE ORIGIN OF ESKERS.

By W. O. Crosby.

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No. 3.—THE ORIGIN OF ESKERS.

BY W. O. CROSBY.

Introduction.

The discussion of the origin of eskers seems to have subsided almost as completely as the glacial streams by which it is universally conceded they were formed. This is particularly true as regards the main question which glacialists have in recent years sought to determine; *viz.*: were subglacial or superglacial streams the principal factors in the making of eskers? A large majority of geologists are resting in the belief that these winding ridges of glacial gravel are the product chiefly, if not wholly, of the subglacial drainage of the ice sheet. In re-opening this discussion, as one of the still unconverted adherents of the superglacial theory, my main purpose is to show that under normal conditions the deposits of gravel and sand formed in a superglacial channel may be let down upon *terra firma* without obliteration and without loss of the distinctive features of an esker. In this connection I appeal especially to basal melting and to the principle, first enunciated by Upham, that the ice beneath a superglacial river will be melted downward and the channel deepened by the water which saturates and flows through the deposit of gravel and sand constituting the embryo esker. But I also hope to reinforce these principal arguments by others which, if less cogent or less vital, are yet essential to a complete theory of eskers.

It is recognized by all that eskers must represent the waning stage of the ice sheet; and although it is probable that the extent of basal melting during this stage is generally underestimated, but few will question that it is to the surface melting or ablation of the ice that we must look for the main source of water for the glacial streams, whether superglacial or subglacial.

It is undoubtedly true that deposits which may be classed as eskers have been formed under a variety of conditions: in superglacial channels, in subglacial channels, in ice-walled, earth-bottomed canyons, open to the sky, and with or without the active agency of water. And all the theories are, no doubt, essential to a complete explanation of eskers, the main question now being as to their relative importance, or as to which best accounts for the more typical and important examples and has, therefore, the best claim to be regarded as *the* theory of eskers.

Evidence of Existing Glaciers and Ice Sheets.

It must be conceded at the outset that nowhere have observations having any obvious bearing upon this problem been made upon existing ice masses which realize, even approximately, the essential conditions of the Pleistocene ice sheet as it existed upon the plain country remote from mountainous tracts, where, chiefly, eskers are now found. In Alaska, we have, besides the Malaspina glacier, only alpine glaciers in lofty mountain valleys of high gradient; and the Malaspina glacier, the type of piedmont glaciers, is simply a lake of ice existing at a level where permanent ice could not form, due to the confluence on the lowlands of the powerful alpine glaciers of the St. Elias range, and deriving its movement, in part at least, from the thrust of these tributary ice streams. On Greenland, which appears to have mountainous borders with an inner lowland, we find a true ice cap, with an area estimated by Peary at 600,000 square miles, and a maximum thickness of probably several thousand feet and possibly a mile or more; and it is well known that in the recent past this ice cap, which has evidently passed its culmination or maximum stage, has covered the whole of Greenland and the islands which fringe its coast, extending, possibly, far into the adjoining seas. But observation, naturally, has been chiefly confined to the margins of the ice, and to the overflow portions of the great *mer de glace* descending as lobes and valley glaciers to and toward the coast, and, as in the case of the Malaspina glacier, to levels at which permanent ice cannot form under existing climatic conditions.

In both Alaska and Greenland, the drainage of the ice is chiefly subglacial; and at many points powerful streams of water, carrying heavy burdens of detritus, are seen to issue from beneath the margins or extremities of the ice lobes; while the superficial streams, due to ablation of the upper surface of the ice, rarely if ever reach its margin, being swallowed by crevasses to form *moulins* and becoming tributary to, and the main sources of, subglacial rivers. In the case of the Malaspina glacier, the principal rivers discharging from its front or seaward margin undoubtedly have their sources high up in the valleys of the St. Elias range; and, as described by Russell ('93, p. 240) are seen in several instances to pass beneath the upper margin of this great piedmont glacier in well-formed, wide mouthed tunnels, the subglacial course of such a stream as the Fountain or Yahtse being merely an incident of its history. But the main point, of course, is that we have here more indubitably than anywhere else ice tunnels of considerable length — 5 to 25 miles at least — occupied by large and rapid streams, the outlets of which are being obstructed and raised by the deposition of coarse detritus swept out of the tunnels by the torrents or discharged by the slow process of ablation from the frontal slope of the ice, the conditions thus favoring the aggrading or building up of the beds of the subglacial streams by still coarser detritus which the deepening water could not urge to the outlet. In short, we appear to find here all the machinery usually regarded as essential to the subglacial origin of eskers.

But eskers are not a conspicuous feature of the land between the Malaspina glacier and the shore, across which the margin of the ice has recently receded — a tract which, though divided by the Sitkagi bluffs, aggregates nearly seventy miles in length. It is natural that it should be so, since, granting for the sake of the argument that ridge-like deposits of gravel may be formed in the earth-bottomed ice tunnels occupied by these impetuous subglacial streams, they must almost inevitably be obliterated or buried by the agency of the same streams, as fast as they are exposed by the recession of the retaining walls of ice and brought within the zone of extremely rapid fluvial deposition, where the overloaded streams are building their detrital cones. In fact, although scores of subglacial streams are escaping from the southern margin of the Malaspina glacier, Russell has noted on this marginal plain, several hundred square miles in area, but one esker, or distinct ridge of gravel, which is clearly the product of deposition and not of erosion. This is on the north side of and parallel with Kame stream, and is described as a sharp ridge of well-rounded gravel which is seen in places to rest on an icy bed and was evidently deposited by a stream which flowed fully one hundred feet higher (Russell, '92, p. 180). Again, it is said to date from a former stage when the waters flowed about one hundred feet higher than now and deposited a long ridge of gravel on the ice (Russell, '93, p. 240). Having been formed on the ice, it is probably to be regarded as the product of a superglacial or englacial stream, and not of a subglacial stream, such as Kame stream is to-day.

It appears probable that the principal subglacial streams of the Malaspina glacier are but little constrained by the ice, or at least that their courses are conformable to the ground topography to the extent that they nowhere flow uphill; and quite certainly we may assume that they do not show the utter disregard of the topography observed in many eskers. In so far as the subglacial streams follow closely the axes of the ground valleys, their courses may be regarded as virtually fixed, and deposits formed in their channels cannot fail of obliteration or burial when uncovered by the recession of the ice; and the same fate will, of course, be shared by deposits formed in the ice-walled canyons in which the ice tunnels frequently terminate. In view of these considerations, it is certainly not surprising that truly subglacial eskers are not now coming into view through the shrinkage of this lake of ice. The piedmont glacier appears fairly comparable in this respect with the tributary alpine glaciers and with valley glaciers in general, including the Muir glacier and other ice streams tributary to Glacier bay.

The only features suggestive of eskers yet noted in the detailed studies of the Muir glacier are the deposits described by Professor G. F. Wright ('89, p. 62) as formed in certain ice tunnels near the thin, débris-covered margins of the glacier. These tunnels have been abandoned by the subglacial streams which made them, and subsequently filled by the sliding in of the superglacial detritus through holes in the roofs. Professor Wright says, "In numerous places the roof of this tunnel (which is 25 to 30 feet high) has broken in, and the tunnel itself is now deserted for some distance by the stream, so that the débris (which overlies the ice to a depth in some places of 15 to 20 feet) is caving down into the bed of the old tunnel as the edges of ice melt away, thus forming a tortuous ridge, with projecting knolls where the funnels into the tunnel are oldest and largest. At the same time, the ice on the sides at some distance from the tunnel, where the superficial débris was thinner, has melted down much below the level of that which was protected by the thicker deposit; and so the débris is sliding down the sides as well as into the tunnel through the center. Thus three ridges approximately parallel are simultaneously forming — one in the middle of the tunnel and one on each side. When the ice has fully melted away, this débris will present all the complications of interlacing ridges with numerous kettle-holes and knobs characterizing the kames [eskers]; and these will be approximately parallel with the line of glacial motion. The same condition of things exists about the head of the subglacial stream on the east side, also near the junction of the first branch glacier on the east with the main stream, as also about the mouth of the independent glacier shown on the map lower down on the west side of the inlet."

We have clearly indicated here a type of eskers in the formation of which running water is not an immediately active agent; and, moreover, at the time of their filling by superglacial detritus, the subglacial tunnels have become gorges open to the sky and the deposits are not in any proper sense subglacial. Undoubtedly this is a true explanation of some kame-like and hummocky forms of modified drift; and it appears that, in general, deposits formed under these conditions would be more properly classed as kames than as eskers, and no one, perhaps, supposes that the more typical eskers of New England and other districts covered by the Pleistocene ice sheet have had this origin.

The search for eskers along the borders of the Greenland ice cap and its dependent lobes or glaciers has been even more fruitless; and Chamberlin ('95, p. 215), among recent competent observers in that field, has expressly noted the practical absence of this class of phenomena, attributing it chiefly to the inadequate drainage, but in part also, to the fact that the glacial streams are mainly lateral, coursing along the margins of the ice lobes, while the medial tunnels of Alaskan and Alpine glaciers are wanting. According to Russell, the drainage of the glaciers of the St. Elias range, above their confluence with the Malaspina glacier, is also largely or chiefly by marginal streams, which, like the lateral moraines, unite at the lower ends of the mountain ridges and pass into or beneath the piedmont glacier.

Nowhere, apparently, have esker-like deposits been formed by the subglacial streams of alpine glaciers, owing in part to the high gradients of the valleys, and in part to the paucity of detritus and the consequent absence of deposits at the lower end of the tunnels of sufficient volume efficiently to clog the outlets and lead to aggrading of the floors of the tunnels.

That observations on the existing ice of the northern hemisphere have made no important positive contributions to the theory of eskers is, perhaps, not an overstatement. We may fairly conclude, however, that the Antarctic ice cap alone, of all existing ice masses, realizes at all closely the conditions of the Pleistocene ice sheets of northeastern North America and northwestern Europe; but unfortunately no observations bearing upon the origin of eskers have been made here; and perhaps none are possible, since the margin of this greatest of living ice sheets is almost everywhere deeply submerged in the Antarctic ocean. Thus we are baffled at every point, and can only say that the testimony of existing ice is almost wholly negative, indicating only where and how eskers have not been formed.

Since, then, the formation of eskers has nowhere been observed, our only resource in seeking an explanation of this highly specialized type of drift, is in a close study of existing examples, followed by a rigid testing of such working hypotheses as have been or may be suggested by the facts. Fortunately the principal facts are now well determined; but, although a good general agreement exists among glacialists as to what constitutes an esker, it appears advisable to enumerate briefly the main features before proceeding to a critical comparison of the rival hypotheses.

Characteristics of Eskers.

Form. — The typical esker is a steep sided, narrow crested and more or less winding ridge, varying in height above the surrounding country up to 100 and even 150 feet. The lateral slopes usually approximate the maximum angle of repose for gravel. Although the crest is often of even height for considerable distances, it is more commonly diversified by cols and knolls, and not infrequently it widens into level topped plateaus. Woodworth ('**94**, p. 197) has shown that the variations in both height and breadth often find a reasonable explanation in the ratio of depth to breadth of the original deposit, before the disappearance of the retaining walls of ice. The eskers rather rarely receive distinct tributaries, but they are often composite, splitting up into two or several ridges, which wind and anastomose, enclosing kettles and even large, irregular basins with floors of till and holding water; and occasionally an esker is double, consisting of two distinct but contiguous parallel ridges. The esker ridge may be uninterrupted for long distances, but is usually more or less discontinuous; and an esker system (to which Stone has proposed to restrict the name osar), embracing all the esker ridges referable to one glacial river or drainage system, may be of any length up to 100 and even 150 miles.

Composition and structure. — Eskers consist chiefly of coarse, and often of very coarse, gravel, mingled or interstratified with which is usually much coarse sand, although the sand may be at times insufficient to fill the interstices between the pebbles and cobbles. The proportion of sand and the fineness of all the material are greatest in the wide, flat topped portions of an esker, corresponding to lake-like expansions of the glacial stream; but even here fine sand and clay are of rare occurrence. The gravel is more or less rounded and water-worn, and includes a larger proportion of far-traveled material than do the adjacent masses of till or ground moraine. This is a necessary deduction from the fact that the esker drift has been transported by water as well as by ice, and it has been fully confirmed by observation. These materials are rudely, irregularly, and very often indistinctly stratified, and a sort of anticlinal structure, due to lateral sliding and settling as the retaining walls of ice melted away, is a characteristic, though by no means a constant, feature. Bowlders, sometimes of considerable size, are rather rarely found resting on the slopes of eskers, and more commonly partially or wholly imbedded. Also, eskers may be more or less completely buried by delta and over-wash plains, and valley terraces and flood plains, but never by till or ground moraine.

Topographic and geologic relations. — Eskers and esker systems or osars, unlike the terminal moraines of the great ice sheet, exhibit a tendency to conform in trend with the movement of the ice as recorded in striae, the major axes of drumlins, and bowlder trains; and this conformity is often surprisingly close. This means that while occurring chiefly, with other forms of modified drift, in valleys, eskers are to a good degree independent of the topography and often do not hesitate to forsake, or to cross at all angles, large and well-accentuated valleys, in order to adhere to their normal courses. They may thus rise to levels far above and cross tracts quite free from all other types of modified drift. But there is a limit to their topographic independence, as recently noted by Stone ('99). He finds in Maine, where exists the finest and most extensive development of eskers on this continent, that while they freely climb slopes and cross ridges from one hundred to two hundred, and more rarely three hundred and four hundred feet in height above the ground on which they rest to the northward, they are constrained to follow still deeper valleys or wind around still higher hills, usually seeking the lowest gap in a ridge or water parting. Valley eskers are very rarely found in the true axis of the valley or resting on the lowest part of the till or bed rock profile, even where, as often happens, the channel of the modern stream is remote from or well above the real bottom of the valley. But the normal position of the esker is lateral or along one side of the valley, and even the base of the esker is not infrequently well above, sometimes a hundred feet or more above, the level of the modern flood plain, which may in turn overlie a great depth of modified drift. The indifference of eskers to the contours of the surfaces on which they rest is further seen in the fact that they may appear first on one side of a valley and then on the other, but rather rarely on both sides simultaneously; and the same continuous esker, broken only by the modern stream, may cross and recross the valley from side to side.

Eskers seldom, if ever, occupy channels in either the bed rock or till, which may reasonably be regarded as due to the erosive action of the streams that formed the eskers. And in general, distinct evidence of erosion by esker streams is wanting, except perhaps in the notching of the protruding drumlins or other nunataks of the waning ice sheet.

Eskers commonly terminate southward in the delta and over-wash plains formed along the southern margin of the ice sheet, and to these they hold the relation of tributaries or feeders; and an approximate agreement in height of these terminal deposits with the proximal portions of the eskers has often been noted. Also, eskers commonly widen as they approach the plains and merge gradually with the latter.

PROBABLE STATUS OF THE ICE SHEET DURING THE FORMATION OF ESKERS.

That eskers were formed by glacial streams in, on, or under the ice sheet and during the waning stage of glaciation, when this border area was rapidly disappearing through superglacial and subglacial ablation, are propositions accepted by all and requiring no argument here. Further, we may postulate, with Davis and other able students in this field, the stagnant condition of this marginal zone during the esker-forming period. In fact, a stationary ice margin is a condition highly favorable, if not absolutely essential, to every theory of esker formation; and, as Davis has insisted, it is demanded by the highly irregular and fragmentary border of the ice, of which we have conclusive proof in the distribution and outlines of the deposits formed upon or against it and in the absence of evidence of glacial thrust.

In my paper on englacial drift ('96), I have accepted and elaborated Upham's idea that over the vast plain or peneplain tracts of the glaciated area, the ice sheet was developed primarily by accumulation and not by invasion, existing at first as a sedentary ice cap, which gradually acquired motion as it gained in thickness and also as it was progressively overridden by the older and already active ice to the northward. Again, I see now, as five years ago, no escape from the conclusion, also first enunciated by Upham, that, during the periods of ice accumulation and of maximum glaciation, the entire volume of the drift, including both the preglacial detritus and all that due to glacial rending and abrasion, was englacial, or firmly frozen in the basal portion of the ice. This conclusion is absolutely demanded by the universal rectilinear striation of the bed rock surface, and is inconsistent, so far as I can see, with no established facts.

I have also shown in the paper cited above, that the observations of Chamberlin and others in Greenland and elsewhere indicate that an ice sheet, in its progress across even a comparatively smooth surface, is subject to oblique shearing movements which tend to transfer the englacial drift to higher levels in the ice. I hold now, even more strongly than when writing the paper on englacial drift, that the tendency to the elevation of the drift in the ice must have been powerfully augmented by the overriding of the sedentary margin of newly formed ice, during every advance of the ice sheet, and the overriding of the stagnant margin of the old and wasted ice during every recession of the ice sheet. The essentially stagnant condition of the outer portion of the Malaspina glacier, with a thickness of at least a thousand feet and a fairly steep frontal slope, and feeling the thrust of the powerful alpine glaciers behind it, is an instructive fact, suggesting that, during the waning of the Pleistocene ice sheet by active ablation over a breadth of one to several hundred miles back from the margin, this wasted marginal zone must have gradually ceased to move; for it is inconceivable that the thrust of the thicker ice to the northward could induce forward movement in a comparatively thin sheet of ice resting upon a strongly dissected but approximately level peneplain. Overriding, or at least a vertical thickening of the ice along the northern edge of the stagnant zone, appears inevitable, and obviously this could not occur without a corresponding elevation of the englacial drift. In view of these considerations, it may, perhaps, reasonably be affirmed that observations on existing ice masses do not afford a safe criterion for judgment as to the amount or the depth of the englacial drift in that portion of the ice sheet which was the locus of esker formation.

During the period of maximum glaciation, when the drift was all englacial and glacial erosion of the bed rock surface was most severe, there could have been no important subglacial drainage; for the basal contact of the ice was perfect and continuous, as indicated by the universality of striation beneath the till or ground moraine; and the temperature of the ice must have been, throughout its entire thickness, well below the freezing point, even after making allowance for the lowering of the freezing point by pressure, this reduction amounting approximately to one degree Cent. under a mile of ice. When, through the rise of the isogeotherms in the earth's crust, the basal temperature rose above the melting point of ice, the deposition of the ground moraine began; and the striation of the bed rock surface must have ceased at the same time, for the striae are everywhere essentially rectilinear, which is inconceivable as due to the movement of the ice over a bed of loose material. We thus reach the conclusion that effective basal melting did not begin until after the ice had so far wasted by superficial ablation that its flow began to be influenced by topographic reliefs of relatively slight value; after, for instance, the trough of the Boston Basin had deflected the basal portion of the ice decidedly to the eastward. This was the period of drumlin formation, which was probably followed closely by the esker and sand plain period.

The absence of basal water during all but the latest stages of glaciation is easier to understand when we consider how low, probably, were the initial temperatures throughout the entire thickness of the ice sheet, and the great depth of frost penetration into the ground beneath the ice. Nowhere, probably, within the range of observation at the present time are the conditions of the Pleistocene ice sheet more nearly realized than in the interior of Greenland; and in this connection Nansen's experience in his memorable transit over the ice from the eastern to the western coast is of special interest. He says ('90, vol. 2, p. 480), "Some of the temperatures which we experienced were far lower than the established meteorological laws would have led us to expect. The temperature on certain nights, September 12 and 14, probably fell, according to the calculations of Professor Mohn, to — 45° Cent. (— 49° Fahr.), while the mean temperature of certain days, September 11–16, when we were about in the middle of the country, or a little to the west of the highest ridge, varied from — 30° Cent. to — 34° Cent. (— 22° to —29° Fahr.). This is at least 20° Cent. (36° Fahr.) lower than anyone would have been justified in expecting, if he had based his calculations on accepted laws, taking for his data elevation above and distance from the sea, as well as the mean temperature of the neighboring coasts." Now, supposing similar climatic conditions to have prevailed during the entire period of the accumulation of the ice sheet, and considering that the glaciation of Greenland is long past its maximum and the climate, therefore, probably somewhat ameliorated, we have indicated a degree of refrigeration in and under the ice which the slow upward flow of the terrestrial heat would require a long time to overcome. The low temperature of the ice is seen not to be necessarily inconsistent with flow through the medium of a granular structure, in accordance with the views of Klocke, Deeley, Fletcher, and others, as summarized by Upham ('96), when we consider that the progressive melting of a granule at one point and its growth at another point demand differential or localized pressures, and therefore pressures the maxima of which must exceed the average of the combined vertical and flowage pressures for the same depth. In other words, the ice may flow by intergranular melting and freezing without any excess of melting over freezing.

Again, it is probable that during the period of glacial erosion the basal pressure is sufficient to prevent the development of both tunnels and crevasses. Nansen found neither crevasses nor superglacial streams nor evidence of appreciable surface melting; and it is certain that surface crevasses would be closed at no great depth by the freezing of water in them, as long as the mean annual temperature remains, as now, far below the freezing point. We must conclude, therefore, that glacial erosion was, and is now except in the case of alpine glaciers whose valleys have been swept free of débris, accomplished in the practical absence of water, derived either from the basal or the superficial melting of the ice.

We thus find that, even in the case of a waning ice cap, superglacial and still more narrowly subglacial drainage is confined to the marginal portion of the ice, and in view of the observations by Nansen and others on the inland ice of a mountainous country, we may question whether crevasses could have been a prominent feature of even the marginal portion of the Pleistocene ice sheet on the plain portions of the glaciated area. Or, in other words, is it not probable that on an approximately level but rough surface, remote from mountainous tracts, the ice would, in general, have ceased to flow before it became thin enough to permit effective crevassing or the development of fissures traversing its entire thickness? I am inclined to think that the burden of proof rests upon those who assume the negative, although glacial potholes are commonly supposed to testify to the existence of at least occasional crevasses, and inequality of basal melting may be cited as a possible cause of crevassing not dependent upon flow.

Stone says (’**99**, p. 240), “Neglecting basal melting, we divide the ice sheet into a zone or area of diffused superficial waters, a zone of superficial streams, and a zone of subglacial streams.” I accept these zones, but hold farther that, in large part, the second zone extended to the margin of the ice, the third or outer zone being characterized by superglacial streams above and subglacial streams below, competing for the englacial drift, of which eskers must be chiefly formed.

Undoubtedly, the very latest direct work of the ice sheet, before its motion finally ceased, was the building of the drumlins. In the lee sides of a few drumlins a limited amount of gravel is interstratified with the till, the product possibly of superglacial streams falling through the ice at these points, since crevassing would probably occur as early where the ice bends over the summit of a drumlin as anywhere. At the same time, the ice must have tended to draw away from the lee slopes and leave the vacant spaces in which gravel could be deposited by superglacial, but not possibly by subglacial streams. We do not discover, however, any such general intercalation of washed drift with the ground moraine, either in drumlins or elsewhere, as to suggest that crevasses were a common feature of the ice just before it ceased to move; and of course none could be formed after it became stationary. Again, it appears probable that, when the ice was thick enough to override drumlins from one hundred to several hundred feet in height, its thickness was too great to permit extensive crevassing, especially in view of the fact that the thickness essential to flow must increase rapidly with diminishing slope and increasing roughness of the ground or basal friction, and the further fact that even alpine glaciers in relatively smooth and unobstructed valleys of high gradient, and seldom exceeding 500 to 1,000 feet in thickness, are but little affected by crevasses, except in cascades and laterally where they feel the friction of the valley walls. In this connection we may profitably note once more that the marginal portion of the Malaspina glacier, with a thickness of at least one thousand feet and a steep frontal slope, at the base of lofty mountains and feeling the thrust of powerful alpine glaciers, and with absolutely nothing to hinder its free motion seaward across the sloping coastal plain, is practically motionless. These considerations clearly point to the conclusion that the Pleistocene ice sheet on the highly dissected and rough peneplain surface of the greater part of the glaciated area, with only extremely low average gradients in any direction, and then often either to the northward or transverse to the glacial movement, must have been at least two thousand feet thick when it ceased to move, and too thick in general for effective crevassing, or the formation of crevasses extending from the top to the bottom of the ice.

Crevasses are the product of tensile stresses; and it is obvious that as, during the progressive cessation of its flow from the south northward, each portion or zone of the ice becomes stationary, the ice still in motion immediately to the northward will crowd forcibly against it and tend to obliterate by compressive stresses any crevasses which may interrupt its continuity. Overriding, or even a local thickening of the ice, may not always accompany the cessation of flow; but it is certainly difficult to see how, in general, crevasses could survive the progressive loss of motion. We have a magnificent illustration of this process in the Malaspina glacier, which is practically free from crevasses and well endowed with persistent superglacial streams on its outer, drift-covered, marginal zone, although crevasses are a common feature of all the central and northern part of this great piedmont glacier, or at least common enough to prevent the development of any important superglacial streams; and we can only suppose that they are closed by pressure from the northward or clogged by superficial drift as the ice gradually ceases to flow. In fact, Russell says that many of the crevasses are filled with clear blue water, and that they appear to be the scars left by rents in the tributary ice streams, indicating a tendency of the crevasses to close at the bottom before they do at the top. Concerning the drainage of the Malaspina glacier, Stone says ('99, p. 421–422), "For some reason the glacial streams have either formed no subglacial tunnels under a marginal zone of uncertain breadth, or the original tunnels have become blocked by ice or sediment or moraines so that the streams have been forced to form englacial tunnels, which become superglacial by the melting away of the overlying ice, and the streams continue such as they flow down the terminal ice slope. If the glacier continues to retreat, it seems probable that a ridge or series of ridges such as are now forming, and abandoned channels of these rivers will be prolonged northward as far as the englacial channels reach. This furnishes an observational basis for the conclusion that during the retreat of the ice sheet, wherever the ice was very stagnant and the subglacial streams found their tunnels choked near their outlets, they freely rose into englacial or superglacial channels." This is important testimony, and all the more interesting as coming from a subglacialist. Surely, if a piedmont glacier on a narrow, sloping, coastal plain, at the base of lofty mountains, with a steep frontal slope, and feeling the thrust of powerful alpine glaciers, can become absolutely stagnant and free from crevasses in a distance of only five to fifteen miles from the mountains, and while still retaining a thickness of a thousand feet or more, we need not doubt that the wasted margin of the Pleistocene ice sheet, on the vast, dissected, peneplain tracts of extremely low gradient and scores and hundreds of miles from the nearest mountains and these never more than one third as lofty as the St. Elias range, also became stagnant and free from crevasses across a marginal zone of considerable breadth. This point of view seems to demand not only great thickness of the continental ice sheet in its prime or before it ceased to move, but also overriding alike of the immature and of the old and wasted margin as a means of inducing and renewing motion in the latter, and this overriding must involve the transfer of englacial drift in great volumes to higher levels in the ice than many glacialists have heretofore been willing to accept.

Glacial potholes, it may be noted further, are, in general, far more likely to be the products of subglacial streams than of *moulins*, for they lack the elongation which the latter explanation requires; and the subglacial stream may or may not have originated in a *moulin*. The assumption that it did is by no means necessary. That the glacial potholes were in general formed after the ice became absolutely and finally stagnant must be obvious to any one who has studied them in the field and noted the perfectly normal and unglaciated condition of their rims.

To summarize, it appears probable that eskers were formed in connection with the sluggish or wholly stagnant marginal portion of the waning ice sheet, after the liberation by basal melting of all that part of the ground moraine, including drumlins, showing evidence of having been pressed down and compacted by the movement as well as by the dead weight of the ice, and after the upper part of the englacial drift had become superglacial through the superficial melting or ablation of the ice. Such crevasses as may have survived the cessation of flow, or resulted from local subsidence due to basal melting, were probably closed by drift washed into them from above. The general absence of modified drift interstratified with the till is an indication that subglacial streams, or a concentrated flow of subglacial waters, did not exist before the ice became stagnant, the only explanation that suggests itself being that while the ice was in motion it would cause the drift to rise and fill any channel opened above it, a principle which is not operative beneath alpine glaciers (and possibly not beneath the Malaspina glacier) because they have long since swept their channels free of drift.

Comparison of Hypotheses.

Although recognizing, as previously stated, that other explanations, such as the filling of abandoned channels by surface slide and wash, are entitled to some consideration, and that they are all, probably, essential to the complete theory of eskers, it is proposed in what follows to take account only of the two main hypotheses; *viz.*, that eskers have been formed by the active agency of subglacial streams, or of superglacial streams. And here again, as already noted, it is merely a question of relative importance, since I hold with Davis and other advocates of the subglacial hypothesis that neither can wisely be discarded *in toto*. Subglacial tunnels are a reality at the present time and were doubtless, to some extent, a feature of the Pleistocene ice sheet; and it would certainly be hazardous to deny that deposits formed in them have never escaped obliteration on the disappearance of the ice.

Superglacial Hypothesis.

This explanation of eskers assumes a stagnant marginal zone of the ice sheet at least one hundred miles in maximum width, practically free from crevasses, sufficiently wasted by ablation to be more or less abundantly covered by englacial drift which has become superglacial, with a general southward slope, and, toward the southern border at least, thin enough to reflect in its surface contours, in some degree, the underlying topography, and even to permit the more prominent land forms to rise as nunataks above its surface. At the southern margin of the ice, the elevation or grade of the superglacial stream finds a limit or control in a barrier of rock or till against which the ice may temporarily terminate, or in a body of standing water (a glacial lake) held against the ice by such a barrier in northward sloping valleys, or, less rigidly, in the detrital cone formed by the stream itself as it escapes from the ice. Whatever the character of the control, it determines for each superglacial stream a base level, towards which it must approximate, but below which it cannot cut its channel by merely mechanical erosive action. The stream discharging across the ragged southern edge of the ice is but the trunk or main stem of a system, deriving both water and detritus from many tributaries as well as by the ablation of its banks. In fact, it holds so far essentially the same relation to the drift-covered ice that an ordinary stream does to the drift-covered bed rock. The tributaries making large angles with the trunk channel, or not approximately agreeing with it in direction, will not share its high gradient; and in consequence their channels will not be deepened so rapidly, but will become hanging valleys in their relations to the main ice canyon. But as the floor of the latter approximates the base level, the higher gradient will be transferred to the tributaries, which must then, in large part, discharge their accumulated burdens of coarse detritus into the main channel and thus lead to its rapid clogging and aggrading. Only unimportant accumulations will remain in the channels of the approximately right-angled tributaries, and we are thus able to explain the practical absence of right-angled branching in eskers. In special cases the base level of the superglacial stream will be the surface of the ground on which the ice rests; and then the clogging and aggrading will take place in earth-bottomed canyons, the slow melting of the ice walls of which will complete the process and leave the eskers as we now see them. There is apparently no reason why, in the absence of a frontal barrier, existing independently of the glacial stream or through its agency, this simple explanation may not fairly be postulated. We are, however, specially concerned with the fate of the esker which finds itself at the end of the base-leveling process on a foundation of ice twenty, fifty, or possibly one hundred feet thick.

To begin with, it is, perhaps, improbable that the coarse detritus, which lags behind as the grade diminishes and gradually clogs and aggrades the channel of the superglacial stream, will have sufficient depth and volume to form a typical esker, or an esker approximating in height the sand plain to which it is tributary, as long as the floor of the ice gorge is nowhere below the base level or the level of the frontal barrier. Down to this level the gorge has been formed by the mechanical erosion or corrasion, as well as by the chemical erosion or melting of the ice; and below this level, corrasion is surely inoperative. But here Upham's suggestion of a farther deepening of the gorge by melting alone, intervenes; and I hope to show that it will continue with increased rather than diminished efficiency.

Basal melting of the ice sheet must be in constant progress, summer and winter, during this stage, and is possibly an important factor in letting down and indirectly deepening the deposits in the superglacial channels; while the even distribution of the effects due to this cause may safely be assumed. But the main question now is, will the superglacial channel persist, or retain its walls, until its bottom reaches the ground? In other words, will the melting of its floor beneath its increasing load of detritus keep pace with, or at least keep ahead of, the general ablation of the interstream surfaces? The familiar instances of medial moraines resting on ridges of ice and isolated bowlders perched on pillars of ice, through the more rapid melting of the drift-free surface, seem to demand a negative answer. On the other hand, the innumerable well-like holes in the ice, noted by many observers, and varying from an inch to several feet in depth, and often containing nothing but the purest of water, although commonly a stone or a little sand, clay, or cosmic dust is seen resting on the bottom, point to an affirmative answer. These holes are usually explained, however, as dependent upon the absorption of the solar heat by a slight thickness of stony or earthy matter; whereas thicker masses protect the ice beneath from the solar radiation. The occasional absence of foreign matter indicates that this explanation is incomplete; and the lakelets described by Russell (**'91**, p. 120) as a common and characteristic feature of the moraine-covered marginal zone of the Malaspina glacier clearly demand a different explanation from that usually accepted for the relatively small holes; for the basins of the lakelets, which may be from fifty to one hundred feet or more in depth and are rarely more than one hundred feet in diameter, appearing to differ from the holes only in size, contain considerable amounts of drift, and the thickness of the deposit in the bottom of each basin constantly increases as fresh material slides in from the top and sides. Obviously these narrow basins with steep and sometimes vertical sides are formed by the downward melting of a cylinder of ice beneath a cover of drift so thick that we cannot think of it as sensibly warmed, and still less as penetrated, by the solar heat, especially as the turbid water usually completely covers the drift.

These contrasts and seeming contradictions are readily explained if we accept the standing water as an essential factor and regard the detritus as secondary. Thin stones and particles of drift absorb heat and sink into the ice; and thicker stones and deposits may do the same if they chance to occupy water-tight depressions in the surface of the ice. A dry stone, if thin enough, transmits heat directly to the ice; but with a submerged stone the transmission is through the medium of the water. Hence as soon as the thin stone or deposit becomes submerged, the thinness ceases to be an essential factor, and it is on a par with the thick stone or deposit. The normal temperature of the water is, of course, that of melting ice, or four degrees Cent. below its temperature of maximum density. The water absorbs some of the solar radiation directly, and it takes up promptly and completely the much larger amount of heat absorbed by the submerged or partially submerged detritus. As fast as the water gains in temperature it sinks to the bottom, displacing colder and lighter water, and expends its surplus heat in melting the ice. As has been noted by others, this principle explains the fact that the ice shores of the Malaspina lakelets are undercut below the water level, the ice, as stated by Russell, melting below the surface more rapidly than above, where it is exposed to the direct rays of the sun. The thickness of the deposit is no appreciable bar to the process, so long as the material is sensibly permeable, but on the contrary it enables the water warmed by contact with its surface to sink promptly and quickly to the underlying ice; and with increasing thickness the pressure cooperates by lowering the melting point, while with such torrential streams as must have been those in which normal eskers were formed, the conversion of mechanical energy into heat may not be neglected. A bed of permeable gravel not only cooperates in the ways indicated, to favor the melting of its ice floor, but it must tend to conserve the heat and to prolong the time during which melting can take place.

In view of these considerations, there seems to be no escape from the conclusion that the ice floor of a superglacial stream will be lowered by the superficial as well as by the basal melting of the ice; that the superficial melting will be more active and efficient in proportion to the extent of aggrading of the channel and the volume of stagnant water saturating the gravel; and that the stream will be lowered at least as rapidly as the interstream surfaces, because, while these are also, according to our initial assumption, covered with drift and thus protected from the direct action of the sun's rays, they lack the standing water essential to the effective indirect utilization of the solar radiation.

Obviously the aggrading of the channel may continue during all the time that the deposit is being let down upon the ground, and the resulting esker will then conform in elevation with the terminal plain, at least as closely as eskers commonly do, and show the characteristic lack of sympathy with the ground topography. Should the stream be diverted to another course before the subsidence of its deposits is completed at all points, the process will continue without essential change, unless a crevasse should draw off the water saturating the gravel, the result being one of the eskers falling in whole or in part below the normal elevation. The exceptionally high points or knolls may, according to this hypothesis, represent the detritus discharged by hanging tributaries into the main canyon after the diversion of the headwaters from the latter. All the conditions favor vertical rather than lateral melting of the ice; and there is, apparently, no tendency to scatter the deposit in getting it down to the ground. At the same time all observed variations in width are fully provided for, and more especially the gradual widening which commonly marks the junction with the terminal plain. Certainly nothing is more probable than the widening of the ice canyon at its mouth in the thin and frayed or lobate southern margin of the ice, where its walls are bathed by a large body of standing water. Stone's maps ('**99**) show that this terminal widening is a particularly characteristic feature of the great esker systems of Maine; and some even of the subglacial tunnels of the Malaspina glacier become, at the last, canyons with rapidly diverging walls. The constant movement and readjustment of the deposit during the settling process keep it loose and permeable, and enable the water to wash out some of the filling of the coarsest gravels and thus give rise to the open-work gravel specially noted by Davis.

In the quite exceptional case where crevasses or other accidents drain the esker channel before its subsidence is completed, the differential melting is likely to be reversed, the interstream surfaces going most rapidly because less protected from the sun's heat; the esker deposit is left on a ridge of ice, and, sliding down on both sides, gives rise to the occasional double esker, of which I have noted several good examples in the vicinity of Boston ('**94**, p. 278–284). The quite common failure of the esker to connect properly with its terminal plain, a weak place or break intervening, may be in part attributed to the deposition of the head of the plain over the sloping margin of the ice and the subsequent melting of the latter;

and the very numerous instances of plains of all the various types without associated eskers or feeder channels are simply the cases where the superficial stream was diverted before its channel was base-leveled, and consequently before it was aggraded to any important extent. Finally, the lateral position characteristic of valley eskers follows naturally from the tendency of the ice, before it ceased flowing, to become concentrated in the valleys or along the lines of freest movement, giving rise to what were virtually valley glaciers with arched profiles in what may still have been at the surface a continuous ice sheet, and possibly with lines of shearing between the free-moving ice and the relatively stagnant ice of the uplands. When the ice becomes wholly stagnant, these lateral lines of weakness and the arched profile still remain to influence the courses of superglacial streams.

Subglacial Hypothesis.

As formulated by Davis ('92), this explanation of eskers also presumes a stagnant and decayed marginal zone of the ice sheet. The water resulting from the basal melting of the ice, together with that due to superficial melting which becomes subglacial through the medium of crevasses, is gathered into streams which, it is stated, hold to meridional courses or, more exactly, conform with the general trend of the ice movement, in obedience to a direct control exerted by the ice. This control being sufficient to force the streams to flow uphill and over elevations of 100 to 400 feet, we must, apparently, suppose that their courses were determined before the motion of the ice ceased and while it was still thick enough to hold to its normal trend regardless even of quite strongly accentuated topographic features. How the subglacial channel or tunnel originated is not considered, beyond the suggestion that it may be due to the enlargement of longitudinal crevasses; but the point is not vital, for it is obvious that the subglacial water must escape and that, no matter how closely pent, there must always be lines of least resistance to its flow.

At and beyond the margin of the ice, the phenomena must be essentially the same as for superglacial streams, and a frontal barrier or sill of any kind causing the stream to rise, perhaps fountain-like, must favor the aggrading of the floor of the tunnel by the coarser detritus and a corresponding elevation of the roof by corrasion and melting. If the stream is sufficiently long-lived, this process may continue until the deposit attains the level of its terminal alluvial cone or delta. The breadth of the deposit is sharply limited by the stability of the ice arch; and if we should assume two hundred feet as the maximum breadth of ice tunnels, portions of most important eskers would demand some other explanation, and in many cases a breadth of 500 or 1000 feet would prove inadequate. In fact, the subglacialist finds it convenient in such cases to suppose, either that the stream rose through crevasses, perhaps in consequence of the clogging of the tunnel, and became superglacial for a longer or shorter distance; or that the tunnel became, by excessive ablation, locally roofless, or open to the sky, and the resulting canyon was widened by the recession or melting back of the walls. As in the case of superglacial streams, the water is supposed to be diverted after a time, and the deposit left in the abandoned tunnel gradually develops the steep lateral slopes and other formal features of eskers during the slow melting of the retaining walls and arch of ice.

Finally, effective crevassing throughout the zone of esker formation and a failure of englacial drift to rise to any considerable elevation in the ice are always postulated as important, if not absolutely essential, elements of the subglacial hypothesis.

Review of Evidence.

Direction or trend of eskers. — That the typical esker tends to conform closely in trend with the movement, and especially with the latest movement, of the ice sheet, as recorded in striae, drumlins, and bowlder trains, is undoubtedly true. The movement of the ice sheet must have been, in general, normal to its margin, or, in other words, in the direction of its steepest surface slope, and therefore in the direction which superglacial streams would necessarily follow. Eskers depart from this ideal trend no more than might reasonably be expected in the case of a superglacial stream, considering that as the ice sheet becomes thin, its surface contours must begin to show the influence of the underlying topography; and considering further the inevitable inequalities in the distribution of the superglacial drift due to and in turn determining unequal ablation, as well as the natural tendency of streams to meander with diminishing gradient. In brief, the trend of the superglacial esker is entirely consistent with the known facts and the reasonable probabilities of the case; and it matters not, so far as this feature is concerned, whether the ice was absolutely stagnant at the time the esker was formed or still retained a part or the whole of its velocity when in its prime.

On the other hand, the only factors which may be considered as directly influencing the direction of subglacial streams and eskers are the ground topography, which is often contrary or indifferent; crevasses, which, in so far as they exist at all, must be chiefly transverse and therefore indifferent; and the movement of the ice, or the differential pressure of the ice upon the ground resulting from its movement. That the basal movement of a sheet of ice thick enough to flow over a deeply and irregularly corrugated surface of very low average gradient (the gradient being often opposite or transverse to the movement) would tend to develop and maintain furrows or tunnels in the bottom of the ice is extremely doubtful. Tunnels meeting the requirements of esker formation would not usually lie in the lee of prominent topographic reliefs — ledges or hills, which might, conceivably, have grooved the bottom of the ice as it flowed past them. Nor is it easy to see how tunnels due in any direct way to ice flow and pressure could have been so indifferent to the topography as eskers are often observed to be, forsaking broad valleys hundreds of feet in depth to continue, perhaps in a very oblique or closely parallel course, across an uneven upland. As previously noted, there must be, as long as the ice is in motion, a tendency to equalize the basal pressures and prevent the development of open spaces by flow of the ice and also by flow, in obedience to the ice pressure, of the underlying drift or ground moraine; and, furthermore, the effects of unequal pressure would be, at least to some degree, neutralized by the differential or localized melting induced by the pressure through the lowering of the melting point. Again, in their longer reaches as well as in their minor meanders, eskers are often obliquely or directly transverse to the last recorded ice movement, and to that extent the movement of the ice must have tended strongly to obliterate or sweep away the deposits of the subglacial streams as fast as they were formed. Stone says ('99, p. 426), "The longer meanderings transverse to the direction of ice flow certainly add some difficulties to the hypothesis of subglacial streams." This difficulty, together with the fact that the formation and maintenance of tunnels transverse to the ice movement is well-nigh inconceivable, and the further fact that eskers and the plains to which they are tributary were clearly formed at a time when the ice was so far wasted as to have a very irregular and fragmentary margin, have led Davis and other adherents of the subglacial theory to hold with the superglacialists that eskers were formed, mainly at least, after the ice became stagnant. But it is obvious that the control of the subglacial drainage demanded by the subglacial theory must originate in the motion of the ice, although it may, conceivably, survive the cessation of that motion. In other words, the subglacial theory of eskers requires us to suppose that the subglacial streams were established before the ice ceased to move, but that, as a rule, eskers were formed by these streams after the ice became stationary. This nice adjustment of conditions made the streams relatively long-lived, and makes it appear the more improbable that they promptly abandoned their courses when the eskers were finished. The meanders of eskers, which are certainly among their most constant and striking features, rather seldom exhibit any definite or causal relation to the topography of the bed rock and till; and since they cannot be correlated directly with the movement of the ice, the subglacialist can only suggest that they may have been determined by one or more systems of crevasses, of the existence of which there is little or no independent evidence. In view of all these considerations, it is perhaps not too much to say that the superglacial theory affords at once the simplest and most natural explanation alike of the general trend of eskers, the major deviations from this trend, and the minor deviations or meanders.

Length of eskers and esker systems. — In the absence of crevasses, superglacial streams are limited in length only by the breadth of the zone of ablation, and superglacial eskers only by the breadth of the zone of englacial drift which has become superglacial by ablation; and the last, in turn, depends upon the height to which the englacial drift has risen in the ice. We have seen that observations on existing glaciers are practically valueless as evidence of crevassing in the Pleistocene ice sheet; that the Greenland ice cap is free from crevasses except near the margins, where it breaks over the restraining mountains; that, if the Pleistocene ice sheet had been effectively crevassed (that is, from top to bottom) in its passage over the vast peneplain tracts of the glaciated areas, the crevasses would have been gradually obliterated during the extremely slow cessation of the movement, anterior to the period of final ablation of the now stagnant ice sheet when eskers were formed; that even on the moraine- and forest-covered outer zone of the Malaspina glacier, crevasses are practically wanting, the streams originating within this zone through surface melting being superglacial and so continuing as they flow down the terminal ice slope; and that glacial potholes are by no means conclusive proof of the existence of *moulins* or crevasses in the ice sheet at these points. Add to all these considerations the probability that such crevasses as might possibly appear in the ice sheet and survive the cessation of its motion would become clogged and closed by superglacial drift falling and washing into them, and it will be seen that the burden of proof fairly rests upon those who find in the crevasses of the Pleistocene ice sheet evidence of the non-existence of important superglacial streams.

During the period of growth and maximum development of the ice sheet, the entire volume of the drift must have been englacial, and through the processes of shearing and overriding it must have tended constantly to rise to higher and higher levels in the ice. As opposed to this elevation of the englacial drift, we have only the supposed fact that the velocity of the ice increases upward from the bottom, tending to bear down the upward-sloping shear-planes. Observation shows that this is true of alpine glaciers of high surface gradient, and doubtless it would be true, in diminishing degree, for the lower gradients of an ice sheet, if the viscosity of the section were uniform. It is in the highest degree probable, however, that, owing to the outward flow of the terrestrial heat or the rise of the isogeotherms, the temperature of the ice sheet during and after its prime increased downward, being highest at the bottom. This accords with Nansen's observations on the Greenland ice cap, previously quoted. Now the mobility of the ice, or its tendency to flow through the differential melting and freezing of its component granules, is a function of the temperature, inasmuch as it must increase with the temperature and reach its maximum at the melting point, which, as previously noted, may be lowered as much as one degree Cent. by the pressure. Here in the lower levels of the ice sheet is the true zone of flow, passing gradually upward into the colder zone of fracture, which normally terminates upward in the *névé*, in which the fractures are promptly healed by the freezing of infiltrating water, by settling, and by fresh snow fall. These considerations clearly suggest a tendency, at least, to a reversal of the law governing the vertical distribution of velocity; and the tendency of the upper layers of ice to bear down or depress the obliquely rising englacial drift will be neutralized to the extent or degree of the reversal. It is even conceivable that the distribution of velocity may favor or accelerate the rise of drift, and the writer feels that, in view of these arguments, the transfer of drift in large volume to a considerable height in the ice, and over a wide area, may be asserted with renewed confidence. Granted a waning ice sheet free from crevasses and well supplied with superglacial drift over a broad marginal zone, and the conditions are ripe for the development, through the agency of superglacial streams, of eskers and esker systems or osars equal in length and continuity to any which have been described.

The difficulties of the subglacial hypothesis are here relatively much more serious, since it requires us to postulate and maintain continuous ice tunnels from five miles or less to one hundred and fifty miles or more in length. In fact, the formation, either before or after the ice has ceased to move, of subglacial streams and tunnels from one hundred to one hundred and fifty miles long, extending back to points where the thickness and pressure of the ice must be very great and crevasses are practically impossible, can be accepted only as a last resort, or when the failure of the alternative explanation has been demonstrated.

Varying width of eskers.— The expansion of superglacial streams to form lakes of greater or less breadth is normal, and the most extreme variations in the breadth of eskers present absolutely no difficulty, while, as the product of subglacial streams, they are simply inexplicable, requiring, according to Stone, tunnels of all widths up to three fourths of a mile. The broad eskers described by Stone ('99, p. 440–444), in which a medial ridge of coarse gravel is flanked on either side by, and merges with, a plain of finer gravel and sand, the whole being often confined to one side of a valley by an ice border, and, like true eskers, crossing ridges from one valley to another, indicate, as recognized by Stone, the formation of a normal esker in a narrow channel, followed by a considerable expansion of the channel, permitting the deposition of the finer material of the bordering plain. This broadening of the channel might, in the case of a superglacial stream, be attributed to the melting back of the ice walls, or, better, to localized surface ablation due possibly to water saturating drift which has accumulated on the ice through previous ablation. So great is the difficulty of explaining these broad deposits by deposition in subglacial channels that Stone ('99, p. 444–448), after a careful study, reaches the conclusion that through the obstruction of the tunnel, perhaps by the sagging of its roof, the subglacial stream rose through crevasses with its burden of coarse gravel and became, for a longer or shorter distance, superglacial. Chamberlin, on the other hand, suggests that an ice tunnel became locally roofless, and then by lateral recession of its walls, the ice canyon became a lake. But it is obvious and generally conceded that superglacial streams afford by far the simplest and easiest explanation of these and all other lateral expansions of eskers, including the not uncommon terminal expansion, where the esker merges with the frontal plain or delta. The only serious questions raised by any one are as to the possibility of persistent superglacial streams with a sufficient volume of formerly englacial drift within their reach; and these difficulties disappear before the conclusions to which we have been forced that effective crevassing was of rare occurrence and high-level englacial drift abundant.

Concerning the more usual widenings of the eskers of Maine, Stone says ('99, p. 415), "When within about 75 miles of the coast, every few miles enlargements of the ridges are found which have various forms. Sometimes they are little tables only 200 to 300 feet wide and two or three times as long. These may be solid or may contain one or more shallow kettleholes. Here and there a hummock appears on top of the osar [esker], rising 20 to 40 feet above the rest of the ridge, and at these 'pinnacles' the ridge is generally broader than elsewhere."

Varying height of eskers. — Woodworth's correlation of variations of height with variations of original breadth of the esker deposit and of the ice channel in which it was formed, applies in only a limited number of cases. It does not, for instance, account for the broad and flat cols or depressions, or for the occasional high knolls or pinnacles, or for sharp crests of rapidly varying height. Except where Woodworth's principle does apply, or masses of ice have been buried by the growing esker, or it has suffered erosion, the subglacial hypothesis calls for substantial uniformity of height, or at least for an even and continuous crest line, as well as for a close approximation of the crest to the level of the terminal plain, with a gradual rise above that level to the northward if the stream was sufficiently long-lived to permit the complete aggrading of its bed. The superglacial hypothesis, on the other hand, explains coincidence in height with the terminal plain, but requires it only where aggrading has continued during the entire period occupied in letting the esker down upon the ground. When aggradation has ceased earlier than this, the final adaptation of the esker to the uneven surface of the ground may give rise to pretty much all the observed irregularities of elevation. The high points or knolls are, however, as previously noted, best explained as due to late deposits contributed by hanging lateral valleys, and this harmonizes well with the fact that they occur usually at a bend in the glacial river. The subglacial hypothesis, on the other hand, appears to leave the exceptionally high points unexplained. Height of the esker above its base and elevation above its terminal plain are not crucial tests; but the superglacial stream appears, on the whole, more competent than the subglacial stream to account for the observed facts.

Branching of eskers. — The subglacial streams of a stagnant ice sheet should branch in essentially the same fashion as the existing or postglacial streams of the same region, and the branches should, in general, be aggraded almost equally with the main stream. But this is clearly not the fashion of eskers, for they are little given to true, river-like branching, especially in their lower or more southern courses; and branches making large angles with the main esker are almost unknown. In fact, there are practically no branches, in the sense of minor tributaries to a main line, but we observe instead an occasional confluence of eskers of approximately equal size and length at very oblique angles, suggesting the primary rather than the secondary or lateral branching of rivers. This, as previously noted, is all precisely what we should expect in the case of superglacial streams on the comparatively high gradient of the marginal slope of the ice sheet, with so great a thickness of easily eroded ice above the base level that the main stream had no difficulty, with its higher gradient, in cutting its canyon below those of its lateral tributaries and making of the latter hanging valleys, in which the aggrading will necessarily be unimportant. Stone says ('99, p. 324) in this connection, "From whatever point of view we look, the difficulties are immense in accounting for the branchings of the rivers of the ice sheet, their directions and their relations to the relief forms of the land, the nature of their sediments, etc., on the theory that we are dealing with subglacial streams alone."

Double and reticulated eskers.— That the superglacial deposits, in the case where the bordering ice disappears before the underlying ice, afford a complete and satisfactory explanation of the double eskers has been noted; while as subglacial deposits they are essentially inexplicable, whether the adjacent and parallel tunnels which must be postulated are regarded as contemporaneous or successive in their formation and aggrading. Similarly, the reticulated eskers and kames are most easily explained as superglacial deposits, representing a delta-like branching of the superglacial stream at points where it was approximately base-leveled and the surface of the bordering ice had been reduced nearly to its level by general ablation. Another explanation would be that the deposit, formed in a lake-like expansion of the river, was split up into a network of ridges through the unequal melting of the subjacent ice while it was being let down upon the ground. It is an essential part of the superglacial hypothesis, that, while through subfluvial and basal melting the more or less perfectly aggraded deposits may be let down on *terra firma* without being seriously disordered, exceptions must occur of such character and frequency as apparently to explain every aberrant phase of esker formation.

Stone shows ('99, p. 465) that the reticulated eskers, like the broad eskers and esker terraces, are most readily and satisfactorily explained by supposing that the subglacial streams became, locally at least, superglacial. Again, he says ('99, p. 299) that subglacial streams crossing hills and ridges are inconsistent with the existence of crevasses which might divert the water, which "bides its time and at the first eligible transverse crevasse steals off sidewise toward the lower ground." Also, in the discussion which follows the tunnels are assumed and not accounted for.

Topographic relations of eskers. — The main points under this head have been duly considered, and it remains simply to note once more that the topographic relations of eskers are, practically without exception, more accordant with the superglacial than the subglacial hypothesis. The very usual haphazard relation of an esker to the contours of the bed rock and till is seen to be entirely normal for a superglacial deposit, while from the subglacial point of view, it is a perpetual enigma. Besides the general indifference of their trends to the modern drainage, which has perhaps been sufficiently considered, we have the fact that they are not, as a rule, distinctly contrasted in size or in the coarseness of the gravel on northern and southern slopes. The subglacial stream was comparable with the flow of water in a pipe, and the velocity for any given head was inversely proportional to the diameter of the tunnel, and independent of the local gradient, the velocity being the same on northern or ascending as on southern or descending slopes. But, obviously, the tendency to aggrading of the stream bed is far greater on northern than on southern slopes, in spite of the uniform velocity; and therefore the esker of subglacial origin should be stronger, more perfectly aggraded, and composed of much coarser material on the up than on the down slopes. This contrast may, perhaps, be noted occasionally, but it is by no means so marked or general as the hypothesis requires.

Eskers belong chiefly to the moderately dissected peneplain tracts and are not specially characteristic of deep mountain valleys where, unquestionably, the conditions were most favorable to crevassing and a concentration of the glacial drainage beneath the ice. Again, the usual lateral position of valley eskers is entirely normal for the superglacial and seemingly inexplicable for the subglacial hypothesis. To cite a single instance, in the village of Bridgewater, Nova Scotia, on the southwest side of the La Have river, the valley of which is here some three hundred feet in depth, a well-formed esker trends approximately parallel with the valley and at an elevation of about one hundred feet above the river. That a subglacial stream of water could have hung on this steep slope is well-nigh inconceivable and contrary, as previously noted, to all our observations on existing glacial streams. The fact, that, in general, eskers trend towards cols or depressions in water partings, calls for no special comment, since it is entirely consistent with both hypotheses.

Relations of eskers to the ground moraine. — Eskers, as well as their terminal plains, normally overlie the ground moraine or till, the only important exception being when, locally, the till is wanting and they are superposed directly upon the underlying bed rock. They are rarely, if ever, covered by till, or even sprinkled with bowlders, except such as might readily be supposed to slide or fall into a superglacial channel from the bordering slopes of ice. This relation is, in every particular, strictly normal for superglacial fluvial deposits, but the subglacial fluvial deposits could not possibly escape being covered by till and angular bowlders on the melting of the ice, except on the supposition that the englacial drift was so strictly limited to the basal portion of the ice during the esker-forming period as hardly to warrant its classification as englacial, which would make the maximum elevation of drift in the Pleistocene ice sheet distinctly less than in the Malaspina glacier and many of the Greenland glaciers. If the normal esker is of subglacial origin, then the englacial drift was indeed scanty and confined to very low levels in the ice; and the subglacial stream was deprived of one important and necessary source of detritus for aggrading its bed and building its terminal plain. The only alternative, apparently, is to suppose that the subglacial stream always held tenaciously to its course until finally, through the general process of ablation, superficial and basal, its tunnel became roofless at all points. This would mean, for one thing, that every esker was formed in part, or at the last, in earth-bottomed canyons open to the sky, which is impossible wherever the grade rises southward, as it practically does for nearly every true esker in some part of its course. The subglacial esker must remain under cover, under a roof of ice thick enough to hold the subglacial stream to a channel which, regardless of the ground topography, crossed directly or obliquely ridges hundreds of feet in height, until it is finished; and then, as a necessary corollary, the stream which made it must completely abandon its channel, perhaps scores of miles in length, before the esker is uncovered at any point south of which it rises to a higher elevation. How the subglacial stream is to be diverted while the ice is still several hundred feet thick above it, and how it fails, in general at least, to build an esker in its new channel, are points which have not, perhaps, been duly considered.

Several writers have emphasized, perhaps unduly in some cases, the brevity of the time required for the formation of an extensive sand plain and its tributary esker, a few years or even a single season being considered sufficient in most cases. On the other hand, we are asked to suppose that the subglacial tunnel, often many miles in length, is formed at a time when the ice still has a definite motion, to the controlling influence of which the tunnel is supposed to owe its general trend; that the meanders and transverse reaches of the tunnel are not obliterated by the motion of the ice; and that the tunnel as a whole survives the necessarily slow cessation of the ice movement. This insures to the tunnel and the stream which formed and maintains it a good degree of longevity and time for the slow building of the esker and terminal plain. But these deposits testify, in composition and structure, to rapid work by torrential streams, and the stationary ice margin during their formation points unequivocally to the same conclusion. It is an interesting question, therefore, as to what the subglacial stream was doing during the relatively long period of its existence anterior to this brief period of tremendous constructive activity, and also as to why it should then abruptly abandon the channel to which it had adhered so long. In brief, the trend of the subglacial stream demands ice control and a long life; its deposits demand a short and intensely active life followed by a sudden disappearance from the scene of its labors. But whether it be long- or short-lived, its existence should be recorded in the ground moraine, in the form of interbedded gravels before the ice ceased to move, and of erosion channels after the ice became stationary. These phenomena, however, are of rare occurrence, and still more rarely can they be correlated with subglacial streams or eskers. This important problem will receive further consideration in connection with the source of the material of eskers and sand plains.

Relations of eskers to frontal and delta plains.— The main facts under this head are well determined and there is little question or controversy concerning them. My purpose is simply to call attention to the very numerous plains of modified drift, including many true delta plains, which have no tributary eskers and apparently never have had. They have, however, undoubtedly been formed through the agency of glacial streams. If these were superglacial streams, the explanation of the absence of associated eskers is simply, as previously noted, that the plain was formed and the stream diverted before its channel was sufficiently base-leveled to permit any notable aggrading. But if, instead, they were subglacial streams, the aggrading of their beds must have been in progress during their entire existence, or at least during all the time required for the formation of the terminal plain, and the aggrading must, approximately, have kept pace with the upward growth of the plain, else we should not have the good general agreement in height between eskers and plains so commonly observed. That a large majority of superglacial streams should disappear and leave no record, save in the terminal plains, is not surprising, but it is difficult to understand how subglacial streams can do the same. They should certainly be marked either by aggraded or by eroded channels, for we cannot suppose that eskers were formed and subsequently swept away by currents which left the ice-contact slopes of the sand plains intact.

Composition and structure of eskers. — Little need be added here to what has been noted under the characteristics of eskers. The true significance and evidential value of the main facts have been well expressed by Stone, where he says ('99, p. 424), "My conclusion is that where the whole of a ridge of till, from which the finer detritus has plainly been washed by water, has lost all signs of stratification and has a pell-mell structure, the best interpretation is that it was deposited upon the ice in a superficial or englacial channel, and that when the ice underneath the sediment melted, the gravel slid down irregularly and the original stratification was lost. In general we remark: A stratified internal structure is consistent with either subglacial or superglacial streams. Pell-mell structure of a large mass of glacial gravel strongly favors the hypothesis that it was deposited on the ice, not beneath it." Add to this confession of a subglacialist the undoubted fact that the structure of the typical esker is essentially pell-mell, or at least chaotic to such a degree that Davis ('92, p. 489) has hesitated to describe the very normal eskers of the Boston Basin as stratified in any true or ordinary sense, and that the occasional appearance of anticlinal stratification must be chiefly, at least, the result of sliding as the gravel gradually adjusts itself to the slowly vanishing walls of ice, and it becomes apparent that no argument fatal or even inimical to the superglacial origin of eskers lurks in the coarse, rude, chaotic or anticlinal structure of the latter. Even the open-work gravel, on which Davis so confidently relies, appeals to me as finding its readiest explanation, as previously noted, in the loosening up and differential settling of the coarse and irregular detritus during the melting and vertical recession of its icy floor, and I make bold to claim it as a specially cogent argument for the superglacial origin of the eskers in which it occurs.

Stone's monograph is the most complete contribution yet made to the natural history of eskers, and no one has discussed the theory of eskers more fully and impartially. In fact, his work is particularly notable for the judicial and fair-minded attitude toward the rival hypotheses which it reveals. Although holding, with Chamberlin, Davis, and others, that the subglacial hypothesis affords the best explanation of a certain ideal type, he is disposed, as we have seen, to refer the wide eskers, the branching eskers, the reticulated eskers, the unstratified eskers, and perhaps others, to the agency of superglacial streams. These concessions are certainly sufficient to give the superglacial hypothesis a good standing; and the chief objection urged against a still broader application of this hypothesis is the supposed prevalence of crevasses in the marginal zone of the ice sheet, a supposition which is, in my opinion, essentially groundless.

Source of the material of eskers and their terminal plains.— The all-important question here is as to whether the material was derived chiefly from the englacial or the subglacial drift, and if from the former, whether it was supplied to superglacial streams through superficial ablation or to subglacial streams through the erosive action of the stream itself on the roof and sides of its tunnel. Assuming, in view of the preceding discussions, that the englacial drift was sufficiently abundant and extended to a sufficient height in the ice to meet the requirements of esker and plain formation through the agency of superglacial streams, and recalling that all the drift set free by superficial ablation is virtually within easy reach of the superglacial streams and available for the aggrading of their beds and deltas, we may now give our attention particularly to the subglacial streams.

The subglacial drainage could derive but little detritus from the englacial drift without such an enlargement of the tunnel as would cause its collapse, and it is, therefore, practically limited to the subglacial drift or ground moraine, for crevasses are probably wanting; and even if they were not, to depend upon detritus washed into them from the surface of the ice sheet would be, as we have already noted, to grant a greater volume and height of englacial drift than subglacialists have heretofore been willing to allow. What opportunity has the subglacial stream to erode the ground moraine? On the first obstruction of its mouth, by standing water or terminal deposit, it must begin to aggrade its bed, and erosion here almost or wholly ceases. We have already noted the absence of tributary streams, and if such existed, their beds also, at least in their lower courses, would necessarily be aggraded with the bed of the main river. On either side of the tunnels the ice rests heavily upon the ground, and the marginal lakes of valley glaciers as well as crevasses filled with water show that the basal contact must usually be so tight as to permit a movement of water only by seepage, which could, at the best, effect the removal of only the finest or clayey part of the drift. The absence of an adequate available supply of material is, to my mind, the most serious of all the objections to the subglacial theory of eskers. Anyone who considers the great extent and depth of many of our delta plains, and the vast volumes of material required to form them and their tributary eskers, will not doubt that, if derived from the subglacial drift, the latter should show extensive erosion over the areas to the northward. But we look in vain for evidence of such erosion, although its record should be very distinct in the cases where many millions of cubic yards of sand, gravel, and bowlders have been delivered through a single narrow channel, not to mention the still greater volumes of clay and quartz flour which we know must once have been incorporated with the coarser detritus. If the subglacial hypothesis be true, the region to the north of some of our extensive sand plains ought to have been, in large part, swept bare of till or ground moraine; but we do not find it so, and it could not be so, as long as the ice sheet rested upon and protected it.

Davis concluded that the Newtonville and Auburndale eskers must be products of subglacial streams acting on subglacial drift, because they contain fragments of slate and conglomerate which must have been derived from the ledges within two to four miles to the northward, and he thinks it improbable that englacial drift could, in so short distance, rise to the level of superglacial streams. The proportion of material from nearby sources is, however, very small, certainly not more than ten and possibly not more than five per cent, and the elevation of this small fraction of the drift a hundred feet or so in, say, three miles does not impress me as offering any special difficulty. Still farther within the Boston Basin, as in the vicinity of Newton Upper Falls and West Roxbury, at distances of from four to eight miles from the granitic northern border of the basin, the proportion of drift of local origin in the eskers and sand plains is still very small, the granitic rocks from the northern highlands constituting from 90 to 99 per cent of the whole, while neighboring sections of till show, as usual, that the ground moraine is mainly of strictly local origin. As I have previously stated, this contrast is what we should expect in any case, since the modified drift has been transported by water as well as by ice; but it is also evidence, if not complete proof, that its glacial transportation was in part englacial. In the eskers to which Davis particularly refers, the detritus of relatively local origin is found near the top as well as near the bottom of the section, though perhaps less abundantly, and *that* detritus is surely even more of a difficulty for the subglacial than for the superglacial hypothesis, since it presupposes that the subglacial stream could erode the bed rock or till above which it had already aggraded its channel from fifty to one hundred feet.

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MEMORIAL OF PROFESSOR ALPHEUS HYATT.

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No. 4.— MEMORIAL OF PROFESSOR ALPHEUS HYATT.

At the General Meeting of the Society held on February 5th, 1902, the President, in the following words, made the formal announcement of the death of Professor Alpheus Hyatt: —

"It is with profound regret that your President has to make the formal announcement, in order that it may appear in our official records, of the death of our honored Curator, Professor Alpheus Hyatt. When we last met here, we missed him from among us, and as he was so constant and faithful in his attendance, many of us doubtless wondered why he was not with us as usual, little suspecting the sad end which deprived us of his presence forever. It was on his way to the meeting of the Society that he was stricken down, his last act being one of faithfulness to that interest in the welfare and needs of the Society which was so strong in him and to which we have owed so much.

"He passed away suddenly as he had wished to pass away. We know now that had he lived, much suffering must have come to him, and we must therefore be content that he has been spared this, though it cannot lessen our loss.

"It is not the time now to attempt an estimate of his work, a review of his life, or an analysis of his services to the Society. And yet we all must wish to pay our tribute to him, and it seems to me that this tribute naturally comes in a triple form. The first form is personal and from each of us. He was always most courteous to every one who approached him in this building, most helpful to those who needed help, and most appreciative of every offer to promote the welfare of the Society. One did not need to be a distinguished scientific man to receive from him a welcome and attention, but every member of the Society has felt his kindly presence, his sympathy, his entire freedom from all feelings of jealousy, of envy, as illustrations of a character which may well serve us for example and encouragement.

"The second form of tribute is the preservation and completion of the plan for the arrangement of the collections in our Museum. This plan he had formulated. It is in itself excellent, but has never been fully completed. He had recently been especially interested in the discussion of arrangements for the perfecting of this plan and for carrying it out in a more effectual manner. I hope, therefore, that the Society will regard it as a duty to build up the Museum according to Professor Hyatt's fundamental scheme, making it our monument to him.

"The third form of tribute which I think we all desire, is that of a memorial meeting to be held under the auspices of the Society, and I should like to suggest to you that such a meeting be held. I think that the Association of the teachers from the Teachers' School of Science would be glad to join with us, for they have already expressed their desire to hold a meeting such as is now suggested. The members of Boston University, of which he was a professor, will also wish to have their share in such a ceremony. I can only suggest this plan. I must leave it to you to decide whether it corresponds to your actual preference. Such a meeting cannot, of course, be held at once, for the occasion will require some one to pronounce a eulogy, the preparation of which ought not to be hastened. It is evident that the decision as to this and to all subsidiary questions must wait. But, after all, the greatest tribute to Professor Hyatt will always be the spontaneous sorrow of his many friends and pupils."

The Society unanimously voted that the Council be requested to make arrangements for a suitable memorial meeting, and accordingly, on April 25th, 1902, there was held a meeting under the joint auspices of the Society, the Teachers' School of Science, and Boston University. Dr. Charles Sedgwick Minot, President of the Society, presided. He opened the meeting with the following remarks on the life of Professor Hyatt: —

"Alpheus Hyatt, a descendant of an old Maryland family, was born, April 5th, 1838, at Washington, D. C. He died at Cambridge, Mass., on January 15th, 1902. His death was sudden and occurred while he was on his way to attend a regular meeting of the Boston society of natural history. In 1856, when eighteen, he entered the freshman class at Yale and remained in that college one year. In 1858, he went to Harvard, in order to study under Professor Louis Agassiz, and graduated from the Lawrence Scientific School in 1862. He served during the latter part of the civil war in the Union army, and retired with rank of Captain. In 1867 he married Miss Ardella Beebe, and in the same year he went to Salem, together with E. S. Morse, A. S. Packard, and F. W. Putnam, his fellow pupils under Agassiz and his life-long friends. They worked together at the Peabody academy and for the establishment of the American naturalist. In 1870 he became the Custodian, in 1881 the Curator, of the Boston society of natural history, which position he held at the time of his death. He was professor of zoology and paleontology at the Massachusetts Institute of Technology from 1870 to 1888, and Professor of biology at Boston University from 1877. He was the founder of the seaside laboratory at Annisquam, and took the leading part in the foundation of the Teachers' School of Science and of the American society of naturalists. He was elected a member of the National academy in 1875, and since then to corresponding and honorary membership in numerous scientific societies. He received the honorary degree of LL. D. from Brown University in 1898."

ADDRESS OF PROF. EDWARD S. MORSE.

Mr. President,—

I am asked to speak of Professor Hyatt's life in his early Cambridge days. An intimate friendship of forty-three years, extending from early manhood to mature life, is, in some respects, a bar to the critical study of a man's life. Everything is taken for granted, nothing offends. It is as if one undertook to describe one's self, for such friendships blend and it is hard to get a perspective. If one could have some premonition of a man's future eminence, one might assume the character of a Boswell, but the free and happy ways of a student's life give little thought for the morrow. In order to get a personal view of Hyatt in his student life at Cambridge, it is necessary to preface it by a sketch of his environment at that time. The associates with Hyatt, now living and who have continued their scientific work, were the younger Agassiz, Scudder, Putnam, Shaler, Verrill, and the writer, and later Bickmore and Packard. Of these, Agassiz lived with his father, Scudder lived at his home in Boston, Hyatt had rooms in Divinity hall, while the rest of us lived in a wooden building which stood on the present site of the Peabody museum. Our rooms were in the second story of the building, the doors of our chambers opening into a large, square, central room which we used for meetings of the Agassiz zoological club. This club was organized in 1860, and we met once a week to read papers and discuss questions connected with our work. Professor Agassiz often attended these meetings and endured patiently our papers, and afterwards commented upon them adversely, or otherwise. Agassiz's conversations at these times were very inspiring. He gave interesting reminiscences of Humboldt, Cuvier, Döllinger, and many other eminent men. Hyatt always attended these meetings and took an active part in the discussions. In looking over my journal, kept during these years, I find no indication that Hyatt entered into the fun and revelries of student life. These revelries were usually of an innocent nature, consisting, among other things, of running to some conflagration and returning afterwards to eat cold mince pie and talk over the events until daylight. As a young man he was contemplative and took life seriously; despite this sober attitude he was brimming over with good nature and was fond of a good time and a good dinner, laughed heartily at a joke and often told one even when he was the victim of it.

An early associate of his, Mr. Emerson, was sober and even austere in his manner. They were much together, living in the same building, and this intimacy undoubtedly exerted an influence on Hyatt.

He was devoted to his work, indeed we all were, and I recall the fact that while the college was deserted in the summer months we were among the few that found greater delight in our work at the museum than in availing ourselves of the usual vacation. Hyatt's concentration to his studies gave him the appearance of an absent-minded man. His attention was, indeed, absent from the immediate surroundings, but was by no means wandering in other directions. So absorbed would he become at times that he appeared to be in a dream, from which state he could be aroused only by some startling demonstration either in the form of a slap or a shout. As an illustration of his absorption, I recall an incident connected with his studies of the fresh-water Polyzoa. At the time of this investigation he spent a few weeks at my house in Maine. He had just come into possession of a new Wales stand. Now this microscope had the exasperating peculiarity of construction whereby the coarse adjustment turned in just the opposite direction from the universal way. In the quiet of our work I would hear an ominous crack, followed by an explosion from Hyatt with the exclamation, "There goes my objective again!" And this occurred day after day. I must mention another incident illustrating how thoroughly he would become absorbed in his studies. He was specially working on certain principles of classification, the outlines of which were then dawning upon him. He sat down at a table opposite me to write out some views we had been discussing. The table was covered with books, the inkstand being on my side of the table. So absorbed was he, that no unconscious cerebration led him to move the inkstand to the middle of the table whence it would have been easily accessible. On the contrary he was forced to reach his pen over a few of the books in order to get at the ink. Noticing this, I began to hedge the inkstand in with books more completely; book after book was added to the impedimenta. Without once noticing the obstructive ramparts I was building up, he had partially to rise from his chair in order to fill his pen. Finally I perched a huge dictionary on top of the pile, and then only, when he had fairly to stand up in order to get at the ink, he broke out with, "Confound it, Edward, what have you been doing!"

I have rarely conversed with one who was so stimulating as Mr. Hyatt. Every idea brought up in discussing some problem of classification excited a response which in turn opened new avenues of thought. As students, we learned Agassiz's "Essay on classification" by heart. So eloquently did Agassiz set forth the embryological system of von Baer that it made a profound impression upon us. The physio-philosophical system of Oken and the high praise accorded him by Agassiz also had its influence, and Hyatt was led to consider his investigations from points of view induced by the ideas enunciated by these great men.

I have always believed that Hyatt's studies of the features attending old age and ultimately his theory of acceleration and retardation received their first impulse from a graphic lecture given by Agassiz on the ammonites of the Jura. In the upper beds of the Jura, as it is well known, the ammonites assume bizarre forms, the whorls become uncoiled, free, and variously turned. In this lecture, Agassiz, by way of metaphor, compared the appearance of these ammonites to the contortions and death struggles preceding the extinction of the group. In referring to these curious forms he said: "As if the contortions of death was an idea on which the forms of life were built! I do not say we know enough to make it certain it is so, but I do not see why they are not features upon which life itself is built." Hyatt was at this time working on the fresh-water mussels of North America. He had collected a large amount of material from the Ohio and other rivers and was hard at work on the anatomy and classification of the family. After this lecture he turned has attention to the ammonites, and his first paper, read before the Agassiz zoological club, March 22d, 1860, was on the ammonites of the Jura, and in that paper he began a series of investigations which only ended with his life. His various memoirs on this subject were published by the Boston society of natural history and the Museum of comparative zoology. His very extensive memoir, published in cooperation with the Museum of comparative zoology, on the Genesis of the Arietidae formed one of the Smithsonian contributions to knowledge.

My task would have been easier had I been asked to analyze the man through his works. This task, however, has been assigned to others, yet I cannot refrain from calling attention to the extent and diversity of his works as shown in the very numerous communications to scientific societies. A study of these memoirs shows a unity of purpose and a continuity of thought which, considering their extent over forty years of time, is somewhat remarkable. Many of these memoirs were beautifully illustrated by their author, whose artistic and accurate pencil aided greatly in making clearer the somewhat abstruse principles involved in his studies. It seems a wide jump from the study of fossil cephalopods to living fresh-water Polyzoa, yet it is easy to explain. Agassiz had so impressed us with the classification of Cuvier that we never doubted the existence of four great plans of structure in the animal kingdom. Indeed nothing could be plainer than the radiate type, the articulate type, and the vertebrate type; the molluscan type was not so clear in our minds. We could follow out the homologies of the three higher classes of Mollusca, but precisely how the Polyzoa and Brachiopoda came under the same category was a serious difficulty in the way of that conformity so apparent in the other branches. I have always felt that Hyatt was first led to the study of the Polyzoa, the results of which were finally published by the Essex institute, simply to make clear the molluscan affinities which were supposed to exist. I know that my attention was first drawn to the Brachiopoda for this purpose. We often discussed their relationships, and our first published conclusions show what violence may be done to creatures in forcing them into relationships which have no existence in nature. Hyatt was always attracted to groups of animals which showed great individual variation correlated with external causes. This impelled him to take up the study of a most difficult group of creatures, the sponges. His "Revision of the North American Poriferae," published as a memoir of the Boston society of natural history in 1877, is an instance of this impulse. In this memoir he showed the profound way in which he grasped the difficulties of this protean group. It was this same impulse that led him to a minute study of the Achatinellidae of the Hawaiian islands, a group of land snails showing an infinite variety of color patterns. At the time of his death he was about starting for these islands to complete a series of investigations that he had carried on for several years. Much of the work had been done and, fortunately for science, his son-in-law, Doctor Mayer, has volunteered to complete the work. Hyatt's investigation of the fossil fresh-water shells found in a circumscribed area at Steinheim, near Stuttgart, was animated by a desire to ascertain if the same laws of growth and decay could be found in this group which was limited to a short period of time, as those laws of growth he had demonstrated in the Jurassic ammonites covering an immeasurable period of time. This memoir was published in 1880 and exhibits again the minute and painstaking manner in which he grasped an infinite mass of detail. Not content with studying the material of the Steinheim deposits which he was permitted to examine in various collections abroad, he visited the quarries and made new and extensive collections of the fossils *in situ*.

That his principles of acceleration and retardation, his old age theory, and other views of the stages of life are not yet fully grasped, is true. Many have not understood them. Though they are all evolutionary, yet Darwin himself was perplexed. I may be permitted to give an extract from a letter which Darwin wrote to me concerning this very matter. In this letter he asks, "What is the meaning of Professor Cope's and Hyatt's views on acceleration and retardation? I have endeavored and given up in despair an attempt to grasp their meaning." Slowly, however, his views are being applied to the consideration of various groups of animals, notably by that acute observer, Dr. C. E. Beecher, of Yale, who has applied Hyatt's principles of growth and decline to the paleozoic brachiopods, and Dr. R. T. Jackson, of Harvard, who has not only discussed the lamellibranchiate molluscs from Hyatt's standpoint but has made additions to Hyatt's nomenclature.

Hyatt was constant in his friendships, his manners were always courtly. He rarely discussed local or national politics, though he held pronounced views on these subjects. He was absolutely indifferent to adverse criticism, for, with a natural sense of justice, he permitted others to enjoy their own opinions. He regarded with equanimity and even kindness the inability of his friends to grasp fully the principles which he had enunciated and in which he was completely absorbed. Fully convinced that time would prove the truth of his views, he never expressed any impatience at their slow recognition. He was never aggressive, but pursued with infinite assiduity and slow German patience the various investigations he entered upon at different times.

Science has indeed met with a very great loss, and those who knew him and loved him are inconsolable.

ADDRESS OF PROF. ALPHEUS S. PACKARD.

Mr. President, —

It has been assigned to me on this memorial occasion, to give my impressions of the value to science of Professor Hyatt's investigations.

His work was mainly confined to zoology, to a study of the morphology and phylogeny of the molluscs and allied groups, but more especially to the fossil cephalopods.

While he may be regarded as a specialist, having devoted the greater portion of his life — some forty years — to the study of the cephalopod molluscs, particularly the ammonoids, he was also an all-round man, a thinker, a generalizer, a philosopher. Whatever problem he attacked, — and his selection of problems was characteristic, for they all had an evolutional bearing, or related to the laws of heredity, — he not only worked out the facts with great skill and patience, exhibiting a Teutonic power of concentration and dogged perseverance, but throughout his special labors, he constantly thought over the general relations and remote bearings of the facts. He kept constantly in mind the ultimate problem of the working biologist: How did life-forms originate?

He was no closet naturalist, but from youth to mature life had a wide experience in out-of-door work, or bionomics. He was not a mere paleontologist, for he was a good field geologist, and in studying the European ammonites acquired an intimate knowledge of the stratigraphy of the ammonite-bearing beds, and of the succession of species and genera from the lower to the higher strata.

He was from start to finish a many-sided zoologist, studying the embryology and morphology not only of the molluscs but of the fresh-water moss-animals (Polyzoa). His most important work in systematic zoology was in assigning the sponges in 1876 to a separate phylum or branch of the animal kingdom, this being the outcome of special work not only in their classification but in their structure and embryology. Although anticipated by MacAllister in referring the sponges to a separate phylum, his own conclusions were the result of independent labor.

The intellectual environment of young Hyatt and others at Cambridge early in the sixties was a complicated and somewhat perplexing one. Louis Agassiz instilled in the minds of his pupils broad ideas, including those underlying the doctrine of transformism. He earnestly advocated the recapitulation law suggested by Meckel, von Baer, and Vogt, giving it much greater expansion as the result of his own extensive researches, particularly in the direction of geological succession. But here he paused, and it was reserved for Fritz Müller, in 1864, and afterwards Haeckel, to add the obvious evolutionary bearings of those facts. Jeffries Wyman was not inhospitable to the theory of descent. Darwin's "Origin of species" had just appeared, and was the subject of much discussion and thought. Haeckel's "Generelle morphologie" was eagerly read by Hyatt, and proved a stimulus to his thoughts, as did Herbert Spencer's "Principles of biology," with its views as to the mechanical origin of structures. It was a time of vigorous thinking. Young Hyatt, like many another neophyte at that date, was buffeted by the most opposing currents of thought, and swayed, though perhaps not so greatly influenced, by every wind of doctrine — since from the early sixties he pursued the even tenor of his own way. He states explicitly that in 1859, or within a year after the beginning of his life as a student under Louis Agassiz, he had become an evolutionist (Cycle in the life of the individual, etc., 1897).

His studies, carried on in an independent spirit, after some gropings in the dark, as seen in his paper on "Parallelism," etc., led him into the path which Lamarck had blazed out half a century previous, though the landmarks had been overgrown or concealed by the temporary growth of the underbrush of reactionary thought.

Natural selection as an active or efficient cause never appealed to him; he regarded it as simply expressing the results of the action of the Lamarckian factors.

Working alone year after year on the rich and well selected collection of nautiloids and ammonites in the Museum of comparative zoology, young Hyatt, while doing an immense amount of purely objective work, classificatory and stratigraphic, finally put himself in the front ranks of paleontologists. He became a leader in the modern methods, a master, and lived to see his views as to the classification and genesis of the shelled cephalopods accepted by such men as Neumayr, Zittel, and others in Germany, by Bernard in France, and by the younger generation of paleontologists in America.

We would not forget the debt we owe to James Hall, Billings, Meek, Wachsmuth and Springer, Whitfield, and others; to invertebrate paleontologists in Europe, such as Quenstedt, D'Orbigny, Suess, and especially the illustrious Barrande, but as regards invertebrate paleontology, Dr. Hyatt led the way to a new phase of the science. For after the date of the appearance of Darwin's "Origin of species," biology and particularly the study of extinct beings entered upon an entirely new line of development.

The shell-bearing cephalopods, particularly the ammonites, are especially favorable for the line of work Professor Hyatt took up. He had access to large series of these forms; he was led perforce to study with care their geological succession, their variations, and probable migrations. Such a study carried out in a broad way by a good field naturalist, was bionomics carried back through the geological ages. He soon established the lines of descent of genetic series, and worked out the phylogeny of this or that group, where the materials were especially suggestive and favorable, and this led him to consider the action, throughout past ages, of the Lamarckian factors, of the effects of migration and geographical isolation such as are known to take place at the present day, and from a study of these subjects he was led to consider how the orders of cephalopods originated.

He showed that the efforts of the primitive straight-shelled nautiloid (Orthoceras) "to adapt itself fully to the requirements of a mixed habitat of swimming and crawling gave rise to the Nautiloidea; the efforts of the same type to become completely a littoral crawler evolved the Ammonoidea. . . We cannot," he says, "seriously imagine these changes to have resulted from intelligent effort; but we can, with Lamarck and Cope, picture them as due to efforts on the part of the animal to take up new quarters in its environment and then acquire habits and structures suitable to the changed physical requirements of its surroundings, and this position is better supported by facts than any other hypothesis."

A most interesting problem is the origin of the spiral shell of the snail-like molluscs. Hyatt was the first, we believe, to point out the obvious correlation between the gradual coiling of the shell and the habit of crawling or gliding. He shows that those gastropod shells which degenerate and tend to lose the spiral mode of growth and become irregularly straightened out in their older stages of growth, are forms which become attached or which lead sedentary lives. He points out the tendency in the descendants of straight shells (Orthoceras, etc.) to become, as the result of assuming reptant habits, first arcuate and then coiled, these being acquired characters which have been "introduced late in the ontogeny and gradually forced back to younger and younger stages in successive generations, or species, or genera." He also accounts for the peculiar horizontal or peripheral growth of the oyster, the scallop, etc., by their fixed or partly sedentary mode of life.

His most peculiar investigation, and one which brought into play his characteristics as a patient analytic student of facts and as a synthetic philosopher, was what he was fond of calling his "old age theory." The idea was suggested by D'Orbigny in his early studies on the ammonites; and it is a most striking and captivating one, being exemplified in other groups of animals than the molluscs. We all know that in molluscs, as well as trilobites and crustaceans, during the evolution of the type, the earliest stages are simple, unornamented, generalized forms, which eventually give rise to those which are more complex or generalized, becoming more or less ornamented with spines and various kinds of markings; or in the case of the ammonites, the septa, at first simple, become divided into folds, and these later become more complex by being beautifully frilled, showing a high degree of specialization. Then the vitality of the over-ornamented organism wanes; it falls into a decline, and old age characteristics develop, such as the effacement of tubercles, folds, and frills, and there is a return, in the descendants of the specialized forms, to the simplicity of form and lack of ornamentations of the primitive ancestors of the group. In other words, there is in certain groups, as in the individual, a period of infancy, youth, maturity, and decline or senility, and in certain classes this is followed by the death or extinction of the class. Paleontology shows us that the type arises, becomes strong and successful in competition with others, then, as if overloaded and enfeebled by its luxurious growth, begins to decay, and finally is driven to the wall by the incoming of more vigorous, aggressive, and highly specialized types. Such has been the case with the classes of graptolites, trilobites, and ammonites. The same law obtains in the history of human races. Gibbon traced the rise, culmination, and decline of the Roman empire. Savage races fade away at the approach of those more civilized, or if they survive, show traces of decay and decrepitude.

Now all these facts and laws were for many years a favorite study with Professor Hyatt, and he worked them out with great detail and thoroughness in his various papers on cephalopod molluscs. He traced the law of acceleration in some characters, and of retardation in others, and showed that these laws were largely conditioned on changes in the environment, on competition, on use and disuse.

He also extended and carried out the idea of Darwin and others that the evolution of species and genera was more rapid in the early geological periods than now. He emphasized the view that a type in beginning its career, on migrating into unoccupied regions, under new conditions of life, and free from competition, varies, greatly accelerates its development, and thus gives rise to new groups. He worked this out for ammonites and in a specially striking way for the Steinheim tertiary shells, and was engaged on the same problem in the case of the existing land shells of the Hawaiian islands. Indeed, he had planned to go to these islands early this spring to study on the spot the causes of the remarkable local variations in these snails, to which attention had been called by the suggestive essays and rich collections of the Rev. J. T. Gulick. The research as begun by Professor Hyatt is a beautiful one, and he went about it in his usual skilled and thoroughgoing way. He had made for his purpose a large plaster model of Oahu, with each range and valley in miniature, indicating the shells in their respective habitats, and representing the lines of migration and origination of new local species by variously colored cords.

The working out of these various problems and showing their connections with the larger and broader phases of biological and geological science were the delight of Professor Hyatt's life. Such theories and views are the poetry of science. They make the life of the naturalist who is obliged to undergo so much drudgery in species-work, nomenclature, etc., worth living.

There are those who are fitted to do excellent analytic and special work, but who are not gifted with the power of generalization, and deprecate all synthetic speculation. They seem unaware of the fact, that, by the framing and use of hypotheses and theories, we forge the instruments by which we open up new fields of research and of discovery.

Professor Hyatt completely resisted and overcame the dangers of too great specialization. In his own generation, if we mistake not, he will take rank with Haeckel, Cope, Marsh, Gaudry, Bernard, Neumayr, and others, who have by their researches placed the science of paleontology on a vastly higher plane. Fossils are not now regarded as time-marks simply, but in the light of modern morphology, they serve to call up hosts of ancestral forms, the founders of the lines of descent, ending, many of them, in forms now living.

Such are some of the labors accomplished by Professor Hyatt, whose death we so deeply deplore. To many here assembled he was a teacher, an adviser, a guide; to others, a fellow-worker, and to all, a source of inspiration.

ADDRESS OF PROF. WILLIAM M. WARREN.

Mr. President, —

It was a happy thought on the part of those who arranged for this memorial meeting, that the speakers should represent several aspects of Professor Hyatt's life and work. And certainly no retrospect of the life work of the man whose memory we are honoring to-night, can be complete without including his long term of service as Professor of biology in the College of liberal arts, Boston University.

It was in 1877 that he assumed the responsibilities of the head of this department in our college curriculum, and he carried them uninterruptedly until the time of his death. He organized the courses in biology and was himself a regular lecturer all through these twenty-four years. His able assistant, Mr. Van Vleck, was of his own choosing, and the methods of the department were entirely left to Professor Hyatt's own determination. Thus in this part of his life work, it seems to me, we can find peculiarly free and untrammeled manifestation of Professor Hyatt's capabilities and ideals as an instructor.

In all the history of modern education there is hardly any fact of such significance for the development of science, both in the dissemination of its best results among the educated classes and in the training of the young men from whose ranks science is ever taking new leaders and discoverers, as the utilization of scientists themselves as educators. It is eminently desirable that the discoverer shall be the teacher, on at least two accounts. In the first place, the scientist, as a teacher, enjoys the great advantage of having his knowledge at first hand. He is no middleman, taking with one hand what he dispenses with the other, indoctrinating his students into the same indirect knowledge that he has himself, the knowledge which is not of the thing itself but about the thing. He is rather like the surgeon at his clinic, who takes his students into his own serious work and lets them look for themselves at process and method and result. I shall never forget the enthusiasm and reverence that the biology students at the university in Jena felt for the man who was both Haeckel of the great world of science and Haeckel of the little world of their own university life. And a second reason why this combination of scientist and teacher in one person is desirable, is, that such a one brings into his work as a teacher the very atmosphere and finer spirit of science. His work is not with the desiccated product of some other man's mind, accepted critically or uncritically. He is one and the same man in all his dealing with the truth, whether he is finding it out for himself on the frontiers of knowledge or sifting and weighing the conclusions of his fellow workers or teaching truth as truth and hypothesis as hypothesis. It is impossible for such a man to split himself up into investigator and pedagogue; he must bring into his teaching the enthusiasms and the methods of investigation.

On the other hand it cannot be denied that there are certain grave dangers connected with this combination of the two offices. There is the peril, for instance, that the investigator will teach in the spirit of his particular specialty rather than in the spirit of his science as a whole or of the whole group of sciences within which his own science and his own specialty are set. He will naturally feel more the interest attaching to the peculiar group of problems with which he is concerned as an investigator than that attaching to the broad principles and the more general or fundamental problems that are of prime importance for the beginner and for the seeker of a general education. Closely allied to this danger is another, — that the investigator shall make too much of those parts of his science around which strife and controversy centre and that he shall teach in a partisan spirit. Both these dangers are by no means imaginary. We have only to glance back through the centuries in order to see how disastrous the effects become when the teacher forgets that he is a guide and not a captain, and that his chief concern is with the truth that already stands fast rather than with polemics and dispute.

Perhaps the deepest reason for the gratitude that Boston University cherishes for its late Professor of biology is our clear recognition of the admirable way in which Professor Hyatt actualized the advantages of which I have just spoken and the no less admirable way in which he avoided these perils.

In all his personal work in the department, it was perfectly evident to the class that Professor Hyatt spoke from knowledge at first hand. He had the scrupulous regard for fact that characterizes the man that knows at what pains facts are determined. When he spoke of sponges and called a sponge a sponge, we knew that there was many a variety of sponge that owed to Professor Hyatt its scientific existence and its very name. And when he mentioned ammonites and nautiloids we felt that he knew them through and through, straight, coiling, close coiled, and uncoiled, and had read in the sequence of their forms the larger principles by which facts are organized into science. In one of his dialogues Cicero mentions a man that spoke with such certitude that he seemed to have come direct from the council of the gods. We who were in Professor Hyatt's classes did not feel exactly in this way about him, but we did feel that he had come direct from interviews with things themselves and that he had brought with him the certitude that comes as the reward of detailed study and comprehensive synthesis. And all this direct knowledge he knew how to employ to the student's best advantage. He was wise in selection of that which is essential to a broad elementary course. In his style of teaching he was simple and direct, with no regard for needless forms. He knew how to make a thing plain, and how to use plain terms. I remember well how much more my own class was interested in what Professor Hyatt called fore-and-aft symmetry than it could have been in what with many another teacher would have been antero-posterior symmetry. Professor Hyatt actualized fully the second advantage of which we were speaking a moment ago. He brought into his class work and into the clear consciousness of his students the methods by which living science grows. He states in one of his prefaces, in a characteristically generous recognition of his indebtedness to his own greatest teacher, that he owed to Agassiz the methods of observation that were employed in all his work. Certainly he brought into his teaching much of the best that characterized Agassiz's methods of instruction.

Professor Hyatt was particularly happy also in escaping the dangers incident to combining the investigator and the instructor. I recently took up my notebook of the zöology course as given by him and Mr. Van Vleck jointly in 1885; and in reading its pages again after the lapse of these intervening years, I was struck with the skill and the breadth of view and the insight into students' needs with which the course was planned and executed. The detailed facts were there, but the principles that they illustrate were there as well. There were minute studies and sketches, but never a study or a sketch that was not of structural significance in the course as a whole. And what was true of this one course in zoology was true of his whole department. The related courses were set in the proper sequence and given the right proportions to furnish the college student with a conspectus, not a skeleton merely, but an actual conspectus, of the biological sciences in their unity.

And the disinterestedness of all Professor Hyatt's work left no chance for the exploiting of his own specialties. Those subjects which must have been to him of supreme interest were not allowed more than their due share in the class room. Professor Hyatt never told his classes things merely because he knew them, or merely because he had discovered them himself; he told the classes what they needed to know and what the plan of a well organized course demanded. The polemics of these biological sciences were not so much introduced as alluded to; the student somehow came to feel that natural science does not grow by simple deduction, like pure mathematics, but that it has abundant room for such factors as surmise and counter-surmise, with evidence for and against. But this information was not secured at the expense of more solid acquisition.

For these reasons alone, apart from other considerations of a more personal character, Boston University must always hold Professor Hyatt in grateful remembrance.

ADDRESS OF MR. ARTHUR C. BOYDEN.

Mr. President, —

We realize that Professor Hyatt's active work for the Teachers' School of Science has closed. The long, earnest, devoted years of service are finished, and with them closes the first period in the life of the school. It is often true that the periods in the life of an institution are coincident with the lives of its great leaders; this is especially true in the case of the founder of the institution. The words of appreciation which have been spoken this evening voice our sentiments, but the teachers feel that they have some words of special tribute due Professor Hyatt for his services to them.

We are indebted to him for the full realization of the thought that the introduction of science teaching in the schools requires the careful preparation of the teachers in the methods and materials of scientific work. It was a fortunate moment for this movement when, in 1870, Professor Hyatt suggested to Mr. John C. Cummings, a Boston merchant, the necessity of scientific lectures and laboratory lessons for teachers exclusively. The suggestion was immediately taken up, funds were forthcoming, and a committee consisting of Mr. Cummings, Professor Hyatt, and Professor Niles was appointed to formulate plans. From that time, for over thirty years, Professor Hyatt continued in general charge of the work, gradually pushing it forward to the high position which it now holds. We can but rejoice that the last plan in his mind was carried into effect before he was called away. It was the formation of an association of all who had in any way been members of the School of Science, as a means of assisting in developing its influence and in forwarding the science work in the schools. He lived to see this organization on its feet and starting upon its work.

Professor Hyatt possessed two qualities of character which were particularly adapted to carrying forward a work which was, in many respects, peculiar in its nature. The first of these qualities was a persistence which carried on to its legitimate conclusion any work which had been undertaken. This movement had many difficulties to be met and overcome; there were periods of ebb and flow in enthusiasm which had to be wisely met. Never, through all these years, did Professor Hyatt give up the thought which was back of this movement in behalf of the teachers. This institution had peculiar difficulties to be overcome — it had no buildings of its own, no organized faculty of instruction, no body of resident students, no invested funds, no recognized place among educational agencies. It had to work up a constituency among busy teachers who were willing to use their spare time for this extra instruction, and at times it must labor against the inertia of a school system which was loath to admit science into the traditional curriculum of studies. All these difficulties were overcome, a recognized position was gained for the school with adequate financial support; many and able instructors were obtained who were fitted to conduct laboratory lectures and field excursions with large numbers of critical teachers; the subject gained the support of school authorities in all parts of the state, and true scientific methods were introduced into a large number of schools. Over twelve hundred teachers came under the influence of the instruction of such experts as Professor W. H. Niles, Professor G. L. Goodale, Professor F. W. Putnam, Professor W. M. Davis, the lamented Dr. R. W. Greenleaf, Professor L. M. Norton, Professor W. O. Crosby, Professor G. H. Barton, and Professor Hyatt himself. In all these years Professor Hyatt persistently pushed forward the plans, gradually placing the school on a firm scientific and educational foundation.

The second quality of Professor Hyatt which was of great value in building up the School of Science was his progressiveness. The beginnings were of necessity modest, but progress demanded constant readjustment and modifications from year to year. A flexible mind open to suggestion, quick to see needs, and willing to try experiments, was demanded of the leader, and well did Professor Hyatt fulfil these requirements. Lectures soon expanded into laboratory lessons with specimens in large numbers; these broadened into field classes; both called for printed directions, which culminated in the "Science guides" prepared under the directions of Professor Hyatt. The ordinary field work in turn developed into the seaside laboratory which finally expanded into the renowned Woods Hole marine biological laboratory. In 1882 the privileges of the school were opened to teachers of the whole state, thus to a large extent increasing the influence of the school. As the general audience gradually decreased it became evident that the school had accomplished its mission in this direction, and new plans were formulated for specialized courses of study. The new policy was inaugurated and it has grown into a definite four years' course of study with regular examinations and diplomas. Thus the busy teacher has the opportunity of a scientific preparation equal to that of the ordinary college or scientific school. The spirit of progressive development and scientific consistency, so marked in Professor Hyatt, has characterized the whole forward movement of the school. The influence on the teaching of science in Boston and eastern Massachusetts has been marked and exceedingly helpful.

Thus far we have spoken of Professor Hyatt's work in connection with the school, but this was not his greatest contribution to the teachers. Others might have accomplished as great results, and, in fact, a large number of able teachers did assist in all the work of the school. The unique contribution of Professor Hyatt was his strong personal influence. Many expressions have come from members of his classes, and since it is impossible that they all speak to-night, allow me to be their spokesman. We are thankful to Professor Hyatt for his spirit — modest, earnest, simple, sincere man that he was. With no proclamation of achievement, with no elaborate organization of knowledge, he taught us to search for the simple truth for its own sake.

"All who ever studied under him cannot fail to feel his influence and enthusiasm through life. It was not simply the facts which he presented; not only the enthusiasm for natural science gained from him; not alone the admission to fellow studentship granted by this great, generous, modest mind to the most elementary student,— but all these combined that made the charm which we all remember."

"Professor Hyatt's spirit and method of instruction were to me a revelation of the purifying and ennobling effect on the mind, of the study of natural science."

"As a teacher he was patient and thorough in the extreme; as a friend, sympathetic, self-sacrificing, and encouraging; and as a man, so modest and unassuming that he often failed to receive his due meed of appreciation. His liberal mind saw good in all sincere effort."

"He, like Agassiz, wished us to 'study the fish,' and because he was so much a master of his subject, he made his teaching simple."

"The wealth of his mind, the simplicity of his nature, the kindness and patience of his great heart placed him without a peer in the hearts of his pupils."

"Professor Hyatt's hold upon the members of the school was so firm, so kind, and so subtle that his earnestness was contagious."

A feeling of personal loss comes over each of his pupils in the School of Science. In the coming years he will remain in our memories as an ideal gentleman, a true teacher, and a sincere friend.

LETTER OF PROF. FREDERIC W. PUTNAM.

My dear Mr. Allen: — Imperative duties will prevent my being present at the meeting to-morrow. It is a great disappointment to me that I cannot be with you and speak a few words in memory of Alpheus Hyatt, my intimate friend for nearly half a century.

From the day we became fellow students under Agassiz we have been close friends and have been associated in many ways. Of late years we have taken many a midnight walk together, at which times it has been my good fortune to learn of his scientific work and of his efforts to make the truth, as he understood it, known to others. His insight was deep, and while one could not always obtain his grasp of the subject, his philosophical reasoning was most convincing.

I think all of us who knew Hyatt well regarded him as one of the most profound students of our generation, — a scientist who had won a name to be quoted with the names of others who have become leaders in the interpretation of the laws governing the development of forms in nature.

By his departure from our circle we have lost a man of wonderful power; a man who could not abide shams in any form, scientific or social; one who was true to his high ideals and untiring in his labor for the truth.

His stand for justice in all things was a marked characteristic. Naturally gentle in disposition, he nevertheless stood firmly for what he believed to be right. A patriot in every sense, when the time came he took up arms for his country; and in the same spirit he was ready to battle when friendship called for action in a righteous cause.

I offer these few words in memory of a noble man, a faithful friend, a great scientist whom I loved and honored.

Sincerely yours,

F. W. Putnam.

Printed June, 1902.

Price list of recent memoirs. 4to.

Vol. V, No. 7. Description of the human spines showing numerical variation, in the Warren Museum of the Harvard Medical School. By Thomas Dwight. 76 pp. $1.50.
No. 6. The anatomy and development of Cassiopea xamachana. By Robert Payne Bigelow. 46 pp., 8 plates. $1.40.
No. 5. The development, structure, and affinities of the genus Equisetum. By Edward C. Jeffrey. 36 pp., 5 plates. $1.00.
No. 4. Localized stages in development in plants and animals. By Robert T. Jackson. 65 pp., 10 plates. $2.00.
No. 3. Synapta vivipara: A contribution to the morphology of Echinoderms. By Hubert Lyman Clark. 35 pp., 5 plates. $2.00.
No. 2. Notes on the dissection and brain of the Chimpanzee "Gumbo." By Thomas Dwight. 21 pp., 4 plates. $1.00.
No. 1. On the reserve cellulose of the seeds of Liliaceae and of some related orders. By Grace E. Cooley. 29 pp., 6 plates. $1.00.
Vol. IV, No. 14. A bibliography of Vertebrate embryology. By Charles Sedgwick Minot. 128 pp. $2.50.
No. 13. Fusion of hands. By Thomas Dwight. 14 pp., 2 plates. 75 cts.
No. 12. The insects of the Triassic beds at Fairplay, Colorado. By Samuel H. Scudder. 16 pp., 2 plates.
No. 11. Illustrations of the Carboniferous Arachnida of North America, of the orders Anthracomarti and Pedipalpi. By Samuel H. Scudder. 14 pp., 2 plates.
No. 10. New Carboniferous Myriapoda from Illinois. By Samuel H. Scudder. 26 pp., 6 plates.
No. 9. New types of cockroaches from the Carboniferous deposits of the United States. By Samuel H. Scudder. 16 pp., 2 plates. Nos. 9–12, $3.25.
No. 8. Phylogeny of the Pelecypoda; the Aviculidae and their allies. By Robert Tracy Jackson. 124 pp., 8 plates. $3.00.
No. 7. The flora of the Kurile Islands. By K. Miyabe. 74 pp., 1 plate. $1.75.
No. 6. The Entomophthoreae of the United States. By Roland Thaxter. 70 pp., 8 plates. $3.50.
No. 5. The Taconic of Georgia and the report on the geology of Vermont. By Jules Marcou. 28 pp., 1 plate. $1.00.
No. 4. A Study of North American Geraniaceae. By William Trelease. 34 pp., 4 plates. $1.25.
No. 3. The introduction and spread of Pieris rapae in North America, 1860–1885. By Samuel H. Scudder. 18 pp., 1 plate. 50 cts.
No. 2. The development of the ostrich fern, Onoclea struthiopteris. By Douglas H. Campbell. 36 pp., 4 plates. $1.50.
No. 1. The significance of bone structure. By Thomas Dwight. 17 pp., 3 plates. $1.25.

Boston Society of Natural History.

RECENT PUBLICATIONS.

Proceedings. 8vo. (For price list of Memoirs, see third page of cover.)

Vol. 30, No. 3. The origin of eskers. By W. O. Crosby. 36 pp., 15 cts.

No. 2. The Medford dike area. By A. W. G. Wilson. 21 pp., 4 plates. 25 cts.

No. 1. Systematic results of the study of North American land mammals to the close of the year 1900. By G. S. Miller, Jr., and J. A. G. Rehn. 352 pp. 95 cts.

Vol. 29, No. 18. The Polychaeta of the Puget Sound Region. By H. P. Johnson. 56 pp., 19 plates. 55 cts.

No. 17. Proceedings of the Annual Meeting, May 1, 1901. 33 pp. 10 cts.

No. 16. Bermudan Echinoderms. A report on observations and collections made in 1899. By H. L. Clark. 7 pp. 5 cts.

No. 15. Echinoderms from Puget Sound: Observations made on the Echinoderms collected by the parties from Columbia University, in Puget Sound in 1896 and 1897. By H. L. Clark. 15 pp., 4 plates. 30 cts.

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No. 13. The embryonic history of imaginal discs in Melophagus ovinus L., together with an account of the earlier stages in the development of the insect. By H. S. Pratt. 32 pp., 7 plates. 75 cts.

No. 12. Proceedings of the Annual Meeting, May 2, 1900. 18 pp. 10 cts.

No. 11. A revision of the systematic names employed by writers on the morphology of the Acmaeidae. By M. A. Willcox. 6 pp. 10 cts.

No. 10. On a hitherto unrecognized form of blood circulation without capillaries in the organs of vertebrata. By Charles Sedgwick Minot. 31 pp. 35 cts.

No. 9. The occurrence of fossils in the Roxbury conglomerate. By Henry T. Burr and Robert E. Burke. 6 pp., 1 plate. 20 cts.

No. 8. The blood vessels of the heart in Carcharias, Raja, and Amia. By G. H. Parker and F. K. Davis. 16 pp., 3 plates. 25 cts.

No. 7. List of marine mollusca of Coldspring Harbor, Long Island, with descriptions of one new genus and two new species of Nudibranchs. By Francis Noyes Balch. 30 pp., 1 plate. 35 cts.

No. 6. The development of Penilia schmackeri Richard. By Mervin T. Sudler. 23 pp., 3 plates. 30 cts.

No. 5. Contributions from the Gray herbarium of Harvard university. New series, no. 17. 1. Revision of the genus Gymnolomia. 2. Supplementary notes upon Calea, Tridax, and Mikania. By B. L. Robinson and J. M. Greenman. 22 pp. 25 cts.

No 4. Studies in Diptera Cyclorhapha. 1. The Pipunculidae of the United States. By Garry de N. Hough. 10 pp. 10 cts.

No. 3. Notes on the reptiles and amphibians of Intervale, N. H. By Glover M. Allen. 13 pp. 15 cts.

No. 2. Variation and sexual selection in man. By Edwin Tenney Brewster. 17 pp. 25 cts.

No. 1. Proceedings of the Annual Meeting, May 3, 1899. 43 pp. 15 cts.

Vol. 28, No. 16. Moniloporidae, a new family of Palaeozoic corals. By Amadeus W. Grabau. 16 pp., 4 plates. 25 cts.

No. 15. Studies in the gold-bearing slates of Nova Scotia. By J. Edmund Woodman. 33 pp., 3 plates. 50 cts.

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No. 13. Some Hydroids from Puget Sound. By Gary N. Calkins. 35 pp., 6 plates. 50 cts.

No. 12. The Odonate genus Macrothemis and its allies. By Philip P. Calvert. 32 pp.. 2 plates. 50 cts.

No. 11. Proceedings of the Annual Meeting, May 4, 1898. 26 pp. 15 cts.

No. 10. On the veins of the Wolffian bodies in the pig. By Charles Sedgwick Minot. 10 pp., 1 plate. 25 cts.

No. 9. Notes on a Carboniferous boulder train in eastern Massachusetts. By Myron L. Fuller. 14 pp. 15 cts.

No. 8. The genus Antennaria in New England. By M. L. Fernald. 13 pp. 15 cts.

No. 7. The land mammals of peninsular Florida and the coast region of Georgia. By Outram Bangs. 79 pp. 75 cts.

No. 6. A contribution to the petrography of the Boston Basin. By Theodore G White. 40 pp., 5 plates. 65 cts.

No. 5. Clymene producta sp. nov. By Margaret Lewis. 5 pp., 2 plates. 15 cts.

Proceedings of the Boston Society of Natural History.
Vol. 30, No. 5,
p. 435–450.

PROCEEDINGS OF THE ANNUAL MEETING, MAY 7, 1902.

BOSTON:
PRINTED FOR THE SOCIETY.
July, 1902.

No. 5.—PROCEEDINGS OF THE ANNUAL MEETING MAY 7, 1902.

In place of the usual Curator's report, the President presented, on behalf of the Museum committee, the reports of the museum assistants on the work done by them in the museum during the past year.

The following reports were also made: —

REPORT OF THE CURATOR OF THE TEACHERS' SCHOOL OF SCIENCE, PROF. GEORGE H. BARTON.

Lowell Free Courses.

Field courses. For the first time, field courses of instruction in botany and zoology were established during the past year; that in botany, under the charge of Mr. Hollis Webster, began on April 13, 1901, with an attendance of about sixty persons. Unfortunately, stormy weather interfered seriously with the course, but it was carried on with a fair degree of satisfaction, having an average attendance of about 20 during the ten lessons given.

The lessons were confined to the city limits of Boston, being given at the Arnold Arboretum, West Roxbury pastures, on Mt. Bellevue, Stony Brook reservation, City Point, Castle island, and the Neponset marshes.

During the autumn the course was continued with an almost uniform attendance of 40 persons. Very many of those taking the course have expressed very great satisfaction with it and the benefit derived from it.

The lessons, ten in number, were given at the Arnold Arboretum, Muddy pond, Brighton, Neponset marshes, Blue Hill reservation, and Prospect hill, Waltham.

The topics treated in the lessons were widely varied. At the Arboretum, shrubs and trees were treated as to family relationship and specific differences, and also as to structure and habit as illustrating general principles of form and growth.

In the early spring, much attention was given to the morphology of buds and bud scales, to general habit, methods of branching, etc.

Much attention was given to the characteristics of the flora of different regions, from that of forests on high rocky ground, through hillsides and pastures, rich woods and meadows to the sea level and marshes. The autumn lessons introduced more attention to systematic work, with certain trees as those of the oak family, with asters and goldenrods, and with the fleshy fungi. Stress was laid, however, as far as possible on questions of morphology and adaptation.

The lessons began again this spring on April 19, with an attendance of 85. These will follow much the same lines and will be reported upon the following year.

The field course in zoology under the charge of Mr. Albert P. Morse, Curator of the zoological museum, Wellesley college, was organized in the autumn. The lessons began on September 14, and closed on November 16. The attendance for the ten lessons varied from 26, the largest, to 7, the smallest. The average attendance was 15.5. With two exceptions, Nahant and Fresh pond, Cambridge, the lessons were confined to the city limits, being given at the Stony Brook reservation, Neponset marshes, Franklin park, Leverett park, Arnold Arboretum, West Roxbury bridlepath, and Castle island. The instruction given was of general and varied character, ranging from elementary principles to special applications according to individual needs and opportunity. Besides a consideration of the general features of the animal life of the localities visited, attention was directed to methods of observation, to the relation of the animal to its surroundings, to phases of life with reference to the time of year, and to certain groups that could best be studied at that season. Among such topics were the following: protective color and form; respiration in aquatic animals; animal life in winter; and the stridulation of orthopterous insects. As an aid to the work and to stimulate and direct independent observations, brief outlines of the topics treated were prepared and furnished to the class at cost. Enthusiasm in the work was manifested throughout the course. The lessons began again this spring with an attendance of 52.

(The single course immediately following is not a Lowell course but is supported through the generosity of a friend of the Society.)

The field course in geology, under the charge of the Curator of the School, has now a fairly definite two years' course. The ten lessons in the spring finished that series and were especially devoted to the subject of historical geology. This involved visits to many places at a distance from Boston, as Attleboro, Haverhill, Mt. Wachusett, Mt. Holyoke and the Connecticut valley, and Gay Head. Owing to bad weather many of these lessons were given under much difficulty. The largest number present at a single lesson was 39, the smallest was 10. The average attendance was 24.3.

A new two years' course began in the autumn with an average attendance of 46.3. The largest number present at one time was 70, the smallest 29. With one exception all the places visited are in the immediate vicinity of Boston. The one lesson at a distance was in the vicinity of North Adams, where a brief study was made of the structure of the Hoosac and Graylock mountains, and observations were made of the Massachusetts plateau and its deeply incised valleys. A lecture illustrated by lantern slides was given on Saturday evening in the State Normal School building, through the courtesy of the principal, Mr. F. F. Murdock.

The spring course has begun with an attendance of 50 and will be reported upon next year.

These lessons in geology are designed to train the members of the class in the methods of observation, how to correlate the results of their observations and finally what conclusions shall be drawn from their results. In addition, a general knowledge of the various species of rocks, their structures and stratigraphical relations is given.

Laboratory Courses.

Each of the laboratory courses consists of a series of fifteen lessons of two hours each during a term of four years. Short examinations are given at each exercise and at the end of each year a final examination of three hours is given.

Those members who have passed satisfactory examinations during the four years, receive a diploma stating the kind and amount of work accomplished.

The course in botany under the charge of Mr. Webster, began on November 23, 1901, and ended on March 22, 1902. Owing to the small size of the laboratory, only 65 tickets were given in response to about 90 applications. Of these 65 tickets, 50 only entitled the possessors to first privilege.

During the first two lessons, the laboratory was overcrowded, but for the remainder of the course, the attendance averaged about 41, and this is as large a number as can be completely accommodated under the present conditions. Thirty-two took the final examination on April 12th.

The method of work was to study, observe, and draw the materials illustrating the subject of the lesson during the first hour of each exercise, while during the second hour the topic was developed by explanations and a full discussion. The subject in general was the anatomy, morphology, and physiology, of the flowering plants. A prime object also was to teach the use of the compound microscope. The regular lessons were supplemented by visits to the Botanical Gardens at Cambridge. This feature, voluntarily contributed by Mr. Webster, has led to some of the teachers taking their classes from the schools to the Botanical Gardens. In order to do the work of this course in a satisfactory manner, the services of an assistant were required and Miss J. F. Conant acted in this capacity.

The course in zoology under Mr. Morse began on November 23 and ended on April 12. Seventy tickets were issued to applicants. The attendance ranged from 32 to 54 with an average of 41. Seventeen took the final examination. This four years' course as planned, begins with the simplest unicellular animals and traces the gradually increasing complexity of structure through representatives of the principal types, closing with the highest type, the mammals.

This year, the second of the series, the Actinozoa and the echinoderms were treated. The aim of the work was to acquaint the pupil with the chief facts of the life and structure of the type studied and with the prominent features of the more common representatives. The method used varies widely according to circumstances but is intended to make the work and the results as practical as possible. The first two lessons were preparatory in character for the purpose of supplying an introduction for those who entered the class for the first time and for connecting the work of this year with that of the last.

Miss M. E. Cherrington was employed as an assistant for this course.

The course in geology, given by the Curator of the School, took up the subject of historical geology. This was the fourth and final series in the four years' course. The instruction was given by means of lectures, illustrated by diagrams and maps and with the use of large numbers of specimens, rocks and fossils, for both class and table use. The stereopticon was also occasionally used.

The number of applications was 110. As these lessons are given in the lecture room of the Society, the entire number received tickets. About 20, however, withdrew after the first two or three lessons. The average attendance for the term was 85. 8. Of these, 52 were not absent a single lesson, and 12 were absent but once. The weekly tests were taken by 73 and the final examination was taken by 61.

As an extension of this four years' course a portion of the class will visit the coal, iron and gold mines of Nova Scotia during the coming summer, as well as its principal regions of geological and mineralogical interest. Nearly fifty have already signified their intention of taking part in this summer school. Mr. Morse will also accompany the party. A full report of this work will be given next year.

REPORT OF THE SECRETARY AND LIBRARIAN,

GLOVER M. ALLEN.

MEMBERSHIP.

During the year 1901–1902, thirty persons have been elected to Corporate Membership in the Society, and one Corporate Member has become a Life Member.

There have died during the year, one Honorary Member — Henri Lacaze-Duthiers — and four Corresponding Members — Clarence King, A. A. Kowalevski, Joseph Le Conte, and Tamerlan Thorell.

The Society has also lost by death, three Corporate Members — Edward I. Browne, Mrs. Sarah H. Fuller, and Alpheus Hyatt who since May 4, 1870, has been the Society's Curator. Five Corporate

Members have resigned during the year and nine have been dropped from membership for non-payment of dues.

The membership of the Society, May 1, 1902, consists of nine Honorary, 125 Corresponding, and 454 Corporate Members. There are sixteen Patrons. The Corporate Membership is now larger than in any previous year, showing an increase of five persons over that of last year.

The Corporate Members elected during the year, and the dates of their election, are as follows: —

Arthur E. Austin, October 28, 1901.
Percy G. Bolster, February 8, 1902.
Jonathan A. Brandon, October 28, 1901.
John L. Brenner, M. D., October 18, 1901.
Laurence Brooks, February 8, 1902.
Frederick G. Clapp, October 28, 1901.
Hubert Lyman Clark, February 8, 1902.
Frederick S. De Lue, M. D., December 11, 1901.
Norman S. Easton, April 9, 1902.
Clarabel Gilman, February 8, 1902.
Alice Bache Gould, October 18, 1901.
Alfred P. Hall, February 8, 1902.
Sydney Harris, December 11, 1901.
Reginald Heber Howe, Junior, October 18, 1901.
Elizabeth Jellison, April 9, 1902.
Frederic H. Kennard, February 8, 1902.
A. Jarratt Lewis, April 9, 1902.
F. T. Lewis, M. D., October 18, 1901.
A. Lawrence Lowell, October 18, 1901.
A. Ware Merriam, October 18, 1901.
Henry H. Newcomb, February 8, 1902.
Henry Farnum Perkins, April 9, 1902.
Benjamin Sharp, M. D., October 28, 1901.
Mary H. Shed, December 11, 1901.
Theobald Smith, February 8, 1902.
Caroline B. Thompson, February 8, 1902.
Annie Eugenia Tilton, October 28, 1901.
R. W. Tower, December 11, 1901.
Hollis Webster, December 11, 1901.
Charles Branch Wilson, April 9, 1902.

MEETINGS.

The total attendance at the fourteen regular meetings held during the year, is 494, an average of about 35 to a meeting. The largest attendance at any one meeting was 68 and the smallest 10.

Sixteen formal communications have been made during the year by as many persons, of whom five had not previously spoken before the Society. Eleven papers have been presented by title.

The meetings, attendance, and communications have been as follows: —

May 1, 1901. Annual meeting. Thirty-three persons present.
- Reports of the Curator, Secretary, Librarian, Treasurer, Trustees, and Walker Prize Committee.
- Dr. Charles S. Minot. Cytomorphosis; a study of cell change in relation to age, growth, disease, death, and sex.
- Mr. James B. Dandeno. An investigation into the effects of water and aqueous solutions of some of the common inorganic substances on foliage leaves. (By title.)
- Dr. Amadeus W. Grabau. The phylogeny of the Gastropoda. The Fusidae and their allies. (By title.)
- Mr. Samuel H. Scudder. Alphabetical index to North American Orthoptera described in the eighteenth and nineteenth centuries. (By title.)

May 15, 1901. General meeting. Seventeen persons present.
- Dr. A. W. Grabau. Parallelism and acceleration in development as illustrated in the shells of Gastropoda.
- Dr. Herbert P. Johnson. The Polychaeta of the Puget Sound region. (By title.)
- Mr. Alfred W. G. Wilson. The Medford Dike area. (By title.)

November 6, 1901. General meeting. Forty-six persons present.
- Prof. William M. Davis. River terraces in New England.
- Dr. James G. Needham. A genealogic study of dragonfly wing venation. (By title.)
- Dr. R. W. Shufeldt. On the osteology and systematic position of the Pygopodes. (By title.)

November 20, 1901. General meeting. Thirteen persons present.
- Prof. Edward S. Morse. Observations on living Brachiopoda.

December 4, 1901. General meeting. Twelve persons present.
Mr. Reginald Heber Howe, Junior. Some photographs of New England birds.

December 18, 1901. General meeting. Sixty-seven persons present.
Mr. J. G. Jack. Forestry and grazing in the Bighorn Reserve, Wyoming.
Mr. Henry L. Clapp. School Gardens.

January 1, 1902. General meeting. Twenty-two persons present.
Dr. George H. Parker. Diurnal migrations of marine Copepods.
Mr. Charles J. Maynard. Observations on the structure and habits of some Florida birds, with notes on the vocal organs of some other species.

January 15, 1902. General meeting. Forty-one persons present.
Mr. William L. W. Field. A glacial lake problem in southern Vermont.
Mr. Edward W. Berry. Notes on Sassafrass. (By title.)

February 5, 1902. General meeting. Forty-seven persons present.
Mr. George B. Gordon. Recent explorations by the Peabody museum in Honduras and Guatemala.

February 19, 1902. General meeting. Fifty-six persons present.
Prof. W. O. Crosby. The origin of eskers.
Mr. Andrew G. Weeks, Jr. An account of an entomological collecting trip in the highlands of Bolivia.
Dr. Harris H. Wilder. The skeletal system of *Necturus maculatus* (Rafinesque). (By title.)

March 5, 1902. General meeting. Ten persons present. No quorum.

March 19, 1902. General meeting. Twenty-three persons present.
Dr. John E. Wolff. Snow crystals and their various forms.

April 2, 1902. General meeting. Thirty-nine persons present.
Mr. J. Henry Blake. The track of the "Hassler," and a sketch of her voyage.
Mr. Carleton E. Preston. Structural and ecological studies upon desert vegetation made in the vicinity of Tucson, Arizona. (By title.)

April 16, 1902. General meeting. Sixty-eight persons present.
Dr. Benjamin Sharp. Two months in Hawaii.
Dr. Winterton C. Curtis. The life history, the normal fission

and the reproductive organs of *Planaria maculata*. (By title.)

There was also held, on April 25, 1902, in Huntington Hall, a meeting in memory of Professor Alpheus Hyatt, under the joint auspices of this Society, the Teachers' School of Science, and Boston University. There were nearly 300 persons present, and addresses by Prof. E. S. Morse, Prof. A. S. Packard, Prof. W. M. Warren, and Mr. A. C. Boyden.

PUBLICATIONS.

During the year, the following publications have been issued: —

Echinoderms from Puget Sound: Observations made on the echinoderms collected by the parties from Columbia University in Puget Sound in 1896 and 1897. By Hubert Lyman Clark. Proceedings, vol. 29, no. 15, 15 pages, 4 plates.

Bermudan echinoderms. A report on observations and collections made in 1899. By Hubert Lyman Clark. Proceedings, vol. 29, no. 16, 7 pages.

Proceedings of the annual meeting, May 1, 1901. Proceedings, vol. 29, no. 17, 33 pages.

The Polychaeta of the Puget Sound region. By Herbert Parlin Johnson. Proceedings, vol. 29, no. 18, 56 pages, 19 plates.

Title pages and contents of Proceedings, vol. 29.

Systematic results of the study of North American land mammals to the close of the year 1900. By Gerrit S. Miller, Jr., and James A. G. Rehn. Proceedings, vol. 30, no. 1, 352 pages.

The Medford Dike area. By Alfred W. G. Wilson. Proceedings, vol. 30, no. 2, 21 pages, 4 plates, 3 cuts.

Index to North American Orthoptera. By Samuel H. Scudder. Occasional papers, vol. 6, 436 pages. The stereotype plates of this paper were prepared under the direction of the author, and by him presented to the Society.

Library.

The additions to the library during the year have been: —

	8vo.	4to.	Folio.	Total.
Volumes	313	68		381
Parts	2,269	406	2	2,677
Pamphlets	438	23	14	475
Maps			38	38
Total	3,020	497	54	3,571

The library now contains 27,035 volumes, 1,450 current or otherwise incompleted volumes, and 14,228 pamphlets.

Eleven new exchanges have been added during the year. These are: Brooklyn (N. Y.) institute of arts and sciences; Königliche botanisches garten u. museum, Berlin; Manchester (N. H.) institute of arts and sciences; Nyt magazin for naturvidenskaberne, Christiania; Natural science association of Staten Island (N. Y.); South African museum, Cape Town; State University of Iowa, Iowa City, Iowa; Studi Sassaresi, Sassari, Italy; University of Missouri, Columbia, Missouri; University of Montana, Missoula, Montana; Washington (State) geological survey, Seattle.

Two exchanges have ceased. The exchanges now number 447.

Twelve periodicals have been added to the subscription list.

By vote of last year's Council, a special appropriation was made for binding books, so that it has been possible to greatly add to the usefulness of the library in this way. In all, 1,562 volumes and pamphlets have been bound in 1,015 covers, 8 volumes have been repaired, and 245 pamphlets have been bound separately.

Seven hundred and sixty-four books have been borrowed by 107 persons, and four hundred and twenty-five books have been borrowed for use in the building. The library has been consulted about 265 times.

The following serials have been indexed: — Abhandlungen naturforschende gesellschaft, Halle, 14 volumes; Abhandlungen naturwissenschaftliche verein für Sachsen und Thüringen, Halle, 2 volumes; Annalen naturhistorisches hofmuseum, Wien, 5 volumes; Mémoires de l'institut national Genevois, Genève, 18 volumes;

Mémoires de la société de physique et d'histoire naturelle de Genève, 34 volumes; Transactions of the Wisconsin academy of sciences, arts and letters, 12 volumes. Current volumes of serials previously indexed, are indexed as received.

In the course of the year, the library has been thoroughly cleaned by men experienced in that work.

A list of the current periodicals for which the Society subscribes, is appended.

CURRENT PERIODICALS FOR WHICH THE SOCIETY SUBSCRIBES.

General.

American naturalist.
Annals and magazine of natural history.
L' Année biologique.
Archives de biologie.
Biological bulletin.
Biologische untersuchungen.
Biologisches centralblatt.
La Cellule.
Library journal.
Marine biological laboratory, Woods Holl, Mass.; Annual report.
Minerva.
Museums journal.
Natural science.
Nature.
Revue scientifique.
Science.
Zeitschrift für biologie.

Anatomy, Physiology, Morphology.

American journal of anatomy.
American journal of physiology.
American microscopical society; Journal.
Anatomische hefte, 1 and 2.
Archiv für anatomie und physiologie; anatomische abtheilung; physiologische abtheilung.

Archiv für mikroskopische anatomie und entwicklungsgeschichte.
Archives d' anatomie microscopique.
Archivo Italiano di anatomia e di embriologia.
Centralblatt für physiologie.
Internationale monatsschrift für anatomie und physiologie.
Journal de l' anatomie et de la physiologie.
Journal of applied microscopy and laboratory methods.
Journal of comparative neurology.
Morphologisches jahrbuch.
Le Névraxe.
Petrus Camper; Nederlandsche bijdragen tot de anatomie.
Quarterly journal of microscopical science.
Revista trimestral micrográfica.
Zeitschrift für wissenschaftliche mikroskopie.
Zoologische jahrbücher; abtheilung für anatomie und ontogenie.

ANTHROPOLOGY.

Anthropological institute of Great Britain and Ireland; Journal.
Anthropological society of Washington; American anthropologist.
L'Anthropologie.
Archiv für anthropologie.

BOTANY.

Annals of botany.
Beiträge zur biologie der pflanzen.
Berichte der deutschen botanischen gesellschaft.
Botanical gazette.
Botanisches centralblatt.
Le Botaniste.
Bulletin de la société mycologique de France.
Hedwigia.
Just's Botanischer jahresbericht.
Napoli. Zoologische station; Fauna und flora des golfes von Neapel.
Phycological memoirs.
Revue générale de botanique.
Zeitschrift für pflanzenkrankheiten.

GEOLOGY, GEOGRAPHY, PALAEONTOLOGY.

American geologist.
Annales des sciences naturelles; zoologie et paléontologie.
Annals of British geology.
Annuaire geologique universel.
Gotha. Justus Perthe's geographische anstalt; Petermann's mittheilungen.
Jahrbuch für mineralogie.
Journal of geology.
Mineral collector.
Neues jahrbuch für mineralogie, geologie und palaeontologie.
Palaeontographia Italica.
Revue critique de paléozoologie.

ZOOLOGY.

Annales des sciences naturelles; zoologie et paléontologie.
Archiv für protistenkunde.
Archives de zoologie expérimentale et générale.
Auk.
Bibliotheca zoologica, Taschenberg.
Bird-lore.
Condor.
Entomological news.
Ibis.
Journal für ornithologie.
Manual of conchology.
Monitore zoologico Italiano.
Napoli. Zoologische station; Fauna und flora des golfes von Neapel. Zoologische jahresbericht.
Nautilus.
New York entomological society; Journal.
Osprey.
Wien. Zoologisches institut du universität Wien und die zoologische station in Trieste; Arbeiten.
Zoologica.
Zoological record.
Zoologische jahrbücher; abtheilung für anatomie und ontogenie; abtheilung für systematik, geographie, und biologie.
Zoologist.

REPORT OF THE TREASURER, EDWARD T. BOUVÉ.

ANNUAL STATEMENT, MAY 7, 1902.

To cash received from income, General Fund	$5,260.61	By cash paid on account of Repairs	$930.47
" " " " " Walker Fund	1,909.72	" " " " " " Fuel and Light	413.17
" " " " " J. W. Randall Fund	250.00	" " " " " " Insurance	66.00
" " " " " H. F. Wolcott Fund	389.56	" " " " " " General Expense	1,187.70
" " " " " Saltonstall Fund	862.85	" " " " " " Salaries	8,530.22
" " " " " C. L. Flint Fund	162.86	" " " " " " Laboratory	43.96
" " " " " Bulfinch St. Estate Fund	1,709.44	" " " " " " Museum	440.45
" " " " " S. P. Pratt Fund	561.57	" " " " " " Library	1,027.56
" " " " " Waterston Fund	450.96	" " " " " " Publications	2,371.33
" " " " Boston University	2,500.00	" " " " " " New England Mammals & Birds	254.64
" " " " Massachusetts Inst. Technology	200.00		
" " " " Admission Fees	160.00	" " " Trustees for Insurance Sinking Fund	384.00
" " " " Annual Assessments	1,400.00	" " " " Donation for Investment	2,005.00
" " " " Museum Fees	140.45	" " " on account of Walker prizes	110.00
" " " " Sale of Publications	381.93	" " " " " " " " (Advertising).	44.25
" " " " General Expense Credit	107.00	" " " " " " Special bookbinding	939.91
" " " " Interest on deposit in Shawmut Bank	61.17	" " " " " " " repairs of cases and new cases	746.37
" " " " Donation	5.00	Balance, belonging to Repairs account	1,088.43
Balance from April 30, 1901	4,079.34		
Total,	$20,583.46	Total,	$20,583.46

To cash received from A. L. Lowell, Trustee, for the Teachers' School of Science	$2,300.00	By cash paid on account of Lectures and Supplies	$2,218.92
To cash received from Tea. Sch. of Sci. Association	56.59	Balance to new account	490.74
" " " " Interest on Deposit in bank	10.28		
Balance from April 30, 1901	342.79		
Total,	$2,709.66	Total,	$2,709.66

To balance from April 30, 1901, Arms Fund	$1,655.47	By cash paid for Supplies	15.00
To cash received from Interest on deposit in Bank	32.29	Balance to new account	1,672.76
Total,	$1,687.76	Total,	$1,687.76

It was voted to accept the reports of the Treasurer and of the Auditing Committee.

The report of the Trustees was accepted and placed on file.

It was voted to proceed to the election of officers for the ensuing year. The President appointed Prof. James H. Emerton and Mr. J. Henry Blake to act as tellers. After the ballots had been distributed and collected, it was announced that twenty-four ballots had been cast, and that the following candidates were duly elected.

PRESIDENT,

CHARLES SEDGWICK MINOT.

VICE-PRESIDENTS,

CHARLES P. BOWDITCH.
HENRY W. HAYNES.
ROLAND THAXTER.

SECRETARY,

GLOVER M. ALLEN.

TREASURER,

EDWARD T. BOUVÉ.

COUNCILLORS FOR THREE YEARS,

Miss Cora H. Clarke.
Robert T. Jackson.
John S. Kingsley.
Edward S. Morse.
George H. Parker.
A. Lawrence Rotch.
William F. Whitney.
J. B. Woodworth.

COUNCILLOR FOR ONE YEAR,

William Lyman Underwood.

OFFICERS FOR 1902-1903.

PRESIDENT,

CHARLES SEDGWICK MINOT.

VICE-PRESIDENTS,

CHARLES P. BOWDITCH.
HENRY W. HAYNES.
ROLAND THAXTER.

CURATOR,

(Not yet appointed.)

SECRETARY,

GLOVER M. ALLEN.

TREASURER,

EDWARD T. BOUVÉ.

LIBRARIAN,

GLOVER M. ALLEN.

COUNCILLORS FOR THREE YEARS,

Miss Cora H. Clarke.
Robert T. Jackson.
John S. Kingsley.
Edward S. Morse.
George H. Parker.
A. Lawrence Rotch.
William F. Whitney.
J. B. Woodworth.

COUNCILLORS FOR TWO YEARS,

Miss Clara E. Cummings.
James H. Emerton.
William A. Jeffries.
George G. Kennedy.
Miss Susannah Minns.
Thomas A. Watson.
Samuel Wells.
John E. Wolff.

COUNCILLORS FOR ONE YEAR,

S. L. Abbot.
William S. Bryant.
William M. Davis.
Samuel Henshaw.
Benjamin Joy Jeffries.
N. T. Kidder.
William H. Niles.
William Lyman Underwood.

COUNCILLORS *ex-officiis*,

George L. Goodale.
F. W. Putnam.
Samuel H. Scudder.

Price list of recent memoirs. 4to.

Vol. V, No. 7. Description of the human spines showing numerical variation, in the Warren Museum of the Harvard Medical School. By Thomas Dwight. 76 pp. $1.50.
No. 6. The anatomy and development of Cassiopea xamachana. By Robert Payne Bigelow. 46 pp., 8 plates. $1.40.
No. 5. The development, structure, and affinities of the genus Equisetum. By Edward C. Jeffrey. 36 pp., 5 plates. $1.00.
No. 4. Localized stages in development in plants and animals. By Robert T. Jackson. 65 pp., 10 plates. $2.00.
No. 3. Synapta vivipara: A contribution to the morphology of Echinoderms. By Hubert Lyman Clark. 35 pp., 5 plates. $2.00.
No. 2. Notes on the dissection and brain of the Chimpanzee "Gumbo." By Thomas Dwight. 21 pp., 4 plates. $1.00.
No. 1. On the reserve cellulose of the seeds of Liliaceae and of some related orders. By Grace E. Cooley. 29 pp., 6 plates. $1.00.
Vol. IV, No. 14. A bibliography of Vertebrate embryology. By Charles Sedgwick Minot. 128 pp. $2.50.
No. 13. Fusion of hands. By Thomas Dwight. 14 pp., 2 plates. 75 cts.
No. 12. The insects of the Triassic beds at Fairplay, Colorado. By Samuel H. Scudder. 16 pp., 2 plates.
No. 11. Illustrations of the Carboniferous Arachnida of North America, of the orders Anthracomarti and Pedipalpi. By Samuel H. Scudder. 14 pp., 2 plates.
No. 10. New Carboniferous Myriapoda from Illinois. By Samuel H. Scudder. 26 pp., 6 plates.
No. 9. New types of cockroaches from the Carboniferous deposits of the United States. By Samuel H. Scudder. 16 pp., 2 plates. Nos. 9–12, $3.25.
No. 8. Phylogeny of the Pelecypoda; the Aviculidae and their allies. By Robert Tracy Jackson. 124 pp., 8 plates. $3.00.
No. 7. The flora of the Kurile Islands. By K. Miyabe. 74 pp., 1 plate. $1.75.
No. 6. The Entomophthoreae of the United States. By Roland Thaxter. 70 pp., 8 plates. $3.50.
No. 5. The Taconic of Georgia and the report on the geology of Vermont. By Jules Marcou. 28 pp., 1 plate. $1.00.
No. 4. A Study of North American Geraniaceae. By William Trelease. 34 pp., 4 plates. $1.25.
No. 3. The introduction and spread of Pieris rapae in North America, 1860–1885. By Samuel H. Scudder. 18 pp., 1 plate. 50 cts.
No. 2. The development of the ostrich fern, Onoclea struthiopteris. By Douglas H. Campbell. 36 pp., 4 plates. $1.50.
No. 1. The significance of bone structure. By Thomas Dwight. 17 pp., 3 plates. $1.25.

Boston Society of Natural History.

RECENT PUBLICATIONS.

Proceedings. 8vo. (For price list of Memoirs, see third page of cover.)

Vol. 30, No. 3. The origin of eskers. By W. O. Crosby. 36 pp., 15 cts.

No. 2. The Medford Dike area. By A. W. G. Wilson. 21 pp., 4 plates 25 cts.

No. 1. Systematic results of the study of North American land mammals to the close of the year 1900. By G. S. Miller, Jr., and J. A. G. Rehn. 352 pp. 95 cts.

Vol. 29, No. 18. The Polychaeta of the Puget Sound Region. By H. P. Johnson. 56 pp., 19 plates. 55 cts.

No. 17. Proceedings of the Annual Meeting, May 1, 1901. 33 pp. 10 cts.

No. 16. Bermudan Echinoderms. A report on observations and collections made in 1899. By H. L. Clark. 7 pp. 5 cts.

No. 15. Echinoderms from Puget Sound: Observations made on the Echinoderms collected by the parties from Columbia University, in Puget Sound in 1896 and 1897. By H. L. Clark. 15 pp., 4 plates. 30 cts.

No. 14. Glacial erosion in France, Switzerland and Norway. By William Morris Davis. 50 pp., 3 plates. 50 cts.

No. 13. The embryonic history of imaginal discs in Melophagus ovinus L., together with an account of the earlier stages in the development of the insect. By H. S. Pratt. 32 pp., 7 plates. 75 cts.

No. 12. Proceedings of the Annual Meeting, May 2, 1900. 18 pp. 10 cts.

No. 11. A revision of the systematic names employed by writers on the morphology of the Acmaeidae. By M. A. Willcox. 6 pp. 10 cts.

No. 10. On a hitherto unrecognized form of blood circulation without capillaries in the organs of vertebrata. By Charles Sedgwick Minot. 31 pp. 35 cts.

No. 9. The occurrence of fossils in the Roxbury conglomerate. By Henry T. Burr and Robert E. Burke. 6 pp., 1 plate. 20 cts.

No. 8. The blood vessels of the heart in Carcharias, Raja, and Amia. By G. H. Parker and F. K. Davis. 16 pp., 3 plates. 25 cts.

No. 7. List of marine mollusca of Coldspring Harbor, Long Island, with descriptions of one new genus and two new species of Nudibranchs. By Francis Noyes Balch. 30 pp., 1 plate. 35 cts.

No. 6. The development of Penilia schmackeri Richard. By Mervin T. Sudler. 23 pp., 3 plates. 30 cts.

No. 5. Contributions from the Gray herbarium of Harvard university. New series, no. 17. 1. Revision of the genus Gymnolomia. 2. Supplementary notes upon Calea, Tridax, and Mikania. By B. L. Robinson and J. M. Greenman. 22 pp. 25 cts.

No 4. Studies in Diptera Cyclorhapha. 1. The Pipunculidae of the United States. By Garry de N. Hough. 10 pp. 10 cts.

No. 3. Notes on the reptiles and amphibians of Intervale, N. H. By Glover M. Allen. 13 pp. 15 cts.

No. 2. Variation and sexual selection in man. By Edwin Tenney Brewster. 17 pp. 25 cts.

No. 1. Proceedings of the Annual Meeting, May 3, 1899. 43 pp. 15 cts.

Vol. 28, No. 16. Moniloporidae, a new family of Palaeozoic corals. By Amadeus W. Grabau. 16 pp., 4 plates. 25 cts.

No. 15. Studies in the gold-bearing slates of Nova Scotia. By J. Edmund Woodman. 33 pp., 3 plates. 50 cts.

No. 14. North American wood frogs. By R. H. Howe, Junior. 6 pp. 10 cts.

No. 13. Some Hydroids from Puget Sound. By Gary N. Calkins. 35 pp., 6 plates. 50 cts.

No. 12. The Odonate genus Macrothemis and its allies. By Philip P. Calvert. 32 pp., 2 plates. 50 cts.

No. 11. Proceedings of the Annual Meeting, May 4, 1898. 26 pp. 15 cts.

No. 10. On the veins of the Wolffian bodies in the pig. By Charles Sedgwick Minot. 10 pp., 1 plate. 25 cts.

No. 9. Notes on a Carboniferous boulder train in eastern Massachusetts. By Myron L. Fuller. 14 pp. 15 cts.

No. 8. The genus Antennaria in New England. By M. L. Fernald. 13 pp. 15 cts.

No. 7. The land mammals of peninsular Florida and the coast region of Georgia. By Outram Bangs. 79 pp. 75 cts.

No. 6. A contribution to the petrography of the Boston Basin. By Theodore G White. 40 pp., 5 plates. 65 cts.

No. 5. Clymene producta sp. nov. By Margaret Lewis. 5 pp., 2 plates. 15 cts.

Proceedings of the Boston Society of Natural History.
Vol. 30, No. 6,
p. 451–513, pl. 5–8.

MONOGRAPH OF THE ACRASIEAE.

By Edgar W. Olive.

BOSTON:
PRINTED FOR THE SOCIETY FROM THE
GURDON SALTONSTALL FUND.
August, 1902.

No. 6.—MONOGRAPH OF THE ACRASIEAE.

BY EDGAR W. OLIVE.

THE organisms which form the subject of the present paper were first brought to the attention of the writer while studying in the cryptogamic laboratory of Harvard University during the winter of 1896–'97. At the suggestion of Professor Thaxter an attempt was made to examine in some detail the morphology and development of the members of the group as well as to revise it from a systematic standpoint. With this end in view, a large amount of material was accumulated from various sources, which forms the basis of the following account.

Although the time at the writer's disposal has for the past five years been greatly curtailed by other duties in the University, the inevitable delay in completing the work has been of advantage in that it has enabled him to keep a majority of the forms considered under observation during this period and thus to determine the constancy of the characters which distinguish the different species. With a few exceptions, which will be hereafter noted, the material has been derived from laboratory cultures of dung and other substances that form the natural substrata on which the Acrasieae develop, and the different forms thus obtained have been cultivated in a pure condition, in gross, on the natural substratum previously sterilized, as well as in nutrient agar tubes and hanging drop cultures. Although the number of representatives previously recorded has thus been nearly doubled, several of the species described by European writers still remain unknown except through the original diagnoses, which are with one or two exceptions, not only very meagre but unaccompanied by figures. Having been unsuccessful in obtaining by correspondence further information concerning these doubtful forms, I am unable to add anything to the scanty information already available concerning them.

I wish to acknowledge my indebtedness especially to Professor Thaxter, for material from various localities, and for advice and assistance in the preparation of this paper. His collection of Acrasieae from New Haven and from Florida has been given me for study, besides several forms which have appeared in laboratory cultures in Cambridge. To Professor Farlow, also, I am under great obligations, and to Miss Josephine Clark of the Library of the Department of Agriculture, I am indebted for the Russian publication of Cienkowsky on Guttulina.

Introduction.

The Acrasieae comprise a small group of organisms, which have been associated by van Tieghem and de Bary with the Myxomycetes. Although these two orders present but slight resemblances in their fructifying conditions, they agree in the possession of an amoeboid state and also in the formation of naked protoplasmic masses during certain periods of their life history. Zopf in recent years ('92) associated also the Labyrinthuleae with the two above mentioned orders, since he thought that in their formation of the so called "net-plasmodium," they presented a vegetative condition which might be regarded as intermediate between the aggregation- or pseudo-plasmodium of the Acrasieae and the true plasmodium of the Myxomycetes. A brief summary of the salient characters of these three groups will serve to recall the main features of their developmental history.

The spores of the Myxomycetes, on germinating, produce swarm cells which swim about in the water with a peculiar dancing motion, each bearing at its forward end a flagellum by which it is propelled. After swarming thus for some time, the flagellum is retracted and the cells assume a myxamoeba condition, during which they crawl about by means of amoeboid movements. During either of these stages, slow drying or similar unfavorable conditions may induce the temporary encystment of the individuals, which thus form isolated "microcysts," and which may be revived into the active state on the addition of water. Following the normal development, however, the amoeboid individuals, after greatly multiplying by successive division, ultimately become aggregated and coalesce to form a mass of naked protoplasm. This vegetative mass, called the plasmodium, may likewise become multiplied by fragmentation as well as through the formation, under certain adverse conditions, of "sclerotia," compacted masses of small cysts, each capable of renewing its activity under favorable conditions by the formation of a small plasmodium.

After a more or less definite period, during which the plasmodium vegetates as a unit and increases greatly in size, it ceases to appropriate further nourishment, begins to reject such foreign material as it may contain, and becomes more or less heaped up, or "aggregated." This aggregation marks the beginning of the fructifying period which ends with the formation of highly differentiated sporangia or sporophores, having various habit, and bearing well defined spores, each provided with one or more walls which are, in some cases at least, composed of cellulose.

The life history of the Myxomycetes is thus clearly separable into two main periods — one of vegetation and one of fructification — in each of which two secondary periods may be distinguished. In the first instance, a period of active existence and of multiplication in the swarm cell and in the single amoeboid condition, is followed by a state in which the coalescence of individual amoebae and small plasmodia combines with continued active growth and nuclear division to increase enormously the number of potential individuals of the vegetative mass. In the second instance, the completion of the vegetative period is followed by one of aggregation which is a preparation for the final condition of fructification.

In the order Labyrinthuleae, are grouped a small number of parasitic and saprophytic organisms, embracing but five species in two genera, which are included by some writers among the Protozoa. In their developmental history, encysted cells in some cases, or spores in others, on reassuming the vegetative state, give rise to from one to four spindle shaped cells, each of which possesses in its active condition two radiating tufts of pseudopodia, borne at nearly opposite poles. These cells may remain separate, each retaining complete individuality, or, as more often happens, as they lie adjacent, their pseudopodia may adhere to or anastomose with those of other cells, thus forming by partial fusion or by contact the peculiar type of association which Zopf has designated as a "net-plasmodium." During this vegetative condition, the fusiform individuals, each showing a limited degree of contractility, appear to glide along the filamentous pseudopodia or fibrous framework thus produced, being evidently thus directed and limited in their wandering. During the active state, the individuals increase in size by the absorption of nourishment and reproduce by division.

The wandering cells finally collect into sessile or stalked masses, or sori, and pass into an encysted state in which the masses are either naked aggregations or else are enclosed in a secreted mucous substance. After resting thus for some time, favorable conditions will again induce the rejuvenation of the cysts and the resumption of the vegetative stage.

The Labyrinthuleae are thus distinguished from the Myxomycetes by the fact that the period of vegetation presents but a single phase which is comparable in a way to the plasmodial condition of the more highly differentiated group, for the reason that the vegetative mass results from the contact or partial fusion of many individuals, each of which retains complete or only partial individuality. It is further apparent that the periods of fructification in the two groups are also comparable, although the somewhat indefinite aggregation through a general contraction or heaping up of the vegetative mass and the subsequent encystment in sessile or stalked masses of the one, are sufficiently far removed from the well defined phenomena presented by the other.

The third order to be considered, the Acrasieae, is represented by a small group of saprophytic organisms comprising seven genera and twenty species. Their spores or pseudospores, when they germinate, send forth myxamoebae which always remain in the amoeboid state and which at no stage assume the peculiar flagellate or zoospore condition which characterizes the swarm cells of the Myxomycetes. The vegetative myxamoebae thus produced, absorb nutriment and become greatly increased in numbers by successive division.

After a period of vegetation as separate and independent individuals, the amoeboid cells pass into a fructifying or resting condition. Through some contagious impulse, numerous myxamoebae move toward central points and become collected into definite colonies, or "pseudoplasmodia," sometimes called "aggregation plasmodia." The heaped up cells forming these colonies do not fuse, nor do they undergo any nuclear changes, but each member retains its individuality throughout further development, and becomes a spore or pseudospore, or else is used in the formation of a stalk which may eventually raise the sorus above the substratum. The resultant fructifications present many variations both in complexity and in general appearance. In the simpler species, the sessile or stalked sori recall to a certain extent the corresponding conditions which occur in Labyrinthula and Diplophrys among the Labyrinthuleae, while in the higher, stalked forms, there is a comparatively high degree of differentiation among the individuals.

The characters of the Acrasieae, while they present certain resemblances to those of the two preceding groups, are thus sufficient to distinguish them very clearly. Their vegetative period includes neither the swarm cell nor the plasmodium condition of the Myxomycetes, and no phenomenon which might be compared to the vegetative net-plasmodium of the Labyrinthuleae, occurs in their developmental history. On the other hand, the aggregations in the Acrasieae commonly called pseudoplasmodia, which precede fructification, are, at least in the higher members of the group, far more clearly defined than the corresponding phenomena in the other orders; while the various degrees of complication presented by the final fructifications combine certain meagre resemblances to the resting stages of both the Labyrinthuleae and the Myxomycetes with other peculiarities found in neither of them.

It should be noted that in the preceding summary, the term *pseudospore* is used in conformity with the suggestion made in a previous paper (: 01), since a comparison of the resting individuals which occur in the so called fructifications has shown that the term *spore* cannot properly be applied to them in all cases. In the coprophilous genera Sappinia, Guttulinopsis, and Diplophrys, the individuals, even in mature fructifications, are merely slightly contracted and encysted, secreting no definite wall. On the renewal of a state of activity, such resting individuals, therefore, gradually assume the form of the vegetative cell without casting off a spore wall of any kind. In order to distinguish these bodies as well from true spores which replace them in a majority of the genera, as from the transitory resting conditions of isolated vegetating myxamoebae which were first called "microcysts" by Cienkowsky, the term *pseudospore* is here employed.

It will be noted, moreover, that in characterizing the Acrasieae, emphasis is laid on the fact, usually overlooked in accounts of these organisms, that the vegetative stage ends before the pseudoplasmodium condition begins. The pseudoplasmodium, therefore, is a phenomenon connected not with vegetation but with fructification, and is by no means homologous with the plasmodium of true Myxomycetes, nor is it comparable in the least to the vegetative net-plasmodium of the Labyrinthuleae. Although the term pseudoplasmodium may thus tend to be misleading, since it may be regarded as implying a body physiologically as well as morphologically comparable to the plasmodium, it is nevertheless retained for want of a better term.

Finally, I have followed Zopf in characterizing as a "net-plasmodium" the peculiar form of association occurring in the Labyrinthuleae, although in *Diplophrys stercorea*, the only member of the family with which I am familiar, the individuals may not necessarily become joined with other individuals through the contact of their pseudopodia, but may in some cases remain isolated and distinct.

As mentioned later in this paper, moreover, the spindle shaped individuals of the Labyrinthuleae, in my opinion, do not present close resemblances to the amoeboid individuals of the Acrasieae, either in their structure or in their peculiar mode of locomotion. While it is true that their mode of development is similar in certain respects, the structural resemblance between the two groups is confined to the superficial similarity of their fructifications and is probably not sufficient to warrant placing the Labyrinthuleae between the Acrasieae and the Myxomycetes.

Historical Summary.

Our knowledge of the Acrasieae is due mainly to the discoveries of Brefeld, Cienkowsky, and van Tieghem. Few observers seem to have met with these organisms, hence the list of publications relating to the group is a short one. The earliest published observation of any of the Acrasieae, so far as I am aware, is that of Coemans in 1863. Without doubt the form which he figures and describes as a pycnidial condition of Rhizopus was one of the commoner species of Dictyostelium. Two other writers, Sorokin and Oudemans, misled by superficial resemblances, have made the mistake of placing Dictyostelium among the Hyphomycetes.

Brefeld ('69) was the first to interpret aright the true nature of one of these peculiar organisms; he misconstrued at first, however, certain details of the life history of his Dictyostelium, in regarding the piled up colony of myxamoebae as a fused mass, which he described as forming a plasmodium. Rostafinski ('75), therefore, in his classic monograph, admitted Dictyostelium into the group of Mycetozoa, and it was not until 1880 that van Tieghem discovered the fact that the so called plasmodium of this organism was readily separable into its constituent individuals when placed in a drop of water.

Cienkowsky in 1873 described as *Guttulina rosea*, a form found in Poland on decaying wood, which, in his opinion, was evidently similar in some respects to Dictyostelium of Brefeld. The paper concerning this new organism was read before the society of Russian naturalists at Kazan in 1873 and was unfortunately printed only in abstract in the report of that meeting. The review in Just's Jahresbericht by Batalin ('73), to which all later writers on this group have evidently referred, is an accurate translation of this original meagre description, with the exception of one minor omission.

Several species of Guttulina and of Dictyostelium were next described by van Tieghem in 1880; he also gave the name Acrasis to a new organism which he had found on decomposing beer yeast. In this same paper van Tieghem proposed for the group of organisms characterized by the possession of myxamoebae and aggregation plasmodia, the term Acrasieae; and removing Dictyostelium from the Myxomycetes, in which Brefeld had placed it, he grouped it with Acrasis and Guttulina. De Bary ('87) accepted this name and characterization and incorporated the Acrasieae as a coordinate order with the Myxomycetes in the group of the Mycetozoa.

Van Tieghem later ('84) discovered on decaying beans another peculiar and complicated form, which he called Coenonia. Unfortunately, we can obtain only an inadequate conception of the appearance of this remarkable organism, since no figures accompany any of van Tieghem's descriptions of the Acrasieae.

About this same time, Fayod ('83) studied a form to which de Bary had called his attention, and described it as *Guttulina protea*. Zopf ('85) later changed this name to *Copromyxa protea* for the reason that it seemed to differ from Guttulina in the fact that the masses of spores in Fayod's species were not stalked, whereas in *Guttulina rosea*, according to Cienkowsky's description, there is a differentiation into head and foot portions. In the same paper, Zopf further suggested the name Sorophoreae as a convenient term to apply to this group of organisms, thus disregarding van Tieghem's earlier term Acrasieae. In a still later classification ('92), however, he proposes to include the Acrasieae and the Labyrinthuleae as coordinate orders under the name Sorophoreae.

Brefeld ('84) was the next to discover another new form, which was evidently closely allied to Dictyostelium, and to which he gave the name Polysphondylium, and in this paper he described in great detail the developmental history of both related organisms.

An amoeboid form, Sappinia, which is evidently similar to certain stalked amoebae mentioned by Cienkowsky in his paper on *Guttulina rosea*, has been recently described by Dangeard ('96) and is included by him in the Acrasieae. In view, however, of the fact that the amoebae become encysted singly, and that, as will be noted hereafter, their aggregation when it occurs is probably accidental, they should perhaps be excluded from the present group, or are at least only to be admitted as doubtful members of it, although they may serve to suggest its possible beginnings.

Finally, the writer, in a preliminary enumeration of the Sorophoreae (:01), has followed Zopf in associating the Acrasieae and the Labyrinthuleae, and in that article has described several new species of the Acrasieae.

In the following account of the Acrasieae, the development of the organisms composing the group has first been traced in some detail through both the vegetative and the fructifying stages; this is followed by the systematic arrangement of the species. Four genera only have been studied by the writer, namely, Sappinia, Guttulinopsis, Dictyostelium, and Polysphondylium, while the original descriptions of the other three genera have been depended upon to supply data in the following comparative account.

THE VEGETATIVE STAGE.

The life cycle of the Acrasieae is clearly separable into two well marked periods,— one of vegetation and one of fructification; the fructifying period may be still further divided into two secondary periods — a preliminary stage of colony formation, and another which embraces the formation and maturation of the resting bodies. During the vegetative stage, the myxamoebae live as separate and independent individuals, while during the subsequent fructifying condition, they become heaped together into colonies, thus forming characteristic aggregations to which the name "pseudoplasmodium" has been applied.

The period of vegetation includes that stage of the developmental history during which the myxamoebae absorb nutriment, increase in size, and become greatly multiplied by successive division. The morphology and the development of the individuals during this condition have been studied in special detail in Dictyostelium and in Polysphondylium, which possess features in their vegetative conditions that appear to be identical. To Brefeld in particular, is due the credit for our present knowledge of the details of the structure and development of these two members of the group, as van Tieghem and others confined their studies rather to superficial characters. I have supplemented Brefeld's observations with others dealing principally with the minute structure of the myxamoebae and have been able also to correct certain conclusions held by several investigators who have studied the group.

I have given special attention also to the vegetative individuals of Dictyostelium and Polysphondylium, and have tried to follow out and explain the nuclear changes which have been observed throughout the life history of the organisms; the whole matter, however, remains as yet in doubt. The living organisms have been studied throughout the entire cycle of development in hanging drop cultures, and these observations have been supplemented by studies of individuals killed and stained at every stage of development.

Nutrient media of various kinds, among which a weak horse dung decoction and a peptone culture medium were found to be the most satisfactory, were added to 1.5% to 2.5% of agar, then filtered and sterilized. Of the various cells employed for drop cultures, one which furnished perhaps the most favorable conditions for prolonged study consisted of a small, shallow stender dish of one inch or more in diameter, containing a small amount of water and covered with a thin cover glass, cemented to the rim. Sufficient light for the examination of the myxamoebae with high powers was obtained by concentrating, by means of a bull's-eye lens, the rays from a Welsbach gas lamp upon the mirror of the microscope. In this way only could enough light be obtained during the employment of immersion lenses and oculars giving magnifications of 2,000 and more diameters, which was necessary to secure any appreciable differentiation of the cytoplasmic contents.

For the most part, fumes from osmic acid solution placed in the bottom of a culture cell, sometimes followed for a few minutes by Flemming's weaker solution placed directly on the object, were used as killing reagents; acetic methyl green also proved useful as a killing and staining agent. The mucus which causes the myxamoeba to adhere to the substratum usually serves to fix the individual, when extended, firmly to the agar or cover glass surface; but when rounded as while undergoing the division subsequently described as resembling indirect division, the bodies are readily washed away and lost. Consequently, such reagents as Flemming's triple stain, or other stains by which the achromatic portion of the nucleus might be differentiated, could rarely be used with much success. Temporary stains and mounts, therefore, were for the most part utilized in studying the internal structures of the developing myxamoebae.

In following out the nuclear phenomena of these organisms, two types of nuclear and cell division seemed to be distinguishable, one of which occurs shortly after germination, while the second occurs during the subsequent active vegetative condition. The first, or primary division, as I have called it, which, so far as I have observed, takes place very slowly and mostly at night, is preceded by certain prolonged internal changes that closely resemble indirect division, while the secondary division invariably occupies but a few minutes and the nuclear phenomena rather resemble direct division. Furthermore, while the secondary division is the one usually observed and may evidently be repeated a number of times for the same individual, I have been unable to decide definitely whether the first division, which has only been observed immediately after germination, is a necessary phenomenon in the life history of the individual, or whether it is only an occasional phenomenon.

For purposes of comparison, I have examined the resting nuclei in the Myxomycetes in some detail throughout the vegetative stage, both in the isolated individuals and in plasmodia, and have failed to find any close resemblance to the corresponding conditions in the Acrasieae. Although extremely small, the nuclei, in their structure as well as in their indirect division, appear to correspond, in essential features with the complicated conditions observed in higher organisms. Lister ('93) also asserts that the nuclei of the vegetative conditions of the Myxomycetes are of the usual type and that they undergo karyokinetic division, preceding the division of the individuals. Strasburger ('84), Harper (:00) and others further find that the nuclei and nuclear division in the fructifications of the same group are of the ordinary type.

The nuclear phenomena in the related Amoebae are so various and the conditions are so little known, that it is difficult to compare these organisms structurally with the myxamoebae of the Acrasieae. For example, *Amoeba protea* has but one nucleus, while *Amoeba binucleata* possesses two. The details of nuclear structure and division have been recently described by Dangeard (:00) and Schaudinn ('95), and the latter is of the opinion that in certain species, at any rate, the chromatin is in the form of minute granules which are arranged about the periphery of the nucleus while the central portion is occupied by an "intra-nuclear division center." So far as I have been able to discover, the nuclear conditions present in the myxamoebae of the Acrasieae do not closely resemble either those seen in the Amoebae or those present in the amoeboid condition of the Myxomycetes.

Primary division of the myxamoebae.— The first type of division in the young individuals, which may for convenience be assumed to correspond to an indirect division and which I have repeatedly observed, was apparently not distinguished by Brefeld, who was of the opinion that division of the nucleus probably occurred in the short time during which the myxamoebae are rounded, preceding the ordinary vegetative multiplication. This short time is evidently inadequate for any such complicated changes as those which usually accompany karyokinetic division, while the phenomena which will now be described occupy a number of hours.

The young individuals, having made their exit from the spore wall, in germination, retain for a long time the oval spore shape, and during the slow swelling which occurs, develop one or more contractile vacuoles. Granules then appear in the cytoplasm; sometimes but one rounded refractive body enclosed in a small vacuole, but more frequently several small granules, occurring usually near the two ends (pl. 6, fig. 49–54). From the subsequent behavior of these refractive bodies, I have been inclined to regard them as the chromatin material of the cell. They become more and more conspicuous and finally appear to be arranged along an irregular thread which suggests a spirem (pl. 6, figs. 55, 56). The granules are next aggregated so as to form a group possibly comparable to a nuclear plate (pl. 6, fig. 57) although I have not as yet been able to differentiate an achromatic spindle associated with it; following this stage there occurs a division and subsequent separation of the rod shaped bodies which may be provisionally designated as chromosomes. A constriction which appears, finally divides the individual into two approximately equal parts, each part retaining usually three or four of the chromosomes (pl. 6, fig. 58–60). A vacuole surrounds these chromatin bodies at this time, so that in the rounded, living individuals, the refractive granules may be readily seen with highest powers, floating in the vacuolar fluid and showing Brownian motion. Such rounded, quiescent individuals are usually especially abundant in the early morning hours, from about twelve to twenty-four hours after the sowing of the spores.

As sufficient data have not been obtained to warrant definite conclusions concerning the complete changes, the details of the anaphase can only be conjectured. The occasional occurrence of single, elongated, twisted or U-shaped rods, leads to the conclusion that the several chromosomes become united again into a spirem (pl. 6, fig. 60, a). The cytoplasm then probably encroaches on the nuclear vacuole so that the cavity finally disappears entirely, and, during the subsequent active amoeboid condition, the one or more chromatin bodies either become scattered and dispersed through the protoplasm, or remain bound together (pl. 6, fig. 74–80).

The active vegetating myxamoebae.— The second type of division mentioned above does not take place until after the myxamoebae have led a more or less prolonged active vegetative existence as independent individuals. For some hours following germination and the structural changes just described, the individuals remain quiescent, except for the slow movements of one or more contractile vacuoles. After a time, however, sluggish amoeboid movements become manifest, and the myxamoebae gradually assume the active vegetative condition.

When actively crawling about, the myxamoebae of the various members of the *Dictyosteliaceae*, frequently throw out delicate, usually pointed, pseudopodia, which extend sometimes to a length almost equalling that of the body of the individual (pl. 6, fig. 48). The very irregular shapes and delicate pseudopodia possessed by the myxamoebae of this higher group furnish a striking contrast to the more rounded or lobose amoeboid stages of the simpler species.

The individuals of Guttulina, for example, have normally the form of an *Amoeba limax* (pl. 5, fig. 35) without pseudopodia; Fayod asserts, however, that those of *Guttulina protea* throw out pseudopodia under certain unfavorable conditions, such as occur when numerous bacteria are present, or when the nourishment is concentrated. The myxamoebae of Sappinia and Guttulinopsis, on the other hand, normally possess lobose or rounded projections (pl. 5, figs. 4, 6, 15, 17). When growing Dictyostelium on hanging drop cultures, it was noticed that an insufficient amount of water causes the individuals to assume also an abnormal shape; they become nodulose and the protoplasm appears dense, while the movement under these conditions is extremely slow (pl. 6, figs. 63, 64).

With the one exception of *Guttulina rosea*, in which, according to Cienkowsky, the protoplasm is reddish, no distinct color can be seen in the cytoplasm of the myxamoebae of any of the species in the vegetative stage. Granules of varying size and distinctness may usually be observed shifting about in the internal streaming, some of which are probably the chromatic bodies of the nuclei, while others may be bodies which have been ingested or which represent certain products of metabolism. As Brefeld asserts, the nuclei in the myxamoebae seem to vary in distinctness during the vegetative condition; this change is probably due to the varying size and degree of refractiveness of the component granules.

The secondary division of the myxamoebae.— After a more or less prolonged vegetative existence on a nutrient substratum, during which the myxamoebae increase in size, they finally divide, becoming thus rapidly multiplied. Just how many times division of a single individual and of its derivatives may occur, can hardly be determined without continuous observation through several days; the number undoubtedly varies, however, with the amount of available moisture and food. In preparing for division, the myxamoeba becomes more or less elongated, the contour becomes more regular through the withdrawal of the pseudopodia, and a constriction appears which finally divides the individual into two more or less equal parts, each part receiving one or more of the deeply-staining nuclear bodies (pl. 5, fig. 18; pl. 6, fig. 66–73). The whole process takes place in a comparatively short time, a minute or even less usually sufficing for its completion. Instances may sometimes be observed in which the connecting isthmus between the two halves becomes almost severed, when for some unexplained reason the two portions become again united into one mass.

This type of vegetative division, the usual one observed, unlike the conditions described by Lister in the myxamoebae and swarm cells of the Myxomycetes, is not accompanied in the present group, so far as I have been able to determine, by an indirect division of the nuclear bodies. Although certain of the figures of these bodies may resemble somewhat a nuclear spindle, the appearance is due rather to the presence of several granules at the periphery of a single vacuole. The granules, moreover, are evidently connected by some invisible achromatic substance, since they move together, always maintaining the same relative position during the internal protoplasmic movements, and several times I have seen instances which led me to believe that they were undergoing fragmentation (pl. 6, fig. 75).

It will be seen by a comparison with the figures of the myxamoebae of Guttulinopsis (pl. 5, figs. 17, 18), that the nuclear conditions present in the single individuals and also in those which are undergoing division, appear to be somewhat similar to those described above for Dictyostelium and Polysphondylium.

It is thus evident that the cytological aspects of the subject are left in great uncertainty as well on account of the minute size of the organisms and apparently primitive nuclear conditions which they present, as from the fact that their character and mode of life render a satisfactory application of modern methods of technique a matter of the greatest difficulty. It may be mentioned, however, that on the zoological side at least, the karyology of amoeboid organisms seems to rest on equally uncertain foundations.

Appropriation of food by myxamoebae.— It is well known that the true Amoebae ingest certain foreign particles, such as minute animals or plants, and that these are enclosed in food vacuoles, there slowly digested, and finally assimilated. Lister ('90a, '90b) has observed also that the swarm spores of Chondrioderma and of other Myxomycetes may ingest bacteria and various other solid bodies and appropriate the digested portion. The same observer ('88) as well as other investigators (Krukenberg, '78; Celakovsky, '92; Miller, '98) have further studied the ingestion of solid food particles by the plasmodium of various Myxomycetes, and find that, occasionally, ingested substances may be digested and assimilated. De

Bary's conclusion is justifiable, however, from their researches, that, in the vegetative stage of the Myxomycetes, food for the most part is appropriated in solution, and only occasionally are solid bodies utilized.

In the case of the Acrasieae, the investigators who have studied these organisms have come to various conclusions concerning their method of taking food. Brefeld in his earlier paper ('69), says that the myxamoebae of Dictyostelium are able to take solid bodies into their interior, but he was unable to settle the question as to whether the ingested particles were in any way utilized. Later ('84), he asserts that solid bodies never penetrate into the interior of the myxamoebae of Polysphondylium or Dictyostelium, and that the latter grow exclusively through the absorption of dissolved nourishment. On the other hand, van Tieghem ('80), thought that there was probably a digestion of the bacteria which were engulfed by the myxamoebae of Acrasis. Fayod ('83), found that in the amoeboid condition of *Guttulina protea*, carmine particles, bacteria, etc., were ingested and assimilable portions retained, while the undigested portion was thrown out at the posterior end of the myxamoeba, remaining fastened to it for some time.

I have made repeated observations on the vegetative stages of various species of Acrasieae in order to discover the source of their food, and have found that pure cultures may be grown to maturity in a hanging drop of nutrient decoction without the ingestion of any solid particles. It is true, however, that such cultures, when absolutely pure, do not develop luxuriantly, for the fructifications are fewer in number and smaller than usual. Cultures free from bacteria, furthermore, are exceedingly difficult to obtain, since individuals or spores of these organisms are carried up by the ascending colony of myxamoebae, and a careful transfer to a sterilized culture medium rarely fails to show within a short time the presence of various species of bacteria. If a complete fructification of Dictyostelium or of Polysphondylium is transferred, colonies of bacteria frequently develop at points along the stalk, and also among the spores of the head, thus indicating the presence of these organisms in the mucus which surrounds the stalk as well as in that of the sorus.

In their natural saprophytic environment, the myxamoebae certainly encounter numberless bacteria during their wanderings. In endeavoring to determine the relationships to the latter, I have introduced various species of bacteria into the hanging drop culture and have noted the behavior of the myxamoebae towards them. The bacteria are often caught by pseudopodia, and held while their free ends swing back and forth; or, one end of the rod may adhere for a time to the mucus or ectoplasmic film of the myxamoeba and then again become free (pl. 6, fig. 87). What appeared to be ingestion has, however, been observed in comparatively few cases. In a few instances, where the conditions for observation were especially favorable, the rods were seen to be engulfed by an infolding of the hyaloplasmic border. I have, however, several times observed vacuoles in which one or more undoubted bacteria were present, and in others, granular substances which might possibly be regarded as bacteria in course of digestion have been repeatedly observed. But I have never, in fact, even after long observation, seen any changes whatever in ingested particles, and I have consequently been inclined to regard the minute granular material enclosed in vacuoles, not as ingested bodies, but rather either as the scattered chromatin or as waste products in the cell. As the difficulties of keeping any one myxamoeba under observation for several hours are very great, the changes which may take place in a certain ingested particle have never been traced as far as its assimilation into the protoplasmic substance, if, indeed, such changes occur at all. Conclusive evidence that certain of the internal granules are bacteria is furnished, however, by staining with such differentiating stains as Flemming's triple stain or acetic gentian violet. The bacterium, surrounded by a clear vacuole, will thus be clearly differentiated from the other included granules, which it may resemble somewhat in shape (pl. 6, fig. 88). Furthermore, in the living myxamoebae, rods precisely like those of the colony of bacteria which may be near, or even the comparatively large spores of Dictyostelium or other species, may be occasionally observed, carried about in the protoplasm of the crawling organism (pl. 6, fig. 86). If bacteria are sown near a transfer of the spores of any of the Acrasieae, the myxamoebae which have just become active after germination soon crawl within the limits of the developing colony and remain for some time almost quiescent, showing more sluggish movements, while they assume a more rounded shape than the usual irregular one. The significant fact that within the limits of every available colony of these micro-organisms, numerous quiescent myxamoebae will be accumulated, while there will be no other myxamoebae visible within a considerable radius, leads one to believe that either the bacteria themselves or, more probably, the dissolved products of their activity are utilized (pl. 6, fig. 85). After vegetating thus for some time, the individuals either crawl out of the colony of bacteria and become aggregated, or more often, form fructifications within the limits of the colony itself. When motile bacteria are especially abundant, myxamoebae are occasionally loosened from their hold on the substratum by the activity of the micro-organisms, assume a rounded form and become seemingly dead. In other instances, the protoplasm of the myxamoebae seems to be attacked by bacteria and destroyed; Dangeard ('96), for example, has described certain endogenous germs which attack the amoebae of Sappinia, and I have myself seen appearances in the amoebae of this form which resemble conditions similar to those which he figures, although I have never seen any destructive action take place in the organism.

Even though these phenomena suggest that bacteria, or more probably, the products of bacterial activity are utilized as food by all the species of the Acrasieae, long and careful study leads one to the same conclusion which de Bary held concerning the Myxomycetes, namely, that during the vegetative stage, nourishment is mainly absorbed in liquid form, and that the ingestion and digestion of solid food particles is exceptional.

Microcyst formation.— Unfavorable conditions may cause the myxamoeba to assume a transitory, isolated, encysted state in which the protoplasm may slowly dry up and form a more or less evident ectoplasmic membrane about itself. To such a temporary resting body, Cienkowsky has applied the term *microcyst.* Slow drying of the hanging drop culture causes the individuals to form such rounded bodies of protoplasm, which may be induced to reassume the amoeboid condition by the addition of more moisture. Fayod describes ('83) a peculiar method of microcyst formation in *Guttulina protea*, which takes place in a concentrated nutrient liquid, or when many bacteria are present or the culture is otherwise impure. The myxamoeba becomes rounded and shows a peripheral vacuole, which, after one or two hours, becomes elongated and continues to grow around within the peripheral protoplasmic membrane until the inner mass is separated from the outer covering by the vacuolar fluid (pl. 5, fig. 36–39). A second inner membrane may be added in the same way. In an impure decoction, the outer wall of the microcyst becomes thickened and incrusted with foreign particles, while in one that is pure, it remains unthickened and colorless.

Van Tieghem has further observed a peculiar method of encystment in Acrasis and in Dictyostelium, in which the myxamoeba pushes out a sort of budding process which forms a protective membrane about itself and finally becomes detached. This formation of microcysts by budding he saw taking place at several points at once, until at last all the protoplasm of the myxamoeba was converted into encysted buds. In *Guttulinopsis vulgaris* also, I have seen a curious phenomenon, possibly comparable to the encystment described by van Tieghem, in which a number of small, rounded pieces were successively pinched off from the individual, although I cannot state with certainty that the detached buds were resting microcysts.

AGGREGATION OF MYXAMOEBAE.

It is only after a more or less prolonged independent existence as vegetating individuals, the time being dependent to some extent on the amount of moisture and food available, that the myxamoebae tend to congregate toward certain centers and form aggregations for the purpose of fructification. Although this period of colony formation is properly connected with the phenomena of fructification, as distinguished from those of vegetation, it may properly be considered apart from either.

This remarkable phenomenon which involves the aggregation of great numbers of individuals to form the so called pseudoplasmodium, in which, though closely adherent, the myxamoebae remain mechanically separable from one another, is a distinctive characteristic of the Acrasieae. In all members of this order with one possible exception, certain individuals, at this period, as a result of what may be assumed to be the secretion of some definite substance, become centers of aggregation, the attractive influence of which extends to a considerable distance. Sappinia, however, appears to be exceptional in this respect, since a chemotactic stimulus which could induce such aggregation is evidently lacking, and this form might, therefore, be properly excluded from the true Acrasieae. It is true, however, that aggregations of the individuals of Sappinia do occur at the ends of straws or other small projections above the surface of the moist substratum; but the amoebae, in my experience, fail to form colonies on a smooth surface, but instead, finally become encysted singly. Nevertheless, while these amoebae do not form aggregations either on nutrient agar tubes or on van Tieghem cell cultures, it does not perhaps, necessarily follow that certain individuals may not exert a chemotactic influence at certain periods, since analogous instances have been recorded among the *Myxobacteriaceae*, in which colonies fail to form on agar surfaces. Sappinia, at any rate, is of special interest in that it might be regarded as a transitional form, in which the phenomena of fructification have advanced a step beyond those of the true Amoebae, but which has probably not attained to the differentiation seen in the lower Acrasieae. The force which causes the occasional accidental aggregations in the case of Sappinia is, in all probability, simply negative hydrotaxis. The same force is evidently operative in the formation of the isolated pedicelled cysts of this form, in which a single amoeba becomes erected at right angles to the substratum, thus producing a rounded or pear shaped body raised on a more or less slender stalk (pl. 5, fig. 2).

In order to discover if possible the cause of the aggregation in the true Acrasieae, experiments were made with dilute solutions of some organic substances, with negative results. Pfeffer's well known methods for investigating the chemotactic influences directing the movements of spermatozoids were used in these experiments. Capillary tubes, about one eighth of an inch long and sealed at one end, were partially filled by means of an air pump with solutions of sugar and malic acid of various strengths. The tubes were then rinsed with distilled water and introduced into the hanging drop cultures of various species of Dictyostelium and Polysphondylium. No evidence whatever was gained as to any directive or repellent influence of these substances on the myxamoebae. At any rate, the substance which causes the contagious stimulus and exerts an attracting influence on the myxamoebae must evidently vary in different forms, since two well marked species of Dictyostelium, one for example, with white spores and another with dark, sown in the same spot of a nutrient agar tube, will result in fructifications showing the two distinct forms growing side by side without any trace of intermixture. Myxamoebae which resemble each other exactly, so far as one can determine with high powers, are clearly very different physiologically. In drop cultures, the first visible indication of a center of aggregation is seen when a few myxamoebae become piled up beside one another. Other individuals congregate toward these central points until radiating streams are formed, each composed of masses of numberless myxamoebae and directed toward the central aggregation. The larger streams, which may be seen even with the naked eye on the agar surface of a culture tube, send off branches whose ramifications soon become invisible except when highly magnified (pl. 7, fig. 94). Sometimes all the incoming colonies approach from one side, and occasionally, before reaching the central mass, all unite into a single stream which may creep some distance along the surface before rising to form a fructification (pl. 6, fig. 81–82). Frequently, colonies are formed simultaneously side by side, thus resulting in a number of gregarious fructifications from one base; more often, however, they are not less than 50μ apart.

The myxamoebae, when crawling toward a colony, show usually but few pseudopodia, and become much stretched out in the direction of their movement. The active individuals of Polysphondylium and Dictyostelium, for example, are especially elongated (pl. 6, fig. 84), while those of Guttulinopsis do not show this phenomenon to any striking degree (pl. 5, fig. 19).

When a number of myxamoebae are united in a stream, even though the lines of separation between the members of the aggregation may be almost or even wholly invisible, their contractile vacuoles remain distinct long after they have seemingly become fused in the mass (pl. 6, fig. 81–82). At any stage in the development of the pseudoplasmodium, however, the colony may be readily separated into its component cells simply by crushing it in a drop of water.

Van Tieghem ('80) is authority for the interesting statement that a young mass of fructifying myxamoebae of Dictyostelium, when transferred to a nutrient surface, will separate and the component individuals again pass through a stage of vegetative reproduction. So far as I can gather from his paper, this deduction must have been based on the fact that several fructifications may be produced from one mass of individuals. He mentions, for example, to support his conclusion, one instance in which ten fruit bodies resulted from the transfer of one mass to the nutrient medium.

During a careful study of the behavior of fructifying colonies when transferred to hanging drop cultures, I have seen also that several small fructifications may undoubtedly be produced from one disintegrated pseudoplasmodium; but I have found no evidence whatever of the resumption of a vegetative existence or of an increase in the number of individuals. I have placed, for example, pseudoplasmodia of various degrees of development in hanging drops of nutrient decoction, and have without exception observed that the colony at once begins to form a stalk carrying the developing fructifications out of the liquid. In one instance, a single pseudoplasmodium of Dictyostelium was transferred to a hanging drop of distilled water, and after a few hours, four fructifications were formed from the mass. At another time, a young colony of myxamoebae in a water drop was broken up with needles into several small aggregations, each of which resumed at once its course of development and formed an independent fructification.

It is evident, therefore, that the production of several fructifications from one mass does not necessarily signify an increase in the number of individuals, but the phenomenon is due rather to the breaking up of the mass into several fructifying portions in consequence of the interruption of the normal development.

Even when the pseudoplasmodium is not visibly disturbed, it occasionally happens that the usual course of development will be interrupted. For example, the mass, even after it has attained a considerable size, may separate and the constituent individuals go to augment some other colony near by. It is possible that in such instances, the separation of the pseudoplasmodium may have been due to the heating effects of the Welsbach lamp used for illumination in the examination of drop cultures. At another time, the writer observed in a culture of Guttulinopsis, many small groups of myxamoebae, each composed of a dozen or more individuals, arranged at varying distances about, and independent of a large central sorus. During the night, however, instead of forming, as might be expected, isolated groups of resting bodies, all had joined the central mass and formed pseudospores.

Pseudoplasmodia in various stages of development have been fixed and stained with various reagents but no nuclear changes have been observed in the individuals, nor have any indications of increase in numbers by division of the myxamoebae been seen, from the first period of aggregation up to the maturation of the fructification. In this respect, the pseudoplasmodium is totally unlike the comparable "aggregated" plasmodium of the Myxomycetes, in which nuclear division precedes the formation of spores. During any stage of its development, the pseudoplasmodium may be satisfactorily stained and permanently mounted after the fixing agent has sufficiently coagulated the mucus which encloses the individuals and causes the mass to cohere, so that division, if it were present, could be very readily demonstrated.

The Fructifying Stage.

As has been stated above, the ultimate purpose of the formation of colonies of individuals is the production of naked masses of resting bodies, either spores or pseudospores, which are formed in fructifications having varied appearance and habit. These colonies, or pseudoplasmodia, develop therefore into fructifications which show increasing complexity of structure, from the slightly differentiated sessile aggregations of the simpler species of the *Guttulinaceae* to the complex stalked sori of the *Dictyosteliaceae*. The fructifications of the simpler forms are in fact little more than heaped up masses of encysted individuals, while those of the higher forms, on the other hand, possess characters which, in their parenchyma-like stalk cells having walls of cellulose, present a degree of differentiation even surpassing in some respects that seen in the fructifications of the allied Myxomycetes.

In all the members of the group, with one exception, the sorus of resting individuals, which is borne either sessile on the surface of the substratum or at the end of a stalk of varying length and structure, forms a globular or somewhat irregular mass. In the single genus Acrasis, however, the conditions are exceptional, in that, according to van Tieghem, a single row or chain of spores surmounts a slender supporting filament which is likewise made up of a single row of superposed cells of varying number.

It is convenient in the following account of the fructifying period in the Acrasieae to discuss first the conditions existing in the simpler forms included in the *Sappiniaceae* and *Guttulinaceae*; following which is a comparative account of the details of the development of the fructifications in the more highly differentiated members of the group embraced under the *Dictyosteliaceae.*

Stalk and sorus formation in the simpler forms.— The myxamoebae in the aggregations evidently seek drier places in which to form resting bodies; hence the pseudoplasmodia tend to turn away at right angles from the moist substratum. The simplest example of this negatively hydrotropic tendency is shown by Sappinia, in which, normally, isolated individuals may form simple fructifications by becoming stretched out from the substratum into stalked bodies which consist of a slender basal portion bearing an ovate or pear shaped cyst (pl. 5, fig. 2). In addition to the normal, isolated, encysted individuals, Sappinia may also form, when growing in its natural environment, aggregations of more or less rounded cysts at the ends of small projections from the substratum. Such aggregations resemble closely the sori of the more simple species of the Acrasieae; but they are probably formed accidentally, since, as was mentioned above, the amoebae fail, in my experience, to form colonies on a surface free from projecting particles. It is probable that the individuals, in responding to the negatively hydrotropic stimulus which directs their movements at the period of fructification, simply move out and away from the moist substratum as far as possible, and may thus accidentally form a naked mass at the end of a projecting piece of straw, for example.

Somewhat similar to these masses in general appearance, are the sessile fructifications of certain species of Guttulinopsis. Such fructifications, composed in this instance of pseudospores, form in a similar fashion at the ends of straws or other particles extending above the surface, or they may form on a surface free from projections, as for instance on an agar culture tube. In this last respect, Guttulinopsis furnishes an important point of difference from Sappinia, namely, in the normal formation, by the concerted aggregation of many myxamoebae, of colonies of fructifying individuals (pl. 5, fig. 9). *Guttulina protea*, according to Fayod, forms somewhat irregular aggregations, differing from those of Guttulinopsis mainly in the fact that each myxamoeba becomes a definitely walled spore instead of a pseudospore (pl. 5, fig. 27–28).

In those fructifications of Guttulinopsis and Guttulina in which the sori are borne on stalks, certain myxamoebae usually become more or less differentiated in form and function, so that slightly altered individuals become stalk cells of the supporting structure, while others form a spherical sorus of spores or pseudospores at the summit. In the fructifications of *Guttulina rosea*, and of some of the short stalked species of Guttulinopsis, for example, the cells of the head become in the first instance spherical spores, or in the second, pseudospores, while those of the stalk or foot portion in both cases retain the elongated or wedge shaped form of the myxamoebae.

In that form of the *Guttulinaceae* which we may regard as having the simplest structure, *Guttulinopsis vulgaris*, we may meet with sessile as well as stalked sori in the same culture; such a phenomenon evidently detracts much from the value of the stalk as a specific character, whereas the culmination of differentiation in this group is reached in the long stalked *Guttulinopsis clavata*, in which elongated stalk cells are firmly cemented together by an abundant enclosing mucus. When such a fructification is placed in water, the base remains intact, while the pseudospores of the head deliquesce, so that where the top of the stalk is broken off, the adherent cells projecting from the apex give the appearance of a conical columella (pl. 5, fig. 21). The fructification of the interesting form, *Guttulinopsis stipitata*, although it may have even a longer stalk than that of *Guttulinopsis clavata*, sometimes reaching the height of more than a millimeter, furnishes an exception in that it shows no differentiation whatever in the shape of the stalk and head cells, these being alike irregularly spherical throughout the whole fructification.

As stated above, the individuals of the sori of Guttulinopsis, during the period of rest, lose water and shrink somewhat as the fructification dries, and finally become encysted, forming without exception, pseudospores which are unprotected by a cell wall of any kind. Guttulinopsis is, in my experience, rarely met with in the winter months, while representatives of the spore-bearing species may, on the other hand, be met with throughout the year. It is possible that the absence of a cell wall in the case of the pseudospores of Guttulinopsis may account for this fact.

Stalk formation in the Dictyosteliaceae.— The differentiation in the simpler groups of *Guttulinaceae* is indeed slight when compared with that seen in the *Dictyosteliaceae.* In the latter group, luxuriant growths of Dictyostelium and Polysphondylium may result in fructifications a centimeter or more in length; in some species, on the other hand, they normally attain a height of only one to two millimeters. The simplest type of fructification in this higher group is evidently that of Acrasis, in which a single row of amoebae becomes converted into a stalk terminated by a single chain of spores. The fructifications of the remaining three genera of the group, on the other hand, furnish examples of increasing complexity of structure; that of Dictyostelium, for example, is usually simple and composed of a stalk bearing a spherical sorus of spores at the summit, thus resembling fructifications of Mucor. That of Polysphondylium is normally a racemosely branching fructification in which the branches, as well as the main axis, are each terminated by a spherical, naked mass; while the greatest degree of differentiation is presented by Coenonia, in the fructifications of which, according to van Tieghem, each peripheral cell of the axis bears an external papilla or tooth, and the summit of the stalk is expanded into a cupule, with a dentate border, in which is supported the spherical sorus of spores.

The following account of the stalk formation in the *Dictyosteliaceae* is based upon a detailed study of the development of the fructifications of Dictyostelium and Polysphondylium only. In all probability, however, the development of Acrasis and Coenonia, concerning which few details are given by van Tieghem, conforms in general with the conditions to be described below, since the principal phenomena connected with the fructifications in all four forms appear to be similar.

The first visible indication of differentiation in form and function in the originally similar myxamoebae of the pseudoplasmodium, consists in the formation of one or more permanent vacuoles in certain centrally placed individuals (pl. 8, fig. 110). It is possible that the contractile vacuoles present in the undifferentiated individuals throughout their active upward movement, may become converted into these permanent vacuoles by the production of a colloidal membrane about each individual destined to take part in stalk formation, although I have so far been unable to determine this point definitely. This peculiar vacuolation occurs at first in certain individuals in contact with the substratum; in a drop culture, such a group of myxamoebae is readily distinguished, since those which are thus differentiated assume a refractive appearance and form a center to which others congregate. Still other myxamoebae which pile on top, also become vacuolated and take up the water which the surrounding ones are constantly losing. An axial vertical column is thus differentiated in the center of the rising mass, which is ultimately to form the support up which the colony climbs. As more water is absorbed, the vacuoles gradually grow larger; in those cells in which there are several, they usually fuse into one, and the protoplasm of the individual becomes stretched until the cell is several times the diameter of the surrounding unvacuolated myxamoebae. These enlarging cells become firmly pressed together, so that the intercellular spaces between them are obliterated. Brefeld asserts that no intercellular spaces occur. It may readily be seen, however, when a pseudoplasmodium is examined in a drop of water, that young stages, or occasionally even old ones, show such spaces (pl. 8, fig. 110). As the cells of the forming stalk take on a polygonal form, each secretes a cellulose wall which becomes firmly cemented to the walls of contiguous cells. The cells still retain a certain degree of individuality, however, as may be proved by the use of maceration agents; by this means, the cementing substance of even an old stalk may be dissolved, thus causing the cells to separate.

Occasionally very favorable conditions occur in drop cultures for examining the development of the stalk with highest powers, as when a small pseudoplasmodium falls over against the cover glass. In such a condition, the growth of the vacuoles and the formation of cellulose walls may be readily observed. Stalk formation may be traced even more satisfactorily, however, simply by examining pseudoplasmodia of various degrees of development in a drop of water, supplemented by tests with various reagents. In water, after pressure is applied to the cover, the middle column of the stalk cells of the pseudoplasmodium may be readily seen, while after the protoplasm has been coagulated by means of killing reagents, some pressure must be applied in order to disclose the forming axis.

If a cover glass be pressed upon a fresh colony in a drop of water, it will be observed that stalk formation is proceeding in the apical papilla usually noticeable at the summit of all young pseudoplasmodia (pl. 7, fig. 96–103). It will be seen that the apical protuberance just mentioned is formed by a number of rapidly expanding vacuolated myxamoebae on the summit of the stalk column, which are surrounded and surmounted by a thin film of undifferentiated individuals on their periphery. This peculiar differentiation thus goes on rapidly at the summit of the aggregation, so that there is constantly being formed a firm support up which the colony climbs (pl. 8, fig. 110).

As the mass external to the stalk moves slowly upward, the ascending cells secrete a mucous substance which is deposited on the central axis, so that the latter becomes bounded by a sharply defined mucous sheath, and, as the colony ascends higher still, the secretion left behind by the whole mass covers the stalk below, thus adding considerably to the strength and rigidity of the support (pl. 7, figs. 97, 106). At the bottom of the stalk also, mucus is especially abundant and serves to bind the base firmly to the substratum (pl. 6, fig. 83). Brefeld mentions an interesting phenomenon which occurs when bacteria interfere with the normal development of *Polysphondylium violaceum.* Under such conditions, the stalk may not be attached to the substratum, but may remain free in the pseudoplasmodium. In all probability, such an abnormality is produced by the activity of motile bacteria, which by their movements, break loose the delicate mucous membrane from the substratum. Normally, however, the attachment is comparatively firm, although in transferring spores with a platinum needle, the whole fructification may rather easily be torn away from the substratum, especially after a sidewise push to the stalk has disrupted the mucous membrane at the base. Where the stalk is curved, this external membrane, which is usually difficult to detect, may be readily seen, stretching across the sinus (pl. 7, fig. 97). Imbedded in it may sometimes be observed isolated, vacuolated cells, whose walls show cellulose reaction, and which have evidently failed to join the other members of the column before becoming differentiated (pl. 8, fig. 111).

This membranous covering which encloses the stalk was said by Brefeld to be cellulose. It is true that it turns a faint blue with chloriodide of zinc, but it does so only after some hours' exposure to the reagent, while, on the other hand, the cellulose walls of the young stalk cells show the blue reaction at once. At first, on being placed in a drop of chloriodide of zinc, the enclosing membrane turns yellow, just as does the surrounding colony of undifferentiated myxamoebae; and with haematoxylin, which colors the cellulose walls of the stalk dark blue, the membrane becomes but little stained. Further conclusive evidence that the membrane is mucus rather than cellulose, is furnished by the fact that it stains instantly with muchaematin.

Chloriodide of zinc applied to the developing fructification discloses the fact that cellulose is being deposited around the protoplasm of each stalk cell, even in a very young stage of vacuolation. A plasmolyzing agent such as a salt solution also shows clearly the limits of cellulose deposition; by this means water is extracted from the vacuolated cells, thus causing those which have no firm membrane of cellulose to lose their vacuoles entirely and to lie loosely as shrunken cells in the mucous sheath. Those, however, in which cellulose formation has begun, remain cemented together and the more or less rigid walls preserve somewhat the vacuolated structure. It is, furthermore, a rather curious fact that while young stalk cells respond to the cellulose test at once, the stalks and spores of mature fructifications require from three days to a week to show the characteristic blue color, a fact which may perhaps be attributed to the resistance offered by the mucous covering which encloses them.

The interesting question as to the nature of the substance in the vacuoles of the myxamoebae of the stalk is one involving many difficulties. Many microchemical tests with litmus and methyl orange solutions, as recommended by Pfeffer, have given unsatisfactory results as to the acid or alkaline reaction of the vacuolar fluid. On the supposition that the dissolved substance of the vacuoles might be uric acid, as is said to be the case in the contractile vacuole of the amoeba and other protozoon forms, (Griffiths, '89), the murexide test was repeatedly tried, but the resultant color reactions were unsatisfactory.

The fructifying pseudoplasmodia of the various members of the *Dictyosteliaceae* are thus seen to be made up of two kinds of individuals: the normal myxamoebae, each of which is ultimately to become a spore in the sorus at the summit, and the differentiated individuals, which together form the supporting stalk. The pseudoplasmodia of the more complicated members of the *Guttulinaceae* likewise form fructifications which show a slight degree of differentiation, in that some of the myxamoebae become rounded or oval spores or pseudospores of the head portion and others in the stalk portion retain their elongated shape; whereas the simpler species show no differentiation whatever in their fructifications.

The resultant fructifications of the *Dictyosteliaceae*, as indicated above, present various habits in the four genera composing the group. They all agree, however, in the fact that the basal cells of the fructifications are generally greater in number or are broader than the other stalk cells, thus forming an expanded foot. Furthermore, all show more or less variation in appearance under different conditions. For example, in most cases, the breadth of the stalk accommodates itself to the size of the pseudoplasmodium; the larger the number of myxamoebae in the latter, usually the broader and firmer the support. In a large fructification, for instance, there may be as many as ten or more polygonal stalk cells in optical cross section near the base, and only one at the distal portion, fewer and fewer cells being thus differentiated the higher it rises above the substratum. Weaker fruit bodies, on the other hand, may have but one row from the beginning; and, according to van Tieghem, *Acrasis granulata* and *Dictyostelium lacteum*, under normal conditions, possess only one row of stalk cells throughout the entire length of the fructification.

Branching fructifications in the Dictyosteliaceae.— Polysphondylium is the only representative of the *Dictyosteliaceae* that possesses fructifications which are normally branched, while those of the other three members of the group, on the other hand, are usually simple. Under certain conditions, however, the fructifications of Dictyostelium and Coenonia may each bear one or more small branches, disposed along the main axis. Furthermore, Polysphondylium may also show an occasional unbranched fructification, which consists of a stalk bearing a single sorus of spores at the top, and which appears similar in all respects to an unbranched fructification of Dictyostelium (pl. 8, fig. 118, a). Such a phenomenon points clearly to the near relationship of these two genera, and indicates, as do the variable, simple, or branched fructifications of Dictyostelium and Coenonia, that the stalk should in reality have little weight in this group as a character of generic value.

Van Tieghem has noted the fact, in the case of Coenonia, that whereas the fructifications are normally simple in cover glass cultivations, a luxuriant culture yields frequently a fructification in which the principal stalk bears a verticel of three equidistant branches. Certain species of Dictyostelium also often show, in luxuriant growths, branched fructifications, in which the axis bears at irregular intervals one or more secondary fructifications, usually of unequal length (pl. 8, fig. 109). In both instances, the branched portion is similar in all essential respects to the main fructification and is attached externally to it. In the case of Dictyostelium, the branching is sometimes evidently accidental; as, for example, when the stalk of the fructification has fallen, there may arise from late ascending colonies erect branches, which are fixed by means of mucus to the inclining main axis in a manner similar to the fixing of the principal stalk to the substratum. In other instances, however, when the growth is vigorous, small colonies, ascending below the larger pseudoplasmodium at the summit, become diverted from the axis and form a stalk placed at right angles or obliquely to the main stalk. The formation of such branches might be explained as the result of loss of water, so that further upward movement of the colony is impossible. Such a conclusion is made the more credible by the fact that tardy colonies, or even individuals having sufficient vigor, may sometimes be seen to reach the main aggregation at the summit. When food is especially abundant, a fructification of *Dictyostelium sphaerocephalum*, for example, has been seen to bear as many as four or five branches of unequal length (pl. 8, fig. 109); and in this form, as well as in others, under similar conditions, it is not unusual for several diverging fructifications to spring from a common base.

As mentioned above, Polysphondylium is the only member of the group in which ordinarily the fructifications are regularly branched. The fructifications of this organism, however, present many variations as to the number of the branches, since, while some may even be simple and unbranched, others may bear but one, or, more often, a considerable number of secondary axes, usually arranged in whorls along the main axis. A mature fructification may sometimes have as many as ten whorls of branches, all of about equal length and disposed at approximately equal distances along the axis, the undermost whorl made up of five or six rows, the uppermost of from one to three (pl. 8, fig. 118).

The phenomena connected with the formation of such branched fructifications in Polysphondylium may be described as follows. The erect pseudoplasmodium in its earlier stages cannot be distinguished in any way from one of Dictyostelium. Soon, however, a variation is noticed, in that colonies are successively detached from the base of the ascending aggregation of myxamoebae or from later ascending masses, so that as the main stalk rises higher and higher, one may note as many as eight or ten isolated groups of individuals at varying heights along the axis (pl. 8, fig. 113–116). The separated colonies move but little upward after being disjoined, but, instead, each begins to move outward, away from the stalk. This tendency of the detached colony to move outward in this manner results in the fragmentation of each mass into several radially disposed portions, each of which proceeds to form stalk cells out of some of its members and a more or less regularly arranged whorl of false branches at the pseudonode results (pl. 8, fig. 117). Occasionally but one branch is sent out at a node; but, if the colony is vigorous and the number of myxamoebae large, there may be as many as five or six in a whorl. In a single instance it was noticed that fructifications of *Polysphondylium pallidum* produced several branches which in turn bore one or two whorls of branchlets; that this doubly verticellate character was not constant, however, was proved by transferring this form to a sterilized nutrient medium, when none but normal fructifications resulted.

The details of the process of the formation and maturation of the branch are similar to those described above for the development of the main axis; in fact, each branch, in the case of Polysphondylium, may be likened to a miniature fructification of Dictyostelium. The stalks of these lateral fructifications arise at right angles to the main axis, or, more frequently, are inclined slightly upward. The proximal end of each, which is composed of several rows of cells, is attached externally to the axis and is cemented to it by means of a mucous membrane (pl. 8, fig. 119); while distally each has usually only one row of extremely delicate, elongated cells (pl. 8, fig. 120).

Sorus and spore formation in the Dictyosteliaceae.— The ascending column of myxamoebae slowly loses water, as is evidenced by the gradual diminution in size of each individual and by the appearance of drops of water along the stalk and about the periphery of the colony. The force which is active in causing these drops of water to be exuded is in all probability similar to that which causes excretion of liquid from the hyphae of Pilobolus or Mucor when grown in a moist culture dish.

When the conditions are favorable for the conversion of the myxamoebae into spores, the pseudoplasmodium slowly ceases its upward movement. The exact cause of the cessation of this movement is as yet undetermined, but it is reasonable to believe that water has been lost by the component myxamoebae to such an extent that further active protoplasmic streaming is impossible. Frequently, vigorous looking colonies on the drier portions of a nutrient agar culture will cease movement and sporulate so quickly that the head does not assume its usual shape, but retains instead the elongated shape of the pseudoplasmodium. Certain species of Dictyostelium have a special tendency to develop thus prematurely when grown on a peptone culture medium. The spores of these abnormal sori may be also prematurely formed, for they then may be spherical instead of oval, and larger than the normal spore.

The normal method of spore formation in the *Dictyosteliaceae* is as follows. Stalk formation ceases, the end of the axis frequently becomes broader and club shaped, and the colony moves upward a little higher and assumes a spherical shape. The end of the stalk does not then project above in the apical protuberance above mentioned as it does in the ascending colony. The myxamoebae, during this stage, show dense unvacuolated contents, each being an oval or spherical body, separated from the surrounding individuals by a film which shows the characteristic mucous reaction with muchaematin. A wall of cellulose is secreted about the protoplasm of each individual which thus becomes a refractive spore, very resistant to stains and other reagents. In Acrasis, according to van Tieghem, this resistance is still further increased by the addition of a cuticularized external zone. The mucous substance between the spores cements them together, and the whole mass forms, with the exception of Acrasis, a naked, deliquescent head.

The size of the sorus is at first much increased by the moisture which it contains, but as the mass of spores dries, the sorus shrinks considerably. If the moisture be allowed to evaporate but slowly, the spores settle by gravity to the bottom of the globule, leaving a clear portion above. The heavy sori of luxuriant fructifications may even overcome the adhesive forces which hold them at the summit of their stalks and slide slowly down the support, when the naked apex then projects above the mass of spores.

The size of the mature sori in all the members of the group varies somewhat with the culture medium, but in the main their measurements are fairly constant for the same species. Another character which is constant in the verticellate fructification of Polysphondylium, is that the sorus at the summit of the main axis is normally about twice the diameter of those of the lower whorls, while its distance above the whorl immediately below is usually two or three times the distance between any two contiguous verticels.

The time required for the complete cycle of the development of these organisms varies from two to several days, and a week or even more may elapse before fructification occurs, which may then continue for a week or more longer. The fructifying portion of the life cycle of a single individual occupies but a small part of this time, since, after the preliminary aggregation, the formation of the stalk takes place so rapidly that the complete fructification may be formed in a day or, in some instances, even in a few hours.

Characters and germination of the pseudospores and spores.— The resting bodies in the fructifications of the Acrasieae, as indicated above, are readily divisible into two groups: *pseudospores*, in which there is no cell wall secreted about the resting myxamoebae, and *spores*, in which a distinct cell wall of cellulose or similar substance is formed around the protoplasm of each individual. Pseudospores are not true spores according to the usual acceptance of the term, but instead they are merely slightly contracted and encysted individuals. While they may have a more or less evident marginal protoplasmic membrane, the wall is never, in my experience, satisfactorily demonstrable with plasmolyzing agents, nor is it ruptured during germination and left behind as a delicate sac as in all the sporiferous genera of these organisms.

Pseudospores are peculiar to Guttulinopsis and Sappinia, while the other five genera embraced in the group possess true spores in their fructifications. When the pseudospores of Guttulinopsis are sown on a nutrient substratum, they soon lose their refractive appearance and the granular protoplasmic contents become visible. Each swells somewhat, one or more pulsating vacuoles make their appearance, and finally, after some time, the individual gradually assumes an active vegetative state and crawls away as a myxamoeba (pl. 5, figs. 3, 4, 10–15).

In my experience, a nutrient medium is necessary to induce the germination of both spores and pseudospores. The spores of *Guttu-*

lina rosea, however, according to Cienkowsky, are able to germinate in water. The process of germination of the spores differs from the renewal of activity above described for pseudospores in the fact that the delicate cellulose spore membrane is ruptured by the swelling of the protoplasmic contents (pl. 6, fig. 40–44). In the case of the spores of Dictyostelium and Polysphondylium, in a few hours to several days from the time of sowing, the myxamoeba emerges, usually from the end, leaving the transparent cellulose wall behind as a ruptured sac. Rarely the slit in the wall extends the full length of the spore along one side, in which case the protoplasmic contents come out from the side (pl. 6, fig. 44) ; while in *Guttulina protea*, according to Fayod, the myxamoeba always germinates through a lateral perforation, evidently due to absorption and not to any rupture which has resulted from the swelling of the contents.

Colored Forms of the Acrasieae.

With the exception of *Guttulina rosea*, which, according to Cienkowsky, possesses a reddish protoplasm, the myxamoebae of the various species of the Acrasieae are devoid of any appreciable color in the cytoplasm. The fructifications of several members of the group, however, although their pseudoplasmodium condition is uniformly whitish, assume some color during the formation of spores and the development of cellulose walls.

In one form, *Guttulinopsis vulgaris*, the color of the sorus may be made to vary according to its dryness or the character of the substratum. When grown on horse dung, for example, the sori are at first usually whitish, and later, in drying, they uniformly assume a yellowish color; whereas, on an agar culture tube the sori at least when young, are, in my experience, uniformly white. It is possible that the yellowish color in the first case is due to the small particles which are carried up by the ascending colony from the horse dung surface, and drying may simply make the color more prominent.

In certain species of the higher group of *Dictyosteliaceae*, there occur fructifications in which the color is a constant and well marked character. Those species which develop colored spores and stalks during the fructifying process are uniformly whitish during the pseudoplasmodium stage. But with the formation of cellulose walls, the colony slowly assumes the characteristic color, the purplish forms, when in a young condition, showing a reddish tinge, later becoming dark violet or purplish. Tests demonstrate the fact that a similar change in the color of the dark spored fructifications can be brought about by varying the acidity or alkalinity, so that the color changes to reddish in acids and resumes the bluish tinge on applying a dilute alkaline reagent.

Further than the fact that the color seems to be associated with the cellulose walls, nothing definite was determined concerning the phenomenon in the three species of the *Dictyosteliaceae* examined, namely, *Polysphondylium violaceum*, *Dictyostelium purpureum*, and *D. aureum*. Van Tieghem makes the statement that the violet color in the case of Acrasis is associated with the cuticularized external portion of the spore; and he further describes a peculiar condition in Coenonia, in which the cells of the stalk are colorless, while the cellulose walls of the spores in the sorus are yellowish.

Irritability of the Pseudoplasmodium.

Certain phenomena connected with the irritability of these fructifying masses are of sufficient interest to merit a special discussion. The plastic masses of naked protoplasm which form the pseudoplasmodia of the higher forms, furnish excellent illustrations for the study of the irritability of such fruiting bodies with respect to certain stimuli. That which renders these phenomena more interesting is the fact that here we have to deal structurally with an aggregation of individuals, each to a certain extent distinct, while physiologically the colony acts as a unit with respect to stimuli. The response of the pseudoplasmodium is similar in most respects to that of the sporophores of certain Myxomycetes and of fungi, such as Pilobolus. For example, young pseudoplasmodia of Dictyostelium and Polysphondylium are strongly heliotropic, so that if a culture tube be turned until the nutrient surface is parallel to the source of light, the colony will turn so as to be almost parallel to the substratum. In general, the direction taken is a resultant between that induced by the heliotropic force and that which causes the pseudoplasmodium to turn at right angles to the agar surface. The fructification comes to maturity in the dark as well as in the light, and when the light is thus excluded, the colony is invariably elevated at right angles to the substratum.

The force which causes the fructification to be directed away from the substratum and at right angles to it, is in all probability negative hydrotaxis. It is true that a colony may creep up the side of the test tube in which it is cultivated, finally turning away from a glass surface which is apparently not moist, thus leading an observer to think that the stimulus may be caused simply by contact with a solid body. Close examination, however, reveals the fact that the water lost by excretion covers the creeping pseudoplasmodium and that, consequently, the substratum is wet by the excreted water. Even more conclusive evidence that movement away from water causes the elevation of the pseudoplasmodium may be deduced from the fact that when a colony is moving along the glass side of a culture dish, and a moist body, such as a piece of dung or wet filter paper, be placed very near the creeping pseudoplasmodium, no fructification will be formed for some time and the creeping may continue until nearly the whole of the colony is utilized in the production of stalk. Evidently the presence of the moist body so close to the substratum on which the mass is crawling prevents the pseudoplasmodium from becoming sufficiently dry to induce it to turn away from the glass.

The fact that the branches in the case of Polysphondylium are almost invariably inclined slightly upward may be also regarded as further supporting this belief. It appears at least reasonable that negatively hydrotropic forces should cause the small branching colonies to be directed upward, away from the moist substratum, as well as away from the main stalk from which they arise.

Gravity does not seem to affect the young colonies in the least, for the pseudoplasmodia may be directed upward or downward or horizontally, according to the orientation of the substratum.

The pseudoplasmodia of most of the other species of Dictyostelium and Polysphondylium further present a curious phenomenon, the cause of which is as yet undetermined. The colonies of certain species especially tend to move more or less spirally, like twiners. Dr. Thaxter ('92) has called attention to an analogous phenomenon in the *Myxobacteriaceae*, in which the aggregated rods which form the fructifying colonies tend to move in "whirlpools" and the stalk shows the torsion induced by the spiral ascent. In order to determine whether the force of gravity may have caused the coil in the case of *Dictyostelium purpureum*, cultures were rotated in a horizontal plane, so that the nutrient agar surface was placed vertically, and both gravity and light forces were thus overcome. Constant rotation for weeks produced no perceptible effect on the spirally moving pseudoplasmodia, for the phenomenon was as pronounced as ever and occasionally the colonies even reversed the usual right to left direction and twisted from left to right. The stalks usually straighten out on maturing and lose the spiral appearance, thus simulating again the phenomena observed in twiners among higher plants.

GENERAL METHODS.

Pure cultures have been utilized as far as possible in making this study of the life history of these organisms. Cultures of dung and of decaying substances in general have been kept in covered crystallizing dishes or in tin boxes, and as forms of the Acrasieae appeared they were transferred by means of a platinum needle to a slant culture tube. The media used for culture tubes included an attenuated dung decoction, horse dung being usually employed, a potato decoction and a peptone nutrient medium, besides several standard culture solutions, such as Pfeffer's solution for cultivating fungi. These were stiffened with from about 1% to 2.5% of agar-agar, and sterilized. The best results were obtained with the horse dung decoction tubes and with the peptone nutrient medium. While all of the *Dictyosteliaceae* usually grow luxuriantly upon either of these substrata, certain species seem to prefer the peptone medium, *Dictyostelium purpureum*, for example, growing with astonishing vigor on the latter medium. In a strong dung decoction, or in one that is too weak, the fruit bodies do not develop well, if at all. Even in tubes made with nothing but distilled water and agar, however, fructifications appear in small numbers, some nourishment being doubtless obtained from the gelatinous substance of the alga.

Sappinia, as mentioned above, failed to form aggregations on culture tubes, while Guttulinopsis produced fructifications in abundance.

Guttulinopsis, however, being sessile or only short stalked, is kept running with great difficulty on cultures on account of the numerous bacteria which are certain to be transferred with the sorus and which interfere with normal development, so that, while studying these organisms, it was usually necessary to transfer them often to sterilized dung in crystallizing dishes.

Drop cultures were made with filtered nutrient media, in van Tieghem cells, or on thin glass covers cemented to small petri or stender dishes by means of a mixture of vaseline and beeswax. Small, shallow stender dishes with a small amount of water in the bottom made especially favorable moist chambers for microscopic study. In examining drop cultures with high powers, such as immersion lenses, it was found that a sufficient amount of light could be directed through the culture dish and up the tube of the microscope only by use of a strong "bull's-eye" lens, placed so as to concentrate the light from a Welsbach gas lamp on the mirror. This method had some disadvantages in its heating effects, sometimes causing the thin agar to soften and fall below the focus of the objective, but in general, it was quite satisfactory.

As killing media for both myxamoebae and fructifications, Flemming's mixture, osmic vapor, acetic methyl green, and acetic gentian violet were used. One of the best nuclear stains for the vegetating myxamoebae proved to be acid Delafield's haematoxylin, after killing for twenty-four hours with Flemming's mixture; while methyl green, following the fumes of osmic acid, also proved useful in this respect.

Permanent mounts of all the species found have been preserved in glycerin in which was dissolved a little eosin, and some were mounted in balsam. Since the sori are so extremely deliquescent, mature fructifications cannot easily be carried through the various processes for mounting in balsam; young fructifications and pseudoplasmodia, however, are sufficiently adherent to permit the use of such reagents. The species have also been preserved in a dry state, on dung or on agar dried slowly, or on paper on which the fructifications have been formed, and type specimens as well as slides are preserved in the cryptogamic herbarium of Harvard University.

SUMMARY.

The Acrasieae are naturally divisible into the *Guttulinaceae* and the *Dictyosteliaceae.* These groups agree, first, in the fact that the individuals, during their vegetative state, assume the form of amoeboid cells which never pass through a swarm cell condition, and secondly, in that the individuals, during the fructifying period, probably in response to some chemotropic stimulus, unite to form colonies, called pseudoplasmodia, for the evident purpose of forming fructifications.

On the other hand, they differ widely in the general character and structure of their fructifications. Those of the *Guttulinaceae*, for example, possess little or no differentiation, while those of the *Dictyosteliaceae* show considerable differentiation among the individuals, both in structure and in function.

In the first mentioned group, the fructifications consist either of sessile, naked masses of pseudospores or spores, in which all of the individuals are similar in form, or of stalked sori, in which there may usually be observed a small amount of differentiation, in that those individuals which, together with an enclosing mucous substance, form the stalk, retain the elongated shape of the myxamoebae, instead of becoming oval or spherical bodies as do those individuals in the sorus at the summit.

In the higher group of the *Dictyosteliaceae*, the myxamoebae of the fructifying pseudoplasmodium become either cells of the more or less highly differentiated stalk, or spores borne in a sorus at the summit of the stalk. In all cases, the differentiation consists essentially in the vacuolation of those individuals which are destined to take part in stalk formation. Large permanent vacuoles, usually one to each individual, are formed in a vertical column of myxamoebae, which is centrally placed in the pseudoplasmodium, the number of individuals which thus undergo differentiation being usually directly proportionate to the size of the aggregation. Each of the turgid vacuolated myxamoebae of the stalk column ultimately secretes a cellulose wall, which becomes firmly cemented to the walls of surrounding individuals, and the mass of polygonal stalk cells thus formed, each with a large central vacuole and a small amount of peripheral protoplasm, closely resembles parenchymatous cells.

The strength and rigidity of this supporting stalk is still further increased by the mucus deposited on its exterior by the colony of undifferentiated myxamoebae, or pseudoplasmodium, as it ascends the stalk; and a mucous membrane, furthermore, binds the base of the stalk to the substratum.

While the stalk in three members of the *Dictyosteliaceae* consists either of a single row of similar superposed cells or a more or less broad column of similar cells, in the fourth genus, Coenonia, the external cells of the column are still further differentiated by the formation of a papilla on the peripheral wall of each, and the summit of the stalk is expanded into a cupule.

While both the sessile and the stalked sori usually consist of spherical naked masses of spores or pseudospores, held together by means of a mucous substance, in Acrasis, the spores are in a single row, or chain, surmounting a stalk which is likewise composed of a single row of superposed cells.

In the fructifications of the *Guttulinaceae* occur two types of resting bodies: in Guttulinopsis and in Sappinia, the individuals, during their resting condition, become encysted, secreting no definite wall, thus forming pseudospores; while in Guttulina, the individuals form definitely walled spores. In the higher *Dictyosteliaceae*, there invariably occur spores, which possess a single membrane composed of cellulose, augmented in the case of Acrasis by a cuticularized external zone. In germination, the wall of the spore is ruptured, while in the case of the pseudospore, the process is not accompanied by the breaking of a membrane, but the resting individuals simply gradually reassume a state of activity.

In the individuals of Dictyostelium and Polysphondylium, occur what appear to be two types of division, one in the young individuals shortly after germination, and the other during the subsequent active amoeboid condition. The first, or primary division occupies a number of hours and is accompanied by prolonged nuclear changes which resemble karyokinetic division. The secondary division resembles rather direct division and takes place usually within a few minutes.

The force which is operative in inducing the fructification to be directed away from the substratum is evidently negative hydrotropism. While gravity does not seem to affect the direction of the sporophores, the fructifications, at least of the higher forms, are strongly heliotropic. Finally, the stalks of certain species of the *Dictyosteliaceae* show when young a spiral twist, the cause of which is as yet undetermined.

Systematic Relations of the Acrasieae.

Affinities. — De Bary ('87) and other writers on the Mycetozoa evidently believed in the common origin and close relationship of the Acrasieae and the Myxomycetes, as well as in the development of the one from the other. De Bary regarded it as more probable that the plasmodium of the Myxomycetes has proceeded directly from the pseudoplasmodium of the more simple Acrasieae rather than that the converse order of development was followed. He suggests (p. 443) that "forms like Guttulina may have developed phylogenetically in two divergent directions, on the one hand into the more highly differentiated Acrasieae, on the other into forms which produce plasmodia."

Harper (:00, p. 235) is of the opinion that "there can be no question that the Acrasieae represent simpler forms out of which the Myxomycetes have developed, and we thus have a developmental series leading from simpler to more complex forms." He adds, however, that "the plasmodium and capillitium, occurring only in the more specialized members of the group, are plainly secondarily acquired structures developed as additions to the structural features of the Acrasieae and are not to be directly homologized with physiologically equivalent structures in other groups."

De Bary and others, on the other hand, would even derive the plasmodium from the pseudoplasmodium and conceive that the aggregation of individuals of the lower group becomes fused into one mass of protoplasm and that the mass then prolongs its vegetative existence for an indefinite time before proceeding to fructify. In other words, the coalescence of the myxamoebae in the Myxomycetes into a plasmodium and the final redivision of the plasmodium into individuals would take the place of the simple aggregation of individuals in the Acrasieae.

There can be no question as to the common origin of the Myxomycetes and the Acrasieae. When, however, the two groups are carefully compared in all their structural and physiological phenomena, it appears unlikely that the Myxomycetes have been derived directly from the simpler organisms, since they have in reality but one feature which is strictly comparable, namely, the amoeboid stage of their existence.

The plasmodium is evidently not at all analogous to the pseudoplasmodium, as Zopf ('92) and others have pointed out, for the aggregation in the latter case is not a vegetative mass as is the plasmodium, but is simply a heaping up of individuals for the purpose of forming a fructifying body, and it therefore follows the vegetative stage. Moreover, the vegetating plasmodium, as Harper has suggested, although a product of cell fusions without nuclear fusion, is in its nutrition, reactions to stimuli, and growth, a physiological unit, just as a myxamoeba is a unit. On the other hand, the pseudoplasmodium, although responding as one mass to certain stimuli, it is true, is not in the least a unit, since the individuality of each member of the colony is preserved throughout the development of the pseudoplasmodium to a sporiferous body. Furthermore, the nuclei of the plasmodium multiply greatly during its nutritive stage, (Lister, '93) as well as again during the preliminary fructifying stage (Strasburger, '84; Lister, '93; Harper, :00), thus increasing enormously the number of potential individuals. On the other hand, the individuals of the pseudoplasmodium of the Acrasieae do not increase in numbers nor are there nuclear changes therein.

Although that period in the development of the plasmodium which may be termed the period of aggregation, during which the protoplasm heaps up preparatory to fructification, is comparable physiologically with the pseudoplasmodium, the structural differences between the two at this time are very apparent. In fact, it becomes evident on careful comparison throughout their development, that the only strictly comparable portion, structurally, in the two groups is, as mentioned above, the amoeboid stage of their existence, since the life cycle of the Acrasieae includes neither the swarm cell nor the plasmodium condition of the more highly differentiated order, while the sporophores of the two, furthermore, show little resemblance. We may, however, see some likeness perhaps in the stalk of Stemonitis, in that it is formed somewhat similarly, as a central supporting column, but neither the main stalk nor the capillitium in this case is protoplasmic in nature. Again, some members of the *Physaraceae* possess stalks, each composed of a column of cells surrounded by a mucous sheath,— conditions which may be compared with those in the stalks of the Acrasieae.

Morphologically, therefore, the plasmodium cannot be assumed to have been derived from the pseudoplasmodium, since there are no evident resemblances between the two and consequently the Acrasieae and the Myxomycetes may be regarded as related only through the Amoebae, with which their myxamoeba condition indicates undoubted relationship. While, in drawing this conclusion, there may seem to be danger of interpreting lack of analogy as lack of homology, it is nevertheless difficult if not impossible to conceive of a near relationship between two such diverse structures, whose morphological as well as physiological differences are so apparent. The facts, therefore, seem to indicate that instead of having but one series of organisms forming one genetic line, as believed by de Bary and other writers, we have two distinctly divergent and genetically independent series which may have had a common origin.

Zopf ('92) has suggested that the Labyrinthuleae may form in some respects a link intermediate between the Acrasieae and the Myxomycetes. To uphold this view, Zopf regards the net-plasmodium of the Labyrinthuleae as the homologue of both the pseudoplasmodium and the plasmodium, and he also believes that this structure indicates closer affinities with the Acrasieae than with its higher relative, since the net-plasmodium, in his opinion, presents conditions in the partial fusion of the individuals which are more nearly comparable with the conditions we have in the pseudoplasmodium, in which the individuals are wholly distinct. While it is true that the vegetative net-plasmodium may be comparable to a certain degree with the plasmodium of the Myxomycetes, it should not be regarded as the homologue of the pseudoplasmodium of the Acrasieae, since the latter is a phenomenon having to do with fructification and not with vegetation. In fact, that portion of the life history of the Labyrinthuleae which is in the least comparable with the pseudoplasmodium is not the so called vegetative net-plasmodium but rather the heaping up of the individuals preparatory to their encystment in fructifying masses. In the case of the dung-inhabiting *Diplophrys stercorea*, for example, the external resemblance of the fructifying colony to that of Guttulinopsis is certainly striking, so that when it appeared in laboratory cultures in Cambridge, it was readily mistaken for one of the latter genus. Notwithstanding the fact, however, that we may call the fructifying colonies of the Labyrinthuleae and the Acrasieae physiologically equivalent, when we come to compare the individuals of the two groups, we see no evident points of resemblance. The spindle shaped individuals, at least in *Diplophrys stercorea* and presumably in other members of the group, do not show the amoeboid movements and internal protoplasmic streaming of the myxamoebae, and they are flexible only to a slight degree. Moreover, in their nuclei and in the peculiar mode of division, the individuals do not resemble in the least those of the Acrasieae. In the peculiar, fine, elongated pseudopodia of Diplophrys, which are constantly borne at two definite points and which are not variable in form and origin as are those of the Amoebae, this organism shows close resemblances to the Reticulariidae rather than to the Amoebae with which Zopf associates the group. The individuals of the Labyrinthuleae, in their fusiform shape, in their internal structure, and in their oblique division, as well as in their peculiar mode of locomotion, clearly differ widely in character from the myxamoebae of the Acrasieae and of the Myxomycetes. It follows, therefore, that, although some similarities are undoubtedly present between the fructifications of the Labyrinthuleae and those of certain simpler forms of the Acrasieae, the likeness may be regarded as probably accidental and confined to external resemblances only.

In searching for undoubted affinities of the Acrasieae, de Bary has pointed out that we are led by a very short step to the Amoebae. The latter are organisms which have the amoeboid movements of the myxamoebae, which multiply similarly by successive division, but which do not form aggregations in any way. They may pass singly and without aggregation into encysted states, which are similar in all respects to microcysts and which do not essentially differ from the spores of the higher Acrasieae. Indeed, in Sappinia we have a naked amoeba which undergoes encystment either singly or in occasional aggregations at the ends of projections above the surface of the substratum. It thus essentially differs from Guttulinopsis only in the fact that the colonies of myxamoebae of the latter aggregate in response to some chemotactic stimulus. We may readily believe that the pseudoplasmodium of the Acrasieae may have arisen from forms which had habits similar to those of Sappinia, and that the latter forms a perfect connecting link between the Amoebae, with which it has perhaps closer relationships, and the Acrasieae.

In tracing the relationship of the allied Myxomycetes, de Bary goes a step below the Amoebae to the Flagellatae. As he has pointed out, the occurrence of such a significant stage as the flagellate swarm cell condition so early in the developmental history of the Myxomycetes, renders highly probable the near genetic relationship of this group with the Flagellatae, with which, however, the Acrasieae show no close and direct connection. Zopf has further shown that the Myxomycetes are probably closely related to certain forms of the Monadineae.

It may be suggested in this connection, that we have in the tendency of the members of the Acrasieae to form the so called fructifying colonies of individuals in response to chemotactic influences, probably a plant character rather than an animal one. While it is true that many Protozoa respond to certain stimuli and some undoubted members of this group may even form colonies of vegetating cells resulting probably in most cases from an incomplete separation of daughter individuals, no known protozoan, so far as I am aware, forms aggregations for the evident purpose of forming resting masses of spores or cysts, as do *Diplophrys stercorea*, and probably other members of the Labyrinthuleae, the Acrasieae, the Myxomycetes, and the *Myxobacteriaceae.*

Opinions have varied much concerning the possible relationships that the Mycetozoa may sustain to higher forms. De Bary has influenced opinion in this respect more perhaps than any other investigator because of his belief that these organisms are the terminal members of a series of forms, and that they do not connect with any higher group, while others have sought to show genetic connection with the Fungi in various ways. It is of historical interest only that Fries ('29) placed the slime-moulds among the Gasteromycetes on the strength of a mere superficial resemblance between the mature sporangia in the two groups; while Brefeld ('69), at first misled by erroneous interpretations, held the opinion that Dictyostelium might connect the two groups through Mucor. Cornu's belief that the Mycetozoa might be connected with the Fungi through those Chytridineae which produce amoeboid cells, was perhaps founded on a more substantial resemblance. For example, the Myxochytridineae, in their possession of flagellate or amoeboid swarm spores, or occasionally a vegetative body which shows amoeboid movements, show characters which are similar in some respects to those of the Mycetozoa. Furthermore, as Harper (:00) has pointed out, the method of formation of spores in the sporangia of Myxomycetes by progressive cleavage, points to another similarity to the Fungi, since the phenomenon is similar to that observed in the sporangia of Synchytrium, Pilobolus, and other members of the group.

As pointed out by Dr. Thaxter ('92), there is also in the life history of the *Myxobacteriaceae* a phenomenon which presents a certain striking resemblance to the Acrasieae. These organisms are distinguished from other bacteria in having two definitely recurring periods in their life cycle — "one of vegetation, the other of fructification or pseudo-fructification through the simultaneous and concerted action of numerous individuals." During the vegetative stage, the rods lie separate. Through some contagious impulse, they concentrate toward central points, by means of oscillating motions, pile up one on another and become either gradually changed into rounded spores, as in one group, or else encysted *en masse.* In Myxococcus, the spores are heaped in stalked or sessile sori and the fructifications resemble those of Guttulinopsis and Guttulina. In the more complicated forms of the *Myxobacteriaceae* in which pseudocysts are produced, the fructifications show little external resemblance, it is true, to those of the Acrasieae, yet one may readily compare the encysted masses of but slightly modified rods which are enclosed in mucus, to the microcyst aggregations of Guttulinopsis, since in both cases little modified individuals are held *en masse* by a mucous substance.

Especially does the possession of the physiological equivalent, the aggregation of bacteria, or "pseudoplasmodium," recall at once the Acrasieae. De Bary considered the aggregation of myxamoebae in the lower order and the fusion into plasmodia in the higher organisms, as the crucial marks separating the Mycetozoa from all other forms. In this group of bacteria, also, we have another instance of pseudoplasmodium formation. But, as cautiously suggested by Dr. Thaxter, notwithstanding the fact that the general nature of the two corresponding periods in the *Myxobacteriaceae* and in the Acrasieae is in certain respects practically identical, the resemblance may be purely accidental, since the cells of the two organisms appear to differ so widely in character.

ACRASIEAE van Tieghem, 1880.

Saprophytic, usually coprophilous organisms, having two definitely recurring stages, — a vegetative period, in which independent myxamoebae crawl about by means of amoeboid movements and undergo multiplication by division; and a fructifying period, in which the myxamoebae typically aggregate into colonies called pseudoplasmodia and form either spores or pseudospores, held together by a mucous substance, and borne in stalked or sessile naked masses, or sori.

Sappiniaceae.

Myxamoebae comparatively large, with lobose pseudopodia. The resting stage consists either of a single encysted individual or of many individuals encysted in masses at the ends of projections of the substratum.

This group is included here only provisionally, since the amoebae normally become encysted singly, thus forming microcysts, and do not show the characteristic phenomenon of aggregation, or colony formation. The aggregations which, it is true, often occur at the distal ends of small projections above the surface of the substratum, do not appear to be due to any chemotactic stimulus such as must be assumed to cause the formation of true pseudoplasmodia, but, although they may perhaps suggest the possible beginnings of such conditions, they are probably accidental, resulting rather from a tendency of the amoebae to seek drier situations at the period of fructification.

Sappinia Dangeard, 1896.

Plate 5, fig. 1–7.
Characters are those of the order.

Sappinia pedata Dangeard.
Le Botaniste, t. 5, p. 1–20, 5 figs. in text, 1896.

Amoebae forming resting conditions of three kinds: "amibes pédicellées," in which they are transformed into a pear shaped body without definite wall, raised above the substratum by a stalk of about equal length; "kystes pédicellés," in which they are similarly modified but form a definite wall about the oval body; and "spores," in which groups of individuals become encysted at the ends of projections from the substratum.

On dung of horse, cow, dog. France; Russia; Massachusetts; Indiana.

At least two species of this genus appear to be common on various kinds of dung in this country, but owing to the fact that Dangeard gives no measurements, I have been uncertain which of them should be referred to *Sappinia pedata.* The larger and more frequent of the American species, which I have assumed to belong to *Sappinia pedata,* has the following measurements: stalk of the "amibes pédicellées", 30 μ–125 μ long; head, 30 μ–60 μ long; rounded individuals ("spores") of the aggregations, 20 μ–50 μ in diameter. The smaller form, which should probably be separated as a distinct species, has stalked individuals measuring 30 μ–40 μ in length, by 15 μ in diameter, while the rounded encysted ones of the masses measure 15 μ–25 μ in diameter. In both forms, resting bodies comparable to the aggregated "spores" occur, as well as "amibes pédicellées," although I have not as yet observed the definitely walled "kystes" which Dangeard appears to distinguish from them.

The bodies which Dangeard calls "spores," are, at least in the American forms, not true spores but merely encysted individuals which do not possess a definite wall and which may be revived into an active condition simply by placing them in water or in a nutrient decoction. Furthermore, while Dangeard found his organism on old cultures which had gone through several alternating stages of dryness and wetness, the American representatives were observed only in fresh cultures.

It is highly probable that the two species of dung amoebae described by Cienkowsky ('73) in his article on *Guttulina rosea,* and to which, so far as I am able to find, he gave no names, were similar to Sappinia; for he describes them as collecting into a naked spherical mass and certain ones as having the "peculiarity of stretching themselves out into a long foot with which they attach themselves immovably to the substratum, the free end of the individual being erected perpendicularly into the air." Among these amoebae that Cienkowsky examined, he noted one especially which was easily distinguished by the presence of two nuclei connected with each other. This double nucleus is also a feature which Dangeard observed in Sappinia and he regarded it as a stage of nuclear division. Many of the individuals of the American forms showed the same peculiarity even in the resting encysted condition, but I was not able to decide whether they were concerned with the phenomena of nuclear division. Gruber has, in fact, described a species, *Amoeba binucleata*, which normally possesses a double nucleus, so that the conditions in Sappinia may be of a similar nature.

It is, moreover, not impossible that in the union of numerous individuals of *Amoeba verrucosa* into a common aggregation, described by Rhumbler (**'98**), we have a phenomenon similar to the aggregation in Sappinia. It is suggested by Calkins, however, (: **01**, p. 218) that the phenomenon in the case of *Amoeba verrucosa* may be the result of the production of numerous swarm spores, as in Paramoeba.

GUTTULINACEAE.

Myxamoebae either limax shaped, without pseudopodia, or of the ordinary form with rounded or lobose short pseudopodia. Sori, irregular in shape or spherical, sessile or stalked, consisting either of spores, which possess a definite wall of cellulose or similar substance, or of pseudospores, which are simply encysted individuals without definite walls.

Guttulinopsis Olive, 1901.

Plate 5, fig. 8–22, 25, 26.

Proc. Amer. acad. arts and sci., vol. 37, p. 335, 1901.

Myxamoebae having lobose pseudopodia. Sori sessile or stalked, composed of pseudospores, those of the stalk usually slightly elongated.

Guttulinopsis vulgaris Olive. Plate 5, fig. 8–19.

Proc. Amer. acad. arts and sci., vol. 37, p. 336, 1901.

Sori usually stalked, sometimes sessile, about 150 μ–500 μ in height, by 150 μ–400 μ broad. Fructifications varying in color from whitish to dirty yellowish according to the character of the substratum and the dryness of the sorus. Pseudospores usually irregularly spherical, about 4 μ–8 μ in diameter.

On dung of horse, cow, pig, mouse, muskrat, etc. Maine; Massachusetts; Alabama; Indiana; Porto Rico.

This organism, which has conspicuous fructifications so large that they may readily be seen with the naked eye, is evidently of common occurrence, for it has been met with quite frequently on fresh cultures of various kinds of dung. On the dung of chicken and goose, I have obtained several times a form which shows at least varietal distinctions from *G. vulgaris*. The fructifications, for example, are usually larger and the pseudospores are somewhat smaller than in the type. While the pseudospores of this form are usually spherical and 3 μ–5 μ in diameter, they may be oval and 4 μ–6 μ by 5 μ–7 μ; the sori of the variety, further, may be either sessile or short stalked and 200 μ–500 μ by 200 μ–700 μ.

Although *Guttulina aurea* of van Tieghem may prove to be identical with the above species, with which it agrees in the measurements of its resting bodies, the fact that, according to the original description, this organism possesses resting bodies which are characterized as "spores," having a golden yellow color, renders it improbable that the two forms are the same.

Guttulinopsis stipitata Olive. Plate 5, fig. 25–26.

Proc. Amer. acad. arts and sci., vol. 37, p. 336, 1901.

Sori yellowish white, long stalked, the stalk composed of individuals similar to those of the head. Sorus about 3 mm.–1.2 cm. high; the stalk about 800 μ long, the head 250 μ in diameter.

On dung of dog. New Haven, Conn.

This species, the largest representative of the genus, has been met with but once, and is founded on a mounted specimen and dried material collected at New Haven some years ago by Dr. Thaxter. It is especially characterized by its long stalk, which, unlike that of the following form, is composed of cells similar in shape and size to those of the sorus.

Guttulinopsis clavata Olive. Plate 5, fig. 20–22.

Proc. Amer. acad. arts and sci., vol. 37, p. 336, 1901.

Sori yellowish white when young, comparatively long stalked, the stalk composed of a column of slightly elongated individuals surrounded by mucus. The stalk cells held within the peripheral mucus, adhere together after the deliquescence of the pseudospores of the head, forming at the apex a rounded or conical columella of elongated, adherent cells. Sorus about 400 μ–800 μ in height, the stalk about 170 μ–250 μ long, the head 100 μ–400 μ in diameter. Pseudospores of the head somewhat broadly oval, 3 μ–4 μ by 6 μ–7 μ, or spherical, then 4 μ–5 μ in diameter; those of the stalk about 3 μ –5 μ by 7 μ–10 μ.

On dung of dog. Cambridge, Mass.; Indiana.

This distinct species has been frequently met with in fresh cultures of the dung on which it has its habitat. The base of the stalk furthermore, is often imbedded in an abundant mucus, which is especially noticeable when it swells after being placed in the water. Although the differentiation in shape seen in the individuals of the stalk is indeed slight, such a phenomenon, nevertheless, serves to suggest the possible beginnings of stalk differentiation leading to the complicated conditions observed in the *Dictyosteliaceae.*

Guttulina Cienkowsky, 1873.

Plate 5, fig. 23–24, 27–39.

Trans. bot. sec. 4th meeting of Russ. nat. at Kazan, 1873.

Myxamoebae normally limax shaped, without pseudopodia. Sori irregular in shape or spherical, sessile or stalked, composed of spores which have a definite protective cell wall. The cells of the stalks somewhat differentiated in shape.

Guttulina rosea Cienkowsky.

Trans. bot. sec. 4th meeting of Russ. nat. at Kazan, 1873.

"Sori short stalked and rose colored; head 700 μ long, supported upon a stalk of about equal length. Spores of the head spherical; those of the stalk closely laid and wedge shaped."

On dead wood. Russia.

This form has never been met with, so far as I am aware, since its original discovery. In view of the fact that the article above quoted marks the earliest record of pseudoplasmodium formation, and also that this is a type to which van Tieghem and Fayod have doubtfully referred other forms, it is unfortunate that *Guttulina rosea* is not described more adequately and illustrated by drawings.

The following translation of that portion of the original description, which is in Russian, that relates to this form is appended for convenience of reference. In Just's Jahresbericht of 1873, may also be found an accurate translation of the complete article, with the exception of some minor omissions relating to Sappinia-like amoebae.

" *Guttulina rosea* represents a simplified type of the Myxomycetes. It appears as a microscopic drop of rose color, attaining a length of .07 mm. and borne upon a stalk of about equal length. Guttulina consists of a heap of cells, which is not covered with a common membrane. In the head, the cells are globular, and in the base they are closely laid and show wedge shaped individuals, arranged in rows. All the cells contain a red protoplasm and a nucleus; in water the whole contents of the cell germinate and appear in the form of an amoeba, similar to *Amoeba limax* Dujardin, the fusion of which the author did not observe. In a young condition, they divide. From this account, it appears that *G. rosea* represents a new organism, which is similar to *Dictyostelium mucoroides* Brefeld, but without the enveloping membrane, and the amoebae here only heap up, form cysts or spores and do not fuse."

Guttulina protea Fayod. Plate 5, fig. 27–39.
Bot. zeit., bd. 41, p. 167–177, pl. 2, 1883.
Copromyxa protea Zopf.

Sori 1–3 mm. high, sessile or short stalked, of somewhat irregular form, yellowish white, with crystalline lustre. Spores 9 μ by 14 μ; hyaline, colorless or slightly yellowish, more or less oblong or oval, bean shaped, or almost triangular in outline.

On dung of horse or cow. Germany.

This form, which is known only from Fayod's original description, is retained under its original name, notwithstanding the fact that it has been separated by Zopf under the name Copromyxa on the ground that "the myxamoebae undergo no differentiation into stalk and head cells, whereas in Cienkowsky's form, there is a slight differentiation." The fact that certain species of Guttulinopsis show both stalked and sessile forms in the same culture diminishes the importance of the stalk as a character of generic value and justifies the resumption of the original name given by Fayod.

Guttulina aurea van Tieghem.

Bull. de la soc. bot. de France, t. 27, p. 317, 1880.

"*Guttulina aurea* has its fruit pedicelled and resembles closely *G. rosea*, but differs in color. Spores spherical, 4 μ–6 μ, golden yellow. Upon dung of horse." France.

Guttulina sessilis van Tieghem.

Bull. de la soc. bot. de France, t. 27, p. 317, 1880.

"Fruit sessile; a simple droplet of pure white, resting directly on the substratum. Spores oval, colorless, aggregated in a sphere and cemented, as in the preceding species, by a gelatinous substance, 4 μ × 8 μ. On the integument of beans in a state of decay." France.

Guttulina aurea and *G. sessilis* are known only from the original descriptions above quoted. Should it prove that these two forms possess pseudospores instead of spores, they should then be transferred to Guttulinopsis.

A form found on skunk dung by Dr. Thaxter (pl. 5, fig. 23–24) possesses oval, colorless, resting bodies of approximately the same size as those of *Guttulina sessilis*. Lack of figures and of other sufficient information concerning van Tieghem's species prevents, however, any certainty as to the relationships of the two organisms.

DICTYOSTELIACEAE Rostafinski.

Myxamoebae possessing slender elongated pseudopodia. Sori consisting of spherical masses of spores or of a chain of spores; stalked, the stalks composed of distinct parenchyma-like cells with cellulose walls.

Acrasis van Tieghem, 1880.

Bull. de la soc. bot. de France, t. 27, p. 317, 1880.

Spores concatenate, terminating an erect simple filament consisting of a single row of superposed cells.

Acrasis granulata van Tieghem.

Bull. de la soc. bot. de France, t. 27, p. 317, 1880.

Spores spherical, with a slightly roughened or granular wall, having a cuticularized external portion of deep violet color; 10 μ–15 μ in diameter, often unequal in the same chain, the chain varying much in the number of component spores and cells.

On a culture of beer yeast. France.

This species also is known only from the original description. Although the writer has made many cultures of all sorts of brewery products, the form has not been found.

Van Tieghem has noted in his article on this organism that luxuriant conditions sometimes yield fructifications in which several stalks are intimately united so that a colony is formed which, with the exception of the blackish color, resembles a Coremium.

Dictyostelium Brefeld, 1869.

Plates 6, 7, 8.

Sori stalked; the stalk simple or only occasionally bearing irregularly disposed branches; luxuriant fructifications frequently gregarious. Sori spherical, or subglobose.

Dictyostelium mucoroides Brefeld. Plate 8, fig. 107.

Abh. d. Senck. nat. ges., bd. 7, p. 85–107, pl. 1–3, 1869.

Ceratopodium elegans Sorokin.

Sorus and stalk white, or when old, yellowish; the fructifications vary in height from 2–3 mm. to 1 cm. or more. Spores oval or elongated ellipsoid, 2.4 μ–3 μ by 4 μ–6 μ.

On the dung of various animals, such as horse, rabbit, dog, guinea pig, grouse, etc. Also found on cultures of yeast, paper, fleshy fungi, etc., in a state of decomposition. Germany; Russia; England; common in America.

This very common species is extremely variable in the size of its spores and fructifications. The limits of the spore measurements as given by Brefeld in his original description have been therefore somewhat increased. The sori also, like those of other species of Dictyostelium, are quite variable in size, ranging from about 100 μ–600 μ in diameter.

It has been mentioned before in the first part of this paper that Coemans ('**63**), misled by finding Dictyostelium in close proximity with certain moulds, regarded it as a pycnidial condition of Rhizopus; his account, moreover, is the first published observation of an organism belonging to this group of the Acrasieae.

Dictyostelium sphaerocephalum (Oud.) Sacc. and March. Plate 8, fig. 109.

Aanw. myc. Nederl., 9–10, p. 39, pl. 4, fig. 4, 1885.

Hyalostilbum sphaerocephalum Oudemans.

Sorus white; when old, yellowish or greenish white. Stalk frequently very long and luxuriant, varying from 2 mm. to 1.5 cm. Spores oval, rarely spherical, or sub-inequilateral, 3 μ–5 μ by 5μ–10μ.

Dung of mouse (common), rat, bird, toad, deer, turtle, muskrat, etc. Holland; Belgium; Liberia; New Hampshire; Cambridge and Boston, Mass.; Pennsylvania; Florida.

In the above description, the limits of the measurements of spores and of the length of stalks are greater than those given by Marchal ('**85**), by whom the maximum length of the spore is stated as 8 μ and that of the stalk as 5 mm. The measurements of the fructifications are certainly more variable than indicated by Oudemans ('**85**), who in his description of this form as a hyphomycetous organism, gives 4 μ as the breadth of the spore, by 5 μ–6 μ in length. Marchal, in founding this species, has evidently utilized his own observations as well as the earlier published description of the Dutch form, since, as will be seen above, he increases somewhat Oudemans' measurements. Judging from the latter's description, it is by no means certain that Oudemans had a form sufficiently distinct from the common *Dictyostelium mucoroides* to warrant making it another species, since his measurements correspond in the main with those of Brefeld's species. Marchal's Belgian form, however, according to his statement, ('85, p. 42), differed from *Dictyostelium mucoroides* in the fact that the spores were twice as large. But, as will be seen by the measurements given above, the great variation in size of the spores makes this difference by no means as great as indicated; and, although the present arrangement is retained for the present, it may prove desirable to unite these two variable species.

Dictyostelium roseum van Tieghem.

Bull. de la soc. bot. de France, t. 27, p. 317, 1880.

"Spore mass spherical, of a bright rose color. Spores elongated oval, 4 μ by 8 μ. On the dung of various animals; especially on rabbit dung, in company with *Pilobolus microsporus*." France.

Dictyostelium lacteum van Tieghem.

Bull. de la soc. bot. de France, t. 27, p. 317, 1880.

"The mass of spores forms a milk white drop at the summit of a stalk which I have always seen composed of a single row of cells. Spores colorless, spherical, very small, 2 μ–5 μ in diameter. This form has been met with several times on decaying agarics." France.

Neither of the two preceding forms has been found in American cultures, hence the writer can add nothing to our knowledge concerning them.

Dictyostelium brevicaule Olive. Plate 8, fig. 108.

Proc. Amer. acad. arts and sci., vol. 37, p. 340, 1901.

Sorus white; stalks 1–3 mm. high. Spores oval, 3 μ–4 μ by 4 μ –7 μ or rarely spherical and 3 μ–4 μ in diameter.

Dung of sheep and goat. Cambridge, Mass.

A small, erect fructification, quite constant in the possession of a short, rather rigid stalk, bearing a sorus of comparatively large size, and very different in aspect from the long, luxuriant, frequently flexuous fructifications of *D. mucoroides* and *D. sphaerocephalum*. Throughout the four years that this species has been kept growing in laboratory cultures, it has retained its original distinct characters.

Dictyostelium purpureum Olive. Plate 7, fig. 98–104.

Proc. Amer. acad. arts and sci., vol. 37, p. 340, 1901.

Sorus and stalk purplish or violet; when mature, almost black. Spores oval, rarely somewhat inequilateral, 3 μ–5 μ by 5 μ–8 μ.

Dung of mouse, toad, cow, horse, sheep, muskrat. Cambridge, Mass.; Indiana; Florida.

This distinct species, well marked by its color, was collected in August, 1897, in Crawfordsville, Indiana, on mouse dung cultures, and in October of the same year by Dr. Thaxter in Eustis, Florida, on toad dung. Both forms have been cultivated ever since in the laboratory, with no particular precautions as to the dissemination of the spores, and it is not impossible that the fructifications which appeared at Cambridge on substrata other than the two just mentioned, represent laboratory escapes.

Dictyostelium aureum Olive. Plate 6, fig. 63–64.

Proc. Amer. acad. arts and sci., vol. 37, p. 340, 1901.

Mature sori light to golden yellow, 1.5 mm.–4 mm. high. Spores oval, or frequently inequilateral, 2.5 μ–3 μ by 5 μ–8 μ. Mouse dung from Porto Rico.

This species, communicated by Dr. Thaxter, is quite well defined through the color of its fructifications, but especially so by its myxamoebae and its manner of growth. It matures very slowly on a horse dung decoction or on other media especially favorable for the rapid development of the common species; while the myxamoebae, instead of possessing the usual form with elongated, sharp pseudopodia, are in general irregularly lobed and nodulated, even when growing under normal conditions. Such irregular shapes are similar to those assumed by the myxamoebae of other species when they are growing under such abnormal conditions as are furnished by an insufficient water supply.

Polysphondylium Brefeld, 1884.

Plates 6, 7, 8.

Schimmelpilze, bd. 6, p. 1–34, pl. 1–2, 1884.

Sori spherical, borne terminally on primary and secondary stalks, the latter branching in whorls from the main axis; the fructification occasionally simple as in Dictyostelium. Whorls varying in number from 1 to 10, and the number of branches at each node from 1 to 6.

The fact that fructifications seemingly similar in all respects to those of Dictyostelium may occasionally be formed (pl. 8, fig. 118, a), especially on van Tieghem cell cultures, together with the fact that the stalks and spores of the two are alike in general structure, indicates that Polysphondylium and Dictyostelium are very closely related to each other. It is possible that the distinction is not great enough to warrant the retention of the two forms as distinct genera. Yet the almost constant character seen in Polysphondylium involving the bearing of whorls of branches all of about equal length, indicates that the two organisms possess important physiological as well as structural differences.

Polysphondylium violaceum Brefeld. Plate 8, fig. 112–118.
Schimmelpilze, bd. 6, p. 3–34, pl. 1–2, 1884.

Sori and stalks purplish or dark violet, varying in height from about ½ cm. to 2 cm.; sori about 50 μ–300 μ in diameter. Spores elongated oval, 2.5 μ–5 μ by 6 μ–8 μ.

On dung of horse, bird, sheep, toad, muskrat. Italy; Maine; New Hampshire; Massachusetts; Florida.

The limits of spore measurement as given by Brefeld have been increased here as in other instances. The form growing on bird dung, brought by Prof. F. O. Grover from Center Ossipee, N. H., and the Massachusetts form on the dung of muskrat, seem to correspond very closely to the type description. The spores of the Maine and Florida forms are somewhat smaller, while the general aspect of the fructifications is different in that they are more delicate and less luxuriant and the sori have a less diameter than do those of the type. These differences, however, seem hardly more than varietal.

Polysphondylium pallidum Olive. Plate 8, fig. 119-120.
Proc. Amer. acad. arts and sci., vol. 37, p. 342, 1901.

Sori and stalks white, the sori about 50 μ–80 μ in diameter. Spores oval, 2.5 μ–3 μ by 5 μ–6.5 μ; or occasionally spherical, about 7 μ–8 μ in diameter.

On dung of ass, rabbit, muskrat. Liberia, Africa; Arlington and Stony Brook, Mass.

This delicate species is well characterized by the small size of its sori. In an interesting specimen, found by Mr. A. F. Blakeslee on muskrat dung, luxuriant fructifications showed that some of the branches themselves bore several whorls of branchlets. That this doubly verticillate character was not constant, however, was proved by growing the form on a sterilized nutrient medium, on which the fructifications showed simply the normal method of branching.

Polysphondylium album Olive.

Proc. Amer. acad. arts and sci., vol. 37, p. 342, 1901.

Sori and stalks white, the sori 100 μ–200 μ in diameter. Spores oval, 2.5 μ–3 μ by 4 μ–5.6 μ.

On dung of toad from Eustis, Florida.

Although the two forms above described have some features in common, their gross characters are such as to justify their being classed as separate species. The sori of *P. album* are not only larger but are usually more numerous in a whorl, hence its fructifications are more conspicuous; moreover, the stalks of this species are rather constantly weak at the base, so that the fructifications lie close to the substratum in a characteristic fashion.

Coenonia van Tieghem, 1884.

Bull. de la soc. bot. de France, t. 31, p. 303–306, 1884.

Sorus globular, borne at the summit of a stalk which is dilated into a sort of cupule, in which the sorus is supported.

Coenonia denticulata van Tieghem.

Bull. de la soc. bot. de France, t. 31, p. 303–306, 1884.

Sorus yellowish; stalk colorless, 2 to 3 mm. high, having a dilated base and expanding at the summit into a cupule which is finely toothed at its edges, each peripheral cell of the stalk bearing a tooth or papilla on its exposed side. Spores 6 μ–8 μ in diameter, with yellowish cell walls.

On decaying beans. France.

This remarkable form, so far as I am aware, has not been met with since it was originally described by van Tieghem. The fructi fications undoubtedly show a high degree of differentiation. The author remarks that the teeth on the periphery of the stalk "evidently facilitate the mounting of the myxamoebae, while those of the border and of the cells constituting the upper face of the cupule retain the spores, playing an analogous role to that of the teeth of *Mucor spinosus*." Luxuriant cultures further showed occasional branching fructifications; the main stalk then bore a verticel of three equidistant branches, each similar to the main axis.

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EXPLANATION OF PLATES.

All the figures are reduced to about one half of their original size. The most of them have been drawn with a camera lucida, and with various combinations of lenses; the water immersions Zeiss J and K, and the oil immersions, Zeiss 2mm. and Leitz $\frac{1}{12}$ and $\frac{1}{16}$, together with oculars Zeiss 12 and 18 were principally used. The magnification given with each figure is the original magnification of the drawing before reduction.

PLATE 5.

Sappinia pedata Dangeard.

Fig. 1. An aggregation of amoebae at the end of a straw, together with three isolated encysted amoebae. × 150.
Fig. 2. An encysted stalked individual. × 950.
Fig. 3–4. Rejuvenation of a stalked encysted individual. × 950.
Fig. 5. An encysted individual from a nutrient agar surface. × 1,230.
Fig. 6. An amoeba showing a lobose pseudopodium. × 950.
Fig. 7. An encysted individual ("kystes pédicellés"), after Dangeard.

Guttulinopsis vulgaris Olive.

Fig. 8. A stalked sorus. × 150.
Fig. 9. A group of sessile sori. × 150.
Fig. 10–15. Rejuvenation of a pseudospore. × 3,500.
Fig. 16. A pseudospore showing peculiar lens shaped vacuolations and another that is disc shaped. × 2,330.
Fig. 17. Three myxamoebae killed and stained. × 2,150.
Fig. 18. Two dividing myxamoebae killed and stained. × 2,150.
Fig. 19. A young pseudoplasmodium. × 1,400.

Guttulinopsis clavata Olive.

Fig. 20. A sorus. × 230.
Fig. 21. A sorus, with the head of pseudospores deliquesced and showing the column of stalk cells enclosed in mucus, together with the columella-like portion persisting at its apex. × 230.
Fig. 22. Pseudospores. × 950.

Guttulina sessilis (?) van Tieghem.

Fig. 23. A sorus. × 150.
Fig. 24. Oval pseudospores (?). × 950.

Guttulinopsis stipitata Olive.

Fig. 25. A sorus. × 150.
Fig. 26. Pseudospores. × 950.

Guttulina protea Fayod.

(Fig. 27–39 after Fayod.)

Fig. 27–28. Sori.
Fig. 29–34. Germination of the spore.
Fig. 35. A myxamoeba showing the *Amoeba limax* form.
Fig. 36–39. Formation of a microcyst.

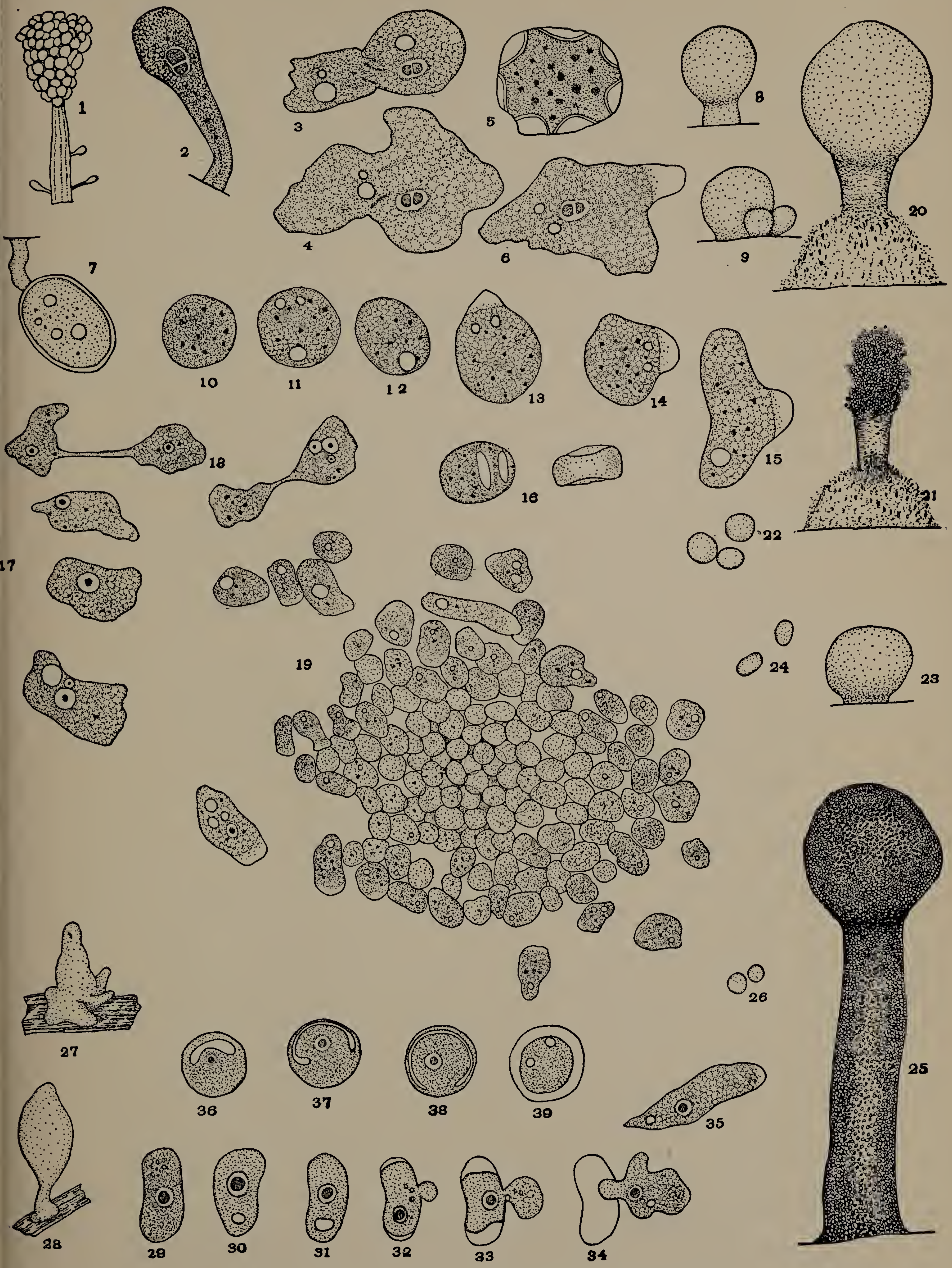
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PLATE 6.

Dictyosteliaceae.

Fig. 40–44. Germination of the spore of *Dictyostelium mucoroides.* × 1,430.

Fig. 45–47. Young myxamoebae of *D. mucoroides*, showing contractile vacuoles. × 1,430.

Fig. 48. Myxamoeba of *D. sphaerocephalum.* × 2,000.

Fig. 49–53. Young myxamoebae of *D. mucoroides* which still retain the oval spore shape, and show nuclear granules. × 2,330.

Fig. 54. A germinating spore of *D. mucoroides.* × 2,330.

Fig. 55–56. Spirem stage of primary nuclear division. × 2,330.

Fig. 57. Nuclear plate stage. × 2,330.

Fig. 58. Separation of the daughter chromosomes and the beginning of fission of the individual. × 2,330.

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Fig. 60, a. An individual with nucleus in anaphase stage showing the diminishing nuclear vacuole. × 2,330.

Fig. 61–62. Myxamoebae of *Polysphondylium pallidum*, stained and fixed. × 2,150.

Fig. 63–64. Myxamoebae of *Dictyostelium aureum*, showing the peculiar nodulose shape. × 1,560.

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Fig. 66. A dividing myxamoeba of *Polysphondylium pallidum* killed and stained. × 2,150.

Fig. 67. A dividing myxamoeba of *Dictyostelium mucoroides.* × 2,000.

Fig. 68. Another dividing individual. × 3,500.

Fig. 69–71. A dividing myxamoeba at intervals of about one half minute. × 3,500.

Fig. 72–76. Myxamoebae of *D. mucoroides*, killed and stained, showing nuclei. × 2,330.

Fig. 77–79. Myxamoebae of *D. mucoroides*, showing nuclei. × 1,450.

Fig. 80. A living myxamoeba of *D. mucoroides*, with nuclear granules enclosed in vacuoles. × 2,330.

Fig. 81. A pseudoplasmodium of *Polysphondylium violaceum* at 11:45 A. M. × 460.

Fig. 82. The same at 1 : 00 P. M. of the same day. × 460.

Fig. 83. The same at 4 : 30 P. M. of the same day, showing the cells at the base of the stalk, surrounded by the mucus left by the pseudoplasmodium. At this stage the colony had reached a height of $\frac{1}{10}$ mm. × 460.

Fig. 84. Myxamoebae of *D. purpureum* when crawling rapidly toward a colony. × 1,450.

Fig. 85. Several myxamoebae in a colony of bacteria in a drop culture. × 650.

Fig. 86. Myxamoeba of *Polysphondylium pallidum* in a group of bacteria, showing one ingested individual. × 2,330.

Fig. 87. Myxamoeba of *Dictyostelium purpureum* showing a bacterium adhering to the ectoplasm. × 2,000.

Fig. 88. Myxamoeba of *D. mucoroides* stained with Flemming's triple stain so as to sharply differentiate the ingested bacterium. × 2,330.

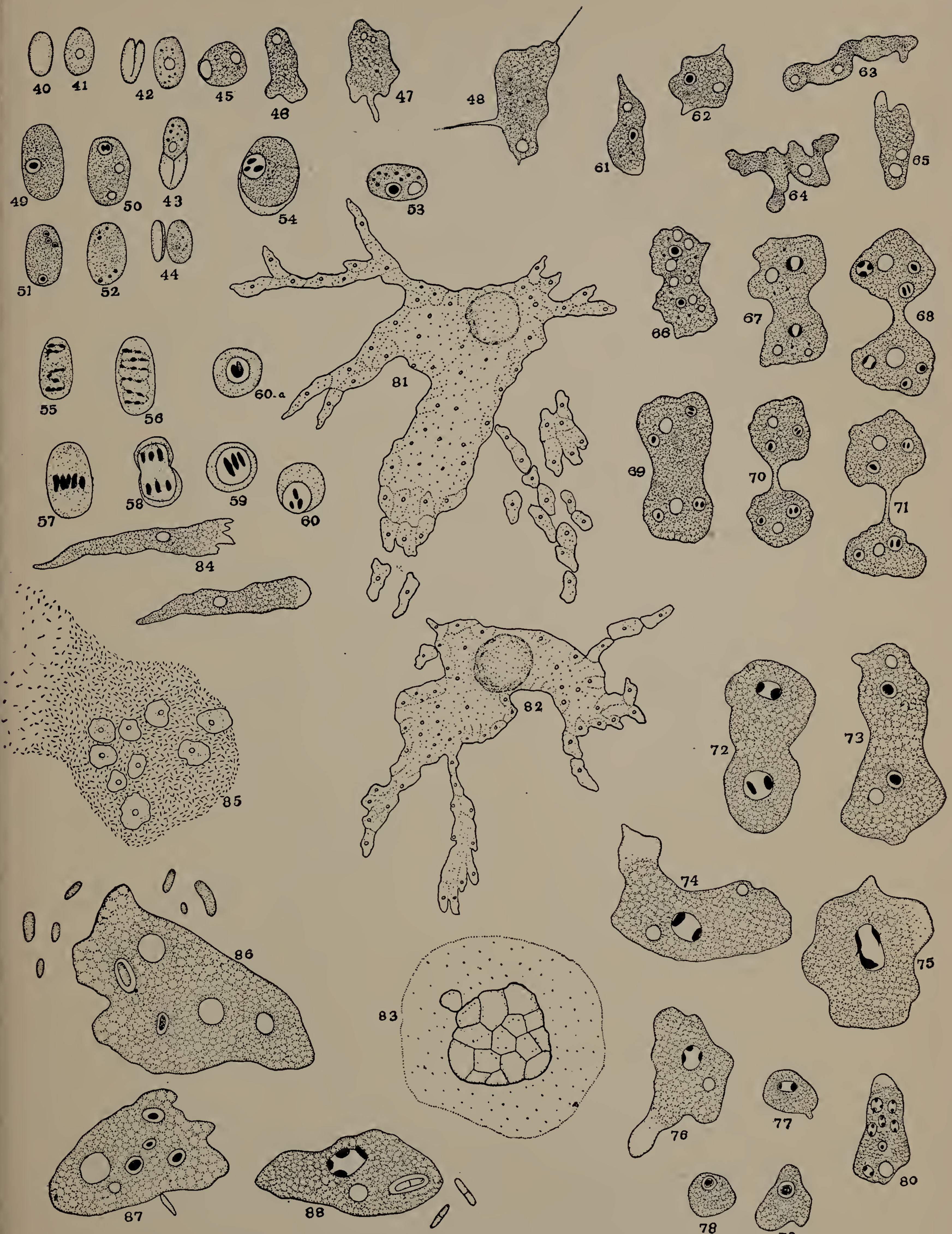
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PLATE 7.

Fig. 89–93. Myxamoebae from a pseudoplasmodium of *D. mucoroides.* × 2,330.

Fig. 94. Pseudoplasmodium of *Polysphondylium violaceum*, viewed from above (partly diagrammatic).

Fig. 95–96. Young pseudoplasmodium of *Dictyostelium mucoroides.*

Fig. 97. Pseudoplasmodium of *D. mucoroides* pressed upon by a cover glass so as to show the stalk column in the axis. The mucus left behind by the colony is shown at the sinuses of the stalk.

Fig. 98–103. Development of a pseudoplasmodium of *D. purpureum*, showing the spiral twist of the stalk. × 130.

Fig. 104. A portion of the stalk of fig. 103, drawn at x. × 950.

Fig. 105. Myxamoebae from a pseudoplasmodium separated by a mucous film. × 1,430.

Fig. 106. A portion of a stalk of *D. mucoroides*, showing the nuclei in the cells and the mucous covering of the stalk. × 2,330.

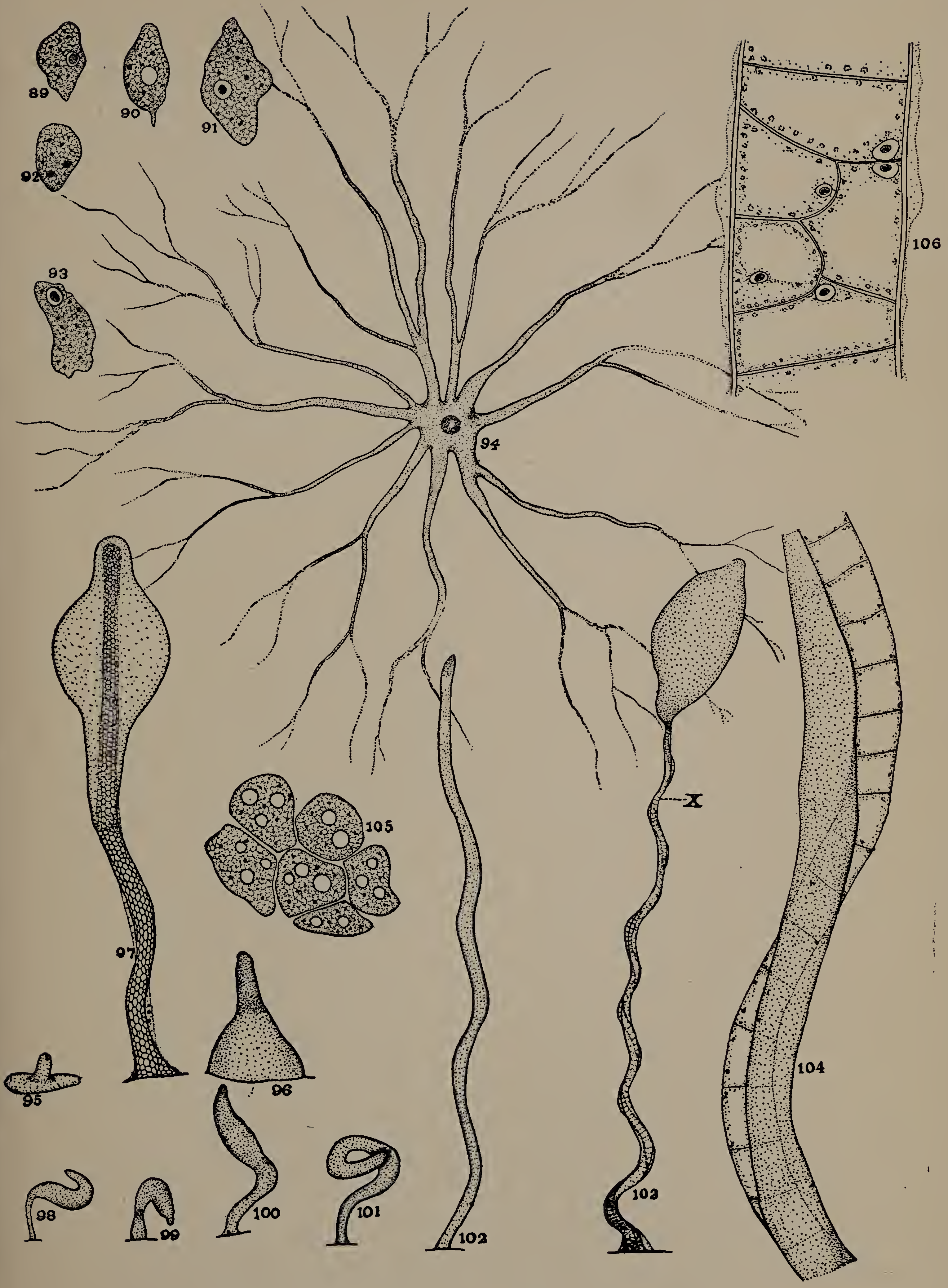
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PLATE 8.

Fig. 107. End of a stalk of *D. mucoroides*, with sorus of spores. × 950.
Fig. 108. Fructification of *D. brevicaule*. × 20.
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Fig. 110. Papilla at the distal portion of a pseudoplasmodium showing stalk formation in the apex; (a) — the mucous sheath deposited by the external undifferentiated myxamoebae of the pseudoplasmodium as they ascend the stalk. × 950.
Fig. 111. Vacuolated cells in the mucus at the base of the stalk. × 950.
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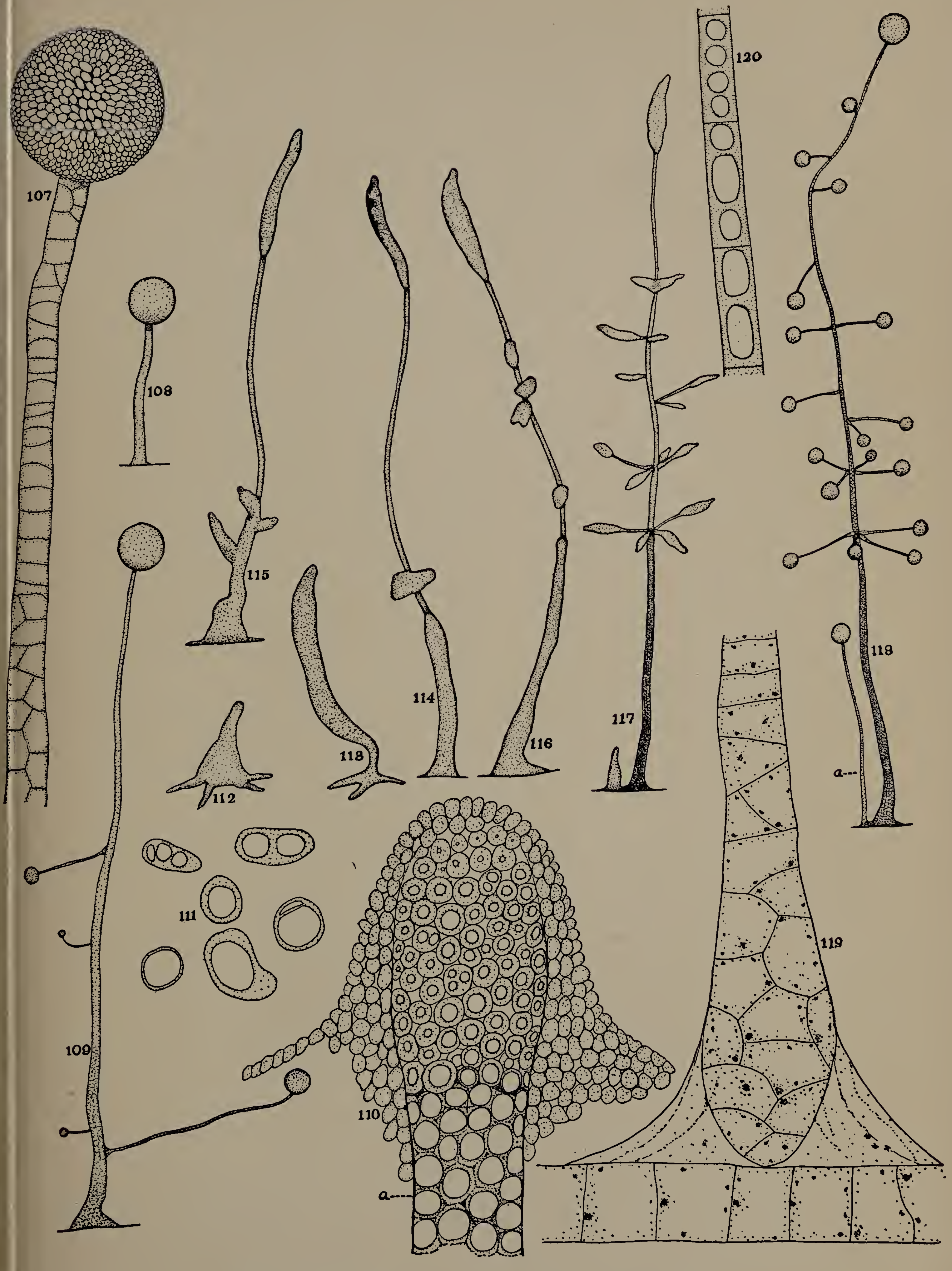
Fig. 120. Cells near the distal end of a branch of *P. pallidum*. × 2,330.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THE LIFE HISTORY, THE NORMAL FISSION AND THE REPRODUCTIVE ORGANS OF *PLANARIA MACULATA.*

By Winterton C. Curtis.

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No. 7.— THE LIFE HISTORY, THE NORMAL FISSION, AND THE REPRODUCTIVE ORGANS OF *PLANARIA MACULATA*.

BY WINTERTON C. CURTIS.

INTRODUCTION.

THE work of this paper has been carried on at the Johns Hopkins University during the three years previous to 1901, and I wish to express my sincere gratitude to Prof. W. K. Brooks for his kindly help and guidance throughout the course of my study. I am also indebted to the authorities at the Marine biological laboratory, Woods Holl, Massachusetts, for the privileges extended to me by that institution in the course of my work there during the past three summers.

The absence of reproductive organs during the entire year in *Planaria maculata* from certain localities and the appearance of these organs regularly each year in specimens from other localities, aroused my interest and led me to seek some explanation. While accumulating data upon the presence or absence of these organs in different localities and seasons, I found in the localities where reproductive organs are not developed abundant material for a study of the normal fission, and since the normal fission of planarians, while mentioned by many writers during the past ten years, has not been adequately described or figured in a single instance, with the possible exception of *Planaria fissipara* (Kennel, '88) which presents just the opposite of the type of fission in *Planaria maculata*, I have attempted a thorough description of this process as it occurs in the latter species. The entire absence of reproductive organs in many localities remains considerable of a mystery, but I give the data thus far obtained under the head of life history. Finding that the reproductive organs of this common form had never been described, I published, in 1900, a short note on their anatomy and development, and these observations are further elaborated in this paper.

THE LIFE HISTORY OF *Planaria maculata* IN DIFFERENT LOCALITIES.

With a single exception, all the Triclads which I have found described as reproducing asexually, are without reproductive organs during the period of fission. The one exception is the land planarian *Placocephalus semperi* mentioned by von Graff ('99, p. 224). There is also to my knowledge but a single exception to this in the Rhabdocoeles, *viz.*, Microstomum (Sekera, '88). Since all planarians for a long time after hatching remain without these organs, it might easily be supposed that it was during this post-embryonic period that the asexual reproduction occurred. In a hypothetical case we might suppose the young hatched in the spring and early summer, and from then until the fall there might be more or less asexual reproduction. In the fall this ceases and the reproductive organs make their appearance. After the egg laying in the following spring the adults might die or they might lose their reproductive organs and live on. In the latter case they would at the end of the summer be indistinguishable from the young of that year. If it could be proved that the adults all die after their egg laying, *i. e.*, live but one year, we should then have a kind of alternation of generations in which all the individuals resulting from the sexual multiplication became sexually mature. If it could not be proved that all the old ones died off, we should have the possibility and even the probability that their reproductive organs disappeared and they again passed through a season of asexual reproduction with the younger worms. We should then represent the life history as made up of alternate periods of asexual and sexual reproduction. This would explain the entire absence of reproductive organs in all the worms of a locality at certain seasons and the abundant occurrence of normal fission.

In one locality, where I have observed them for three years, *Planaria maculata* goes through some such series of changes as that I have just indicated, with the probability that the old ones live on after the egg laying. The point of interest is, that there seem to be different courses in different localities. I have taken systematic observations in a number of places during the past three years, the results of which can best be presented by a statement of the data obtained. I should preface this by saying that I have taken as many precautions as seem to me necessary to guard against the possibility of my dealing with two distinct species or two varieties of a species where but one has been previously recognized. There are no external differences between the worms of the several localities beyond the variations in color which one might expect. Specimens from a single locality will often differ more in color than any specimens collected from localities where the life history is entirely different. So far as I can ascertain from the most careful measurements, the shape of the head and other proportions are identical in all the localities. What I have learned regarding the changes in the several localities is as follows: —

Locality 1. All the worms are large and sexually mature in the spring. During May and June they lay their eggs. In July the young and adults are found together and are easily distinguishable. In the latter part of July and during August the adults are found with their reproductive organs in all stages of degeneration and sometimes show evidence of fission before these have entirely disappeared. Toward the end of August and in early September no reproductive organs are to be found in any of the individuals and the old ones, if still alive, cannot be distinguished from the young. They are found during these two months reproducing by fission to a very considerable extent. In the fall the fission stops and all the individuals develop reproductive organs in preparation for the egg laying of the next spring. This has been observed for three years.

Locality 2. The same as locality 1, save that I have never seen any satisfactory indications of fission. This is then, as far as the observations go, an exclusively sexual locality. Observed the same course for three years.

Locality 3. A period of very active fission was observed during June, July, and August. No reproductive organs have ever been discovered, but a single egg capsule was once found which shows that sexual individuals do sometimes occur. Observed for one year.

Locality 4. A period of very active fission, as in locality 3, which begins in June and lasts until the last of September, but no reproductive organs or traces of the egg capsule have ever been seen. Specimens examined in November and again in May showed no sign of reproductive organs. Observed the same for two years. The account of the fission in *Planaria maculata* given by Randolph ('97) was based upon worms from this locality.

In another locality which I have kept track of for one year there seems to be the same condition as in locality 1.

These observations are based upon many more individuals than those I have been able to stain whole, or to section. The egg capsules remain upon the stones for three or four months after the young worms have broken from them and afford unmistakable evidence of the occurrence of a reproductive season even though no sexual worms are found. In like manner when the capsules have never been found, though the under sides of thousands of stones were examined in collecting and I was constantly looking for them, it amounts to a disproof of any extensive egg laying in a given season, which alone would be sufficient without the additional evidence obtained from the absence of reproductive organs in all the specimens examined. When worms have their reproductive organs even partially developed, the genital pore can be readily seen on the ventral side, and as they approach sexual maturity the two vasa deferentia full of sperm are very noticeable ventrally as two white cords on either side of the pharynx. This makes it possible at the egg laying season to determine the presence or absence of reproductive organs in every specimen collected. These facts are familiar to every one who has studied planarians, but I mention them in order to show the number of specimens examined to furnish the basis for the statements regarding the presence or absence of the reproductive organs in the respective localities.

As to the interpretation to be put upon these conflicting data: if I had only localities 2 and 4, the one with no evidence of fission, the other with no sign of sexual organs, I should conclude that there were two varieties of *Planaria maculata*, one of which reproduced almost entirely by fission and in which reproductive organs were very rarely found. Locality 1, however, shows that fission may occur in what I have termed a sexual locality, and locality 3 shows that an asexual locality may sometimes produce worms with sexual organs. The gradation which the four localities present, can, it seems to me, be explained by supposing that *Planaria maculata*, having the power of reproducing itself by fission, which is common to many planarians, this mode of reproduction has been in some localities substituted almost entirely for the sexual method. Whether this substitution is permanent or only temporary can, of course, only be ascertained by observations extending over a number of years.

The fact that all the specimens collected from a sexual locality are found each fall with reproductive organs developing, shows that this species becomes sexually mature the year after hatching, whereas Ijima ('84) found that the young of *Dendrocoelum lacteum* did not develop any reproductive organs until the second year. *Planaria simplissima*, which I followed through the fall and winter at Williamstown, Mass., (:00a) showed exclusively sexual individuals during that time. The ovaries and testes were at first found in their younger stages, but in the early spring they were so far developed as to indicate the nearness of the sexual season. It is therefore probable that this form also develops its reproductive organs the first year.

The Act of Normal Fission and the External Changes Following.

Jacob Keller ('94), in an article based upon the investigation of normal fission in rhabdocoele Turbellaria (Stenostoma and Microstomum) and the regeneration of fresh-water planarians, has tabulated the various modes of normal fission in Triclads and Rhabdocoeles. This and his review of the literature make any such attempt on my part unnecessary. I will merely indicate the schema of the types of fission according to Keller and the place in this which the type found in *Planaria maculata* occupies. He divides the normal fission of Triclads into two types: (1) that in which the new organs develop previous to the separation of the new formed individuals (*Planaria fissipara*, Kennel, '88) and (2) that in which the development does not begin until after the new individuals have separated (various land planarians and *Planaria albissima*, Sekera, '88). Such a distinction is not hard and fast, because the process in *Planaria subtentaculata* (Zacharias, '86) is somewhere between these two conditions. The first type is similar to the fission which occurs in many Rhabdocoeles; the second is in some cases a simple fragmentation and with difficulty distinguished from the regeneration following accidental mutilation. *Planaria maculata* supplies just the type of fission necessary to make a very complete series from the one extreme to the other. Briefly, this series is as follows: —

1. In the normal fission of *P. fissipara* (Kennel, '88), a con-

striction appears a short distance behind the mouth and a new worm is produced at the posterior end of an old one. Before the two separate, the new individual has begun to feed for itself and its eyes, brain, gut, etc., are in the same condition as those of any normal adult specimen. As the time for separation approaches, a furrow makes its appearance at the place of division and deepens slowly as the internal changes progress. There is little difficulty in recognizing individuals about to divide, as for some hours before the separation we have two perfect worms with the head of the smaller attached to the tail of the larger by a narrow isthmus. This type is the same as is found in all Rhabdocoeles.

2. In *Planaria subtentaculata* (Zacharias, '86) the separation occurs when the new organs of the tail piece are partly formed. The posterior gut rami are fused in front of the new pharynx, but the formation of the head has been delayed. There is an external furrow which is the first sign of the approaching fission and is visible until the separation occurs four days later. My figure of a *Planaria maculata* on the third day after normal fission (pl. 9, figs. 5, 17) shows the condition of a tail piece of *P. subtentaculata* immediately after fission.

3. The division in *P. maculata* is at a corresponding place behind the pharynx, but is preceded by no external furrow, internal development of organs, or histological changes along the line of separation, so far as I can discover (pl. 10, fig. 22). The animal pinches itself in two at a definite place (pl. 11, figs. 24, 25), and the head and tail pieces after division are as though cut in two with a knife a short distance behind the pharynx. The occurrence of the division at a corresponding place links this with (1) and (2), while the separation without any previous rearrangement of old, or development of new organs makes the fission of *P. maculata* almost the same as the last.

4. This is found in many land planarians (Lehnert, '91; von Graff, '99; Bergendal, '87; Fletcher & Hamilton, '87) when one or more pieces of varying lengths are pinched off at the posterior end and each fragment, on regenerating the necessary organs, becomes a normal individual.

Although *Planaria albissima* (Sekera, '88), in which the division occurs just anterior to the pharynx, might be used to fill the place (3) which I have assigned to *Planaria maculata*, the latter completes the series in a more satisfactory manner since its division is posterior to the pharynx and in exactly the same place as (1) and (2).

On reviewing the accounts of these authors (Zacharias, '86; Kennel, '88; Sekera, '88; von Graff, '99, and others), one finds nowhere given a complete description with adequate figures of either the external or the internal changes from day to day in a normally divided Triclad. The external changes have been quite well described by Kennel ('88) in the single case of *Planaria fissipara*, which is a different type from *Planaria maculata*, and some of the papers reviewed by von Graff ('99) seem to have indicated pretty well the simple external changes of the land Planaria. The histological changes connected with normal fission have been quite generally neglected. Although Keller ('94) mentions them as similar to those following the regeneration after artificial mutilation, he gives no figures of the process and seems to have studied mainly the regeneration after artificial cutting. The occurrence of fission in *P. maculata* was first noted by Miss Randolph ('97) in a paper upon the regeneration of this form. This is, however, only a brief mention and there is no attempt at a detailed description. As so much study is being devoted to the regeneration of planarians after artificial mutilation, it seemed to me worth while to offer a thorough description of every phase I could observe of the normal fission and subsequent regeneration of *P. maculata*, and this is embodied in the following.

If previous to the normal fission of *Planaria maculata* there is any external furrow to indicate the place of division, it can last but a very short time, for many of my specimens divided within a few minutes after I had scrutinized them very closely for some trace of a furrow and found none. This is illustrated by figure 22, of plate 10, a whole specimen which was found divided (pl. 11, figs. 24, 25) soon after it was drawn. I believe, therefore, that the single case where I saw the actual separation was the normal process. In this case the worm, just after being transferred upon a spatula from one dish to another, pinched itself in two apparently by a quick muscular contraction. There was nothing more to the process (pl. 10, fig. 22; pl. 11, figs. 24, 25). The two pieces moved away without inconvenience and were exactly alike all other newly divided pieces found in the ponds or the laboratory (pl. 9, fig. 2; pl. 10, fig. 19).

During the collection at different times of over three thousand worms for my experiments, I was constantly on the watch for specimens with some furrow or constriction at the place of division and I isolated many specimens which I fancied were thus marked. These invariably failed to show any furrow when they were fully expanded and could be more carefully observed. Some of them divided several days later, but the absence of any furrow had been previously determined by several close examinations.

The examination of a large number of whole worms at the season when the fission is at its height did not show any with signs of new organs developing as a forerunner of fission. Serial sections of tail pieces killed soon after the division also show no trace of the new pharynx, or brain, nor any change in the gut. The making of the new organs and rearrangement of the old are hardly apparent externally until the second or third day after the fission occurs, although within twenty-four hours the parenchyma cells at the anterior end cover the naked scar left by the fission with a delicate epithelium and form a small cap of new tissue which increases in size from day to day (pl. 9, figs. 3, 12, 13).

These facts seem to show that the worm when it is ready for division quickly pinches itself in two at a definite place behind the pharynx and explain why, out of one hundred and eighty-six divisions which occurred in the laboratory, I saw the process in only one case though many individual specimens were examined at frequent intervals for days at a time.

As I can discover no histological changes at the place of fission in the parenchyma or other tissues of the whole worms which I have sectioned, I believe that the division is accomplished by a constriction of the circular muscles which can take place only when the animal is of suitable size and proportions for division, and in this latter respect differs from what is found in some of the land planarians (von Graff, '99; Bergendal, '87), which will almost always divide if sufficiently irritated.

Wilson (:00) has recently explained the fragmentation of a Nemertean (*Cerebratulus lacteus*) as due to a violent muscular contraction not preceded by any discoverable histological processes which can aid the separation. The Nemertean fragmentation may be quickly brought about by almost any stimulus which irritates the animal, and may cut through opposite any one of the gut lobes. The effect of irritation here and in the land planarians led me to try the effect of irritating *Planaria maculata* in various ways.

The killing fluids used never caused whole worms to separate, as frequently happens with the land planarians. No amount of irritation with blunt instruments produced any result. Many small cuts at different places on the surface, transverse cuts which almost divided the specimen at the place where normal division occurs, or at other points, and irregular mutilations at different places, are all quickly healed and do not produce any more divided specimens in a lot of twenty or twenty-five worms than are to be found from day to day in lots which have not been thus mutilated, and it is the same when single specimens are isolated. According to my records, the division was even less in lots so treated. It seems, therefore, that ordinary irritation will not produce the division, which must be considered a *spontaneous and perfectly normal process serving the purpose of multiplication.* The facts which were noted at the beginning of this paper, upon the absence of reproductive organs in worms from localities where fission occurs extensively, further demonstrate that the multiplication of the species in such localities must be accomplished almost entirely by this asexual method.

The only influences by which I succeeded in regulating the fission were food and a fresh supply of water. These were effective only in a general way. If twenty or twenty-five worms are isolated and not fed, some of them will be found divided from time to time during the first three or four days. They may be kept in this way for many weeks, but after the first few days, even though the water is frequently changed, the divisions are so rare as to be practically *nil* and might easily be explained by their obtaining food from eating one another, a thing which frequently happens. On the other hand, if they are kept well fed and in clean water, such a lot of worms will have several divided specimens almost every day, and these pieces will often redivide before they have reached normal proportions. The amount of division is therefore directly dependent upon the amount of food. It can, however, be checked by foul water.

In feeding the worms upon crushed snails, the water was often fouled and could not be replaced as soon as would have been desirable by the pond water in which they were kept. In such cases the fission ceased, but from six to ten hours after changing the water there seemed to be an epidemic of division. My records show that I obtained as many divided specimens in the twelve hours following such changes of water as in all the other times of my experiments, although the ratio in time was only 1 to 10. This proportion can hardly be considered an accident, but I think the point is in need of more careful investigation.

All that these experiments indicate is, that the worms will not divide unless well fed, and that even when they are ready for division it may be prevented by an abnormal condition such as the foulness of the water. This emphasizes the necessity of having all the conditions as favorable as possible in any such experiments.

In the laboratory the fission occurred between 10:00 P. M. and 6:00 A. M. in thirty-nine specimens out of forty-two in which the approximate time of division was recorded. This did not seem due to the amount of light to which the animals were subjected during the day, for some of the dishes were so shaded that there was practically no light, day or night, except when they were being examined, and the division was the same in these as in others which were exposed to the full daylight. Lehnert ('91) observed in *Bipalium kewense* that the division took place at night.

In trying to show that the fission occurring in the laboratory is a normal reproductive process I have taken pains to show that it occurs to an even greater extent in nature. To do this I collected some three thousand worms from different localities and found them with the marks of more or less recent division always abundant. The following count of the specimens collected at one time is representative. Whole, 75; heads, 110; tails, 60; odd mutilations, evidently the result of collecting, 5. These figures are good in asexual localities at any time from June to October, and when it is known that tail pieces may redivide after five days and heads after about twice that time, one realizes how much multiplication may be thus effected in a short time. A smaller number of tails is constant in about the above proportion. The tails are also in the minority in the laboratory unless isolated, from the fact that they are eaten by the whole worms and their own head ends, and even when isolated they sometimes die apparently from becoming entangled in their own mucous secretions. As they are without the pharynx or sense organs of the head (pl. 9, figs. 3, 12, 13; pl. 10, fig. 21; pl. 11, fig. 25), there is probably more destruction of tails than of heads in nature where they may be preyed upon by other hunters than their own kind. Another partial explanation of the smaller number of tail pieces in my count is, that they become almost indistinguishable from whole worms after the sixth or seventh day, while in head pieces the proximity of the pharynx to the posterior end remains for ten or twelve days as a sure evidence of recent division (pl. 10, fig. 29; pl. 11, fig. 30). The abundance of tail pieces in all stages of regeneration is sufficient proof that a large proportion of them do become perfect worms. There is no limit of growth which when reached causes the fission, since the heads and tails when collected are of all sizes (compare pl. 10, figs. 19, 20, pl. 11, fig. 24, with pl. 9, figs. 2, 13, 16).

The figures on plates 9, 10, 11 which illustrate the following description of the external changes were all made from living specimens, which were kept well fed upon a darkly pigmented pond snail. The presence of this food in the digestive tract enabled me to follow the changes of the gut by measurements of the same specimen on successive days. In the figures I have only represented the main gut branches, as the smaller ones could not be accurately made out in the live worm and if shown would only obscure the course of the larger ones.

After their normal separation the heads and tails follow the same course as though artificially cut in two (pl. 9, fig. 2–7, 16–18; pl. 10, figs. 19, 28, 29; pl. 11, fig. 30). I have no observations upon any differences between the processes following normal and those following artificial separation. Viewed from the dorsal or ventral side the naked end of either piece immediately after division shows a straight transverse edge with just a little line of white parenchyma protruding beyond it (pl. 9, fig. 2; pl. 11, figs. 24, 25). Viewed head on, the scar is like a transverse section of the worm somewhat reduced in size. The sides of the body are curved in slightly as though the scar were always kept a little drawn together. If the pieces contract, as they frequently do, a crescentic area of scar tissue appears, and just behind it a very dark line produced by the drawing together of the pigment flecks (pl. 9, fig. 1; pl. 10, figs. 21, 26; pl. 11, fig. 24). Sections show the parenchyma to be naked and occasionally portions of the gut are in contact with the outside (pl. 13, fig. 35).

During the first twenty-four hours the cut end becomes pointed by the appearance of a small triangular area of white scar tissue, and in the tail piece (pl. 9, fig. 3–7, 13, 14, 16–18) this forms the part of the new head lying anterior to the tips of the auricles. In the head piece it merely caps the posterior end (pl. 10, figs. 19, 28, 29). During the second day this new tissue increases in size. On the third day, the first indication of the eyes is found as two minute dots just on the line between the old and the new tissues (pl. 9, figs. 4, 14, 16). The halo about them is first seen when the pigment flecks become apparent on the fourth or fifth day (pl. 9, figs. 6, 18). The area of the new tissue has by the fourth day become considerably larger and its anterior edges have begun to make the angles of the normal head (pl. 9, figs. 5, 17). The points of the auricles do not show plainly until the sixth or seventh day (pl. 9, figs. 7, 8) and even on the tenth day, although the head has reached its normal shape, it may still be much lighter in color and so indicate the recent fission. From the sixth day on, it is difficult to distinguish a tail piece from a normal specimen and many tail pieces even of this age are probably counted as whole specimens in collecting (pl. 9, figs. 7, 8).

A word explaining some of the figures will review these changes. Figure 2 to 7 of plate 9 represent the changes of a single tail piece on six successive days, and figures 20 and 21 of plate 10 represent this piece redivided on the eighth day. Figure 16 to 18 (plate 9) represent a single tail piece on the third, fourth, and fifth days respectively after normal fission, and figures 13 and 14 (plate 9) another tail piece on the second and fourth days. Figure 8 (plate 9) is a tail piece the eighth day after separation. All the figures of the external changes were made from live specimens studied under a dissecting microscope. They are as accurate as the constant movement of the extended animal will allow and were drawn only after careful measurements of the length, breadth, and other proportions with a pair of compasses. For the sake of clearness the finer branches of the gut are omitted.

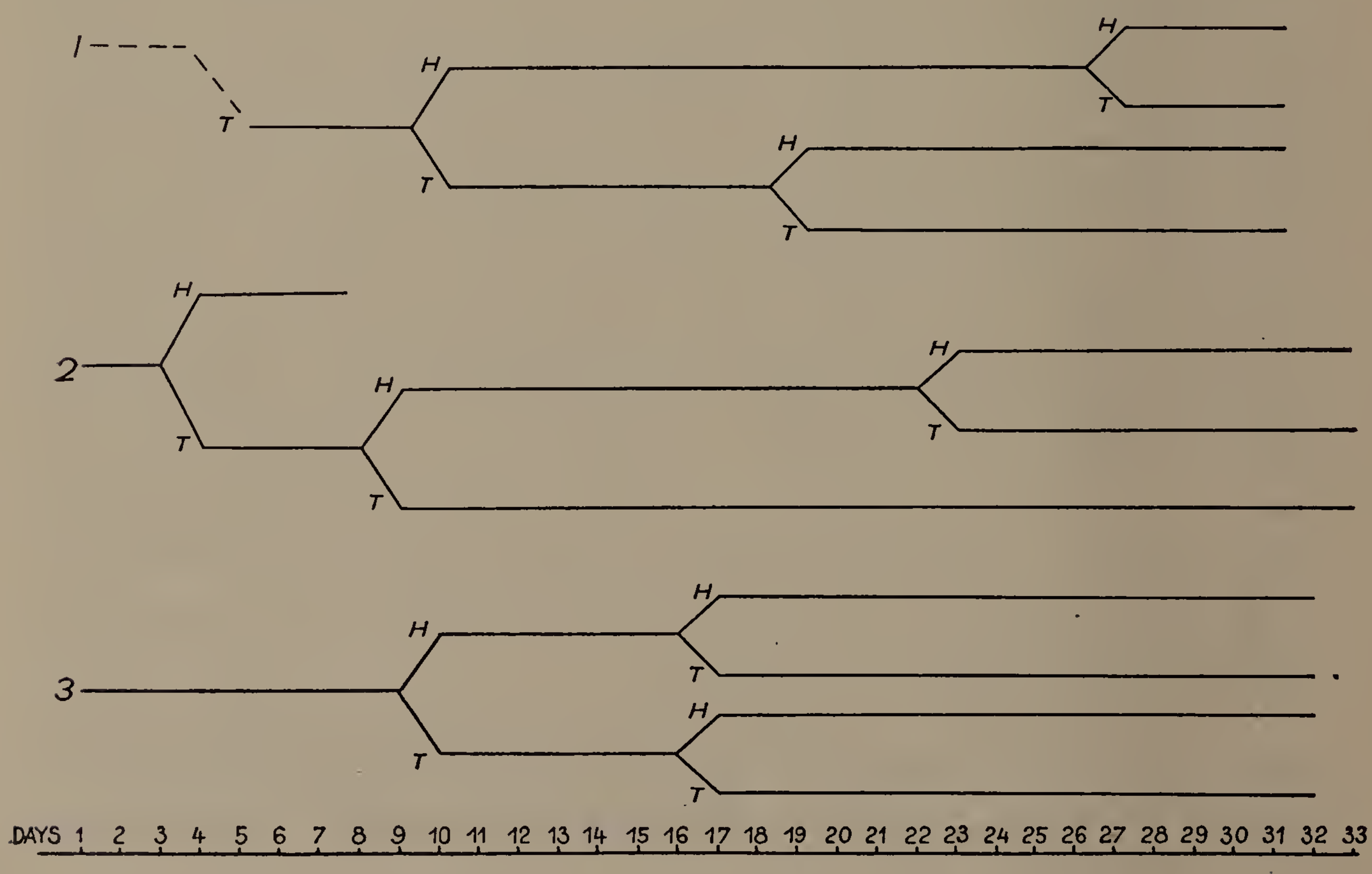
When the tail is pinched off, there has been no rearrangement of the gut and we therefore have two parallel gut rami with their various branches (pl. 9, fig. 2; pl. 10, fig. 21; pl. 11, fig. 25). The gut in whole worms of this species has, however, so many branches and secondary connections that it is exceptional to find but two long rami in the posterior end (pl. 10, figs. 22, 23, 29; pl. 11, fig. 31). Three or four is the common number and there are sometimes as many as five. Where there are but two main branches the changes are easily followed. As late as the third day, the anterior ends may remain separated (pl. 9, fig. 4), but usually on the third day they have met and fused together (pl. 9, fig. 16). During the third and fourth days this fusion has extended farther back (pl. 9, fig. 17). A small pharynx, not as yet connected with the gut, is visible on the fourth day in the live animal (pl. 9, figs. 5, 17). The fused rami make themselves over anteriorly into the single anterior gut ramus of the Triclad with no apparent increase in the amount of tissue involved (pl. 9, figs. 5, 6, 17, 18). The new pharynx is connected with this posteriorly by the end of the fourth day. On the fifth day (pl. 9, figs. 6, 14) the pharynx may be protruded and used in feeding, though as yet quite small. In the tail pieces the pharynx develops somewhat anterior to its final position (pl. 9, figs. 5, 9). From the fifth day on, (pl. 9, fig. 6) the only change is the slow rearrangement of the proportions as the pharynx moves back to its normal position, or if the pharynx be taken as the fixed point the old tissue may be said to move around in front of it. This remodeling of the contour is similar to that described in all studies of regeneration (Morgan, '98, :00; Bardeen, :01).

As will be seen from the figures (pl. 9, figs. 2, 12, 13; pl. 10, fig. 21; pl. 11, fig. 25) the portions of the gut found in tail pieces are hardly the same in any two cases, but the same formation of a single ramus always follows when the several rami unite at their anterior ends (pl. 9, figs. 6, 14, 18). The fission is probably the cause of the complexity in the branching and interconnections in all parts of the gut in *Planaria maculata* (pl. 9, fig. 14; pl. 10, figs. 20, 22, 23; pl. 11, fig. 31). Many other planarians have long branches extending from well up on the posterior rami toward the posterior end, while anteriorly the gut is quite regular. If fission occurred to any extent in these forms it would produce the same kind of irregularity that is found in *Planaria maculata*. Indeed, the production of these bizarre connections can often be actually followed, as in plate 9, figures 13 and 14. Zacharias ('86) was struck by the great complexity of the gut branching in *Planaria subtentaculata*, but did not correlate it with the fission in that species.

In many cases the tail pieces redivided before the pharynx had reached its normal position or the proportions of the adult had been attained (pl. 10, figs. 20, 21). The only requisites for a new division seem to be plenty of food and time to accumulate enough material behind the pharynx to make a new worm. Because of the latter condition, tail pieces redivided much sooner than heads. The shortest time in which a head redivided (tenth day) was just twice that in which tails frequently redivided.

In the laboratory, the intervals between divisions were so irregular that nothing can be said except that tail pieces redivide much sooner than the corresponding heads. One must suppose that in nature some individuals go for a longer time than others without division, since the heads and tails when collected are from worms of all sizes.

To show the irregularity between the acts of normal fission, I have inserted a text figure which has for its basis the record of three individuals which were isolated and followed for 31, 33, and 32 days respectively. Beginning with the whole specimens 1, 2, and 3 on the left, their acts of normal fission into a head and a tail piece are indicated by the divergence of the horizontal lines and the time at which each occurred by the scale of days given below. I have similar records of quite a number of the products of division for a longer or shorter time than the above, but these three cases sufficiently indicate the entire lack of any observed regularity in the intervals between the acts of fission.



In the head piece, after the normal fission, the remodeling goes on in such a way that the portion anterior to the pharynx remains the same size, or at least the most careful measurements do not show any change in its proportions, while the portion posterior to the pharynx grows until it has completed the normal proportions. Figures 19, 28, 29, 30, and 32 on plates 10 and 11, will serve to illustrate this, as will also figure 11, plate 9, which represents the changes in outline at the posterior end of a head piece during the seven consecutive days following normal fission. Apparently the rapid growth of the animal when fed, masks to a certain extent the rearrangement of proportions, morpholaxis, which is so evident in pieces artificially cut from different parts of the worm for experiments in regeneration (Morgan, '98, :00) and in the tail pieces (pl. 9, fig. 2–7) which must go without food until the new pharynx develops.

Internal Changes After Fission.

Before describing the histological processes involved in the regeneration after normal fission, it is necessary to describe the parenchyma of this species, and I also take occasion to review to some extent the various descriptions which have been given by different authors of the normal parenchyma and its part in regeneration.

Leaving out the gland cells, muscle and nerve fibers, and other organs which are set in the parenchyma as a matrix, the parenchyma (pl. 16, fig. 43; pl. 15, fig. 41) in an adult *P. maculata* has the appearance of a syncytial mass, the cytoplasmic portion of which is relatively large. The structure of the cytoplasm is such that it has, after fixation, a varying number of vacuoles and irregular clefts surrounded by a substance made up of what resemble the fibers of a network. The nuclei (*np*) which seem properly to belong to this syncytium are set irregularly through it and as in a typical syncytium have no trace of a cell outline. Where the clefts and vacuoles are greatly increased in size and number, the tissue has something the appearance of scattered, multipolar cells, the processes of which are everywhere continuous with those from neighboring cells. This condition is what is more frequently observed in the central parts of the adult planarian, but around the edges of the body and at the ends there is a closer resemblance to the condition of the parenchyma in an embryo, for here the nuclei are more closely set and there is so little cytoplasm between them that large vacuoles or clefts are absent (pl. 15, fig. 42).

In *P. maculata*, the adult parenchyma has much more the appearance of a syncytium which has its cytoplasm very greatly vacuolated, than of a large number of multipolar cells which are connected by their branching processes. The latter, however, is evidently the structure in some forms, for Krsmanovic ('98, p. 188) says, "Das Mesenchym ist auch bei meinen beiden Formen von reticulärem Bau, wie dies die Fig. 9 (*me*) deutlich zeigt. Die Ausläufer der Zellen verbinden sich zum Theil unter einander, zum Theil umspinnen und umgreifen sie in Form von Fasern und Platten."

Ijima ('84) also described the parenchyma of *Planaria polychroa* as made up of anastomosing cells.

Whether the parenchyma is a vacuolated syncytium or is made up of connecting multipolar cells, is of course of little importance, for there may be differences in the parenchyma of different species of Planaria such as Böhmig ('90) describes in the Rhabdocoeles. I have also observed that fixation with plain corrosive sublimate makes the vacuoles more irregular and gives an appearance very much like Ijima's ('84) description, while such a fluid as Zenker's gives the more regular appearance shown in my figures with evenly rounded vacuoles.

In the foregoing description I have mentioned as belonging to the parenchyma the cells of a syncytial mass. In addition to these there are scattered through the syncytium other cells of a distinctly different type which have a large nucleus and a nucleolus which is surrounded by a clear space (pl. 16, fig. 43; pl. 15, fig. 41, *s*). The outline of the cell cytoplasm is distinct and, if not sharply spindle-shaped, usually extends out much more from either end than from the sides of the oval nucleus. While these individual cells are of a type distinctly different from the fused cells of the syncytium, there are others which seem (pl. 16, fig. 43; pl. 15, fig. 41) intermediate between the two and it seems a fair presumption that there is a transition from one to the other, but it is not so clear in which order the series can be interpreted.

There is nothing particularly new in the above description, but I give it in detail and also the review which follows in order that my description of the regenerative processes may be as complete as possible.

There is substantial agreement in the observations of Ijima ('84), Hallez ('79), Chichkoff ('92), Woodworth ('91), and Krsmanovic ('98) upon the parenchyma of the Planaria. Böhmig ('90) gives the following résumé of his conclusion regarding the parenchyma of the Turbellaria as a whole. He says (p. 205), "Das Parenchym der Turbellarien besteht ursprünglich aus individualisirten Zellen. Die Art und Weise der Verschmelzung dieser Zellen ist eine verschiedene. Bei den Alloicölen und wohl auch einem Theil der Rhabdocoela wenigstens tritt eine Differenzirung in Gerüst- und Saftplasma in jeder Zelle ein, und die Zellwandungen resp. die Zellen verschmelzen unter einander. Innerhalb der beiden Gruppen der Dendrocölen und vielleicht bei einigen Rhabdocölen treten zugleich mit der Verschmelzung der Zellen Vacuolenbildungen auf. Diese sind zum Theil mindestens intercellulär bei den Tricladen, stets intracellulär bei den Polycladen."

Ijima ('84) first recorded the existence of two kinds of cells in the parenchyma. He says (p. 385), "Die so von einander verhältnissmässig weit entfernten Kerne sind mit anastomosirenden Strängen von Protoplasma umgeben. Mit anderen Worten heisst dies, die Bindegewebszellen verästeln sich mehr oder minder deutlich und die Aeste stehen in Zusammenhang mit einander, wodurch das Reticulum oder die Bindegewebsbalken gebildet werden. Mitunter kommen auch unverästelte Bindegewebszellen vor, welche aber mit reticulumbildenden Zellen durch Zwischenformen verbunden sind." His figures seem to show a structure similar to what I have interpreted in *P. maculata* as a syncytium. Ijima also says that the individual branched cells are more numerous at the periphery of the body than elsewhere, a fact to be compared with my observations which follow, upon the large number of such cells in *P. maculata* when it is undergoing normal fission.

Woodworth ('91) speaks of the parenchyma of *Phagocata gracilis* as a "reticulate mesenchyma" and does not describe any unbranched type of cells.

Chichkoff ('92) summarizes his views of the parenchyma as follows (p. 490): "Je considère donc le parenchyme des Dendrocoeles d'eau douce comme uniquement composé de cellules à prolongements, qui, s'entrecroisant, se reliant les uns aux autres, déterminent de petits espaces lacunaires, ainsi qu'on le sait déjà. Mais à côté de ces cellules à prolongements, il n'est pas rare d'en rencontrer d'autres, qui en sont dépourvues, revêtant une forme plus ou moins ronde, et possédant un noyau avec nucléole bien visible ; ce dernier, du reste, se trouve dans toutes les cellules parenchymateuses." Farther on he says that the "cellules sans prolongements" are found in greatest abundance at the peripheral parts of the body. Chichkoff, therefore, sharply separates the cells without branching processes from the cells of the parenchyma proper and says nothing of any intermediate stages.

F. von Wagner ('90) describes in the parenchyma of Rhabdocoeles what he calls "Bildungszellen," which he says are parenchymatous in origin and which are the starting points of all the new organs in regeneration. From his own work and that of others he makes the statement (p. 385), that, "bei den Turbellarien die Regenerationen vom Parenchym (Mesoderm) ihren Ausgang nehmen, das Regenerationsvermögen dieser Thiere somit an die Bildungsfähigkeit dieses letzteren gebunden erscheint." That is, he goes back to the parenchyma as the source of his *Bildungszellen* and hence of all the rest and what he calls *Bildungszellen* are homologous with the *unverästelte Bindegewebszellen* of Ijima, the *cellules sans prolongements* of Chichkoff, and the large cells which I have described in the parenchyma of *P. maculata.*

That the parenchyma is the tissue from which the new parts come is, I think, agreed by all who have studied the histological details of regeneration in planarians (von Wagner, '90; Keller, '94; van Duyne, '96; Flexener, '98; Bardeen, :01).

Keller ('94), in his study, which is principally upon Rhabdocoeles, although he examined Triclads for comparison, has gone a step farther than von Wagner felt justified in doing, and instead of deriving the "Bildungszellen" from the parenchyma, he believes that the unbranched parenchyma cells, which von Wagner called "Bildungszellen" and of parenchymatous origin, are almost like a fourth germ layer which remains undifferentiated and from which most of the adult body originally came. He interprets the transitional stages between these "Bildungszellen" or "Stammzellen," as he calls them, and the branched cells of the parenchyma reticulum as the origin of parenchyma from these cells. He explains his theory by a diagram which represents the development of a planarian after the stage in which the embryo consists of seventy or eighty similar blastomeres, as follows: from the blastomeres arise (1) the primary ectoderm, (2) the primary endoderm, forming a kind of blastocoele in which lie a few wandering cells. From these last there arise one after another the secondary ectoderm, the secondary endoderm, the remainder of the parenchyma, the nervous system, gland cells, and muscle fibers, the definitive pharynx considerably later, the reproductive organs, and in case of mutilation the parts which are made good. He further says that from his examination of a number of planarians he finds that those species having the power of regeneration most marked, possess the greatest number of these cells. In view of their supposed primitive character, Keller prefers the term "Stammzellen" to von Wagner's "Bildungszellen."

How far our knowledge of the cell lineage of Triclads admits of such a definite interpretation, I am not prepared to say. The theory is a suggestive one, though from the nature of the case, impossible of actual demonstration. Spindle-shaped and oval cells with oval nuclei and the characteristic nucleoli of the "Stammzellen" do exist in *P. maculata* embryos at the time when the permanent pharynx is forming. I should myself be inclined to the more conservative statement which is merely a résumé of the facts, that the cells left between the primary ectoderm and endoderm of the embryo produce pretty much everything else and that when the syncytial parenchyma can be first discovered there are also individual cells scattered through it, which, though the larger ones may be easily distinguished as such, are connected with the syncytial mass of the parenchyma by every possible intermediate stage, and this series of intermediate stages may be interpreted as "Stammzellen" becoming parenchyma or as parenchyma becoming "Stammzellen." If the latter be the interpretation, these cells would be continually arising from the parenchyma, we should lose the continuity of the "Stammzellen" which Keller assumes have come on down unchanged, giving off the others as from an undifferentiated stock, and we should then consider the cells of the parenchyma as the final ones to which we can trace the power of regeneration.

The facts which do come out clearly from this review are, that we can distinguish (1) the parenchyma proper and (2) certain other individual cells with intervening stages between the two and that the individual cells as such, be their origin early from the embryonic cells or later from the parenchyma, are the histological basis for regeneration in the Rhabdocoeles and Triclads which have been carefully studied and that these studies have extended over a sufficient number of forms to show their general occurrence.

In my description of the parenchyma of *P. maculata*, I have heretofore referred only to what is found in worms from a locality where there is practically no asexual reproduction. In localities where normal regeneration is going on as a result of the normal amputation occurring in fission, the condition of the "Bildungszellen" is of particular interest. The number of these "Stamm" or "formative" cells, as I shall call them, using a translation of Keller's term, is so enormously increased in the dorsal region of the body (pl. 14, fig. 38, *ds*) above the gut that they are far more numerous than any of the other mesodermal elements. There seem to be more of them throughout the body than are found in worms from localities where fission is not occurring, but this would probably not have attracted attention were it not for the very great number in the dorsal region (pl. 14, fig. 38, *ds*). These cells both dorsally and ventrally and in all parts of the body in all the specimens during the entire season of normal fission are at all times dividing very rapidly, as shown by the mitotic figures which are everywhere abundant (pl. 14, fig. 38; pl. 13, fig. 35, *k*). It is always the large individual cells which are dividing, and never the smaller nuclei of the parenchyma proper. The daughter cells resulting from these divisions, have nuclei exactly like those of the parenchyma in size and appearance, but have their own cytoplasm, though this is of very small amount. These are the only cells in which mitotic figures have been discovered. Cell division may occur in the endoderm, but I have never seen any indications of it though I have searched through many sections. The same result came from the examination of the ectoderm, though here the rhabdites greatly obscure the nuclei and, as noted above, the small nuclei of the parenchyma proper have never been found dividing. This makes it evident that it is the formative cells which are increasing far more than any others at the time when the worms are making good the parts lost by fission and growing so fast that they frequently double in all their proportions in twelve days (compare pl. 10, fig. 19, and pl. 11, fig. 32). In worms taken at the same season of the year from localities where sexual reproduction is in progress and fission is practically absent, formative cells may be found dividing, but only by considerable searching. What part these cells play in the regeneration of the new parts after normal fission, will appear from the following description of the histological changes found in the head and tail pieces during the four or five days after their separation.

The figures (pl. 13, figs. 35, 36; pl. 14, figs. 37, 38; pl. 15, fig. 42) upon which this description is based, are all from sagittal sections of tail pieces which are better adapted to illustrate the facts than sections in any other plane. The changes in the posterior part of the head ends are exactly the same in character minus, of course, the formation of the organs peculiar to the head; and any one of the figures might do as well to represent what occurs in the posterior end of a head piece. In all the figures of plates 13, 14, 15, except figures 39 and 42, the anterior end of the animal lies to the left. In figures 39 and 42, the anterior end of the animal lies to the right. Figure 35, of plate 13, represents a sagittal section of the anterior portion of a tail piece such as is shown in plate 9, figure 2. Figure 36 (plate 13) is a similar section of a tail piece about thirty hours after fission (pl. 9, fig. 3). Figure 38 (plate 14) is part of a sagittal section from about halfway between the anterior and posterior ends of a tail piece which has just separated from its head, but it might equally well represent any vertical, longitudinal section toward the middle of any animal from a locality where active fission is occurring. Figure 42 (plate 15) represents a sagittal section through just the tip anterior end of a tail piece on the third day after fission (pl. 9, fig. 4). Figure 39 (plate 15) is a section similar to figure 38 (plate 14) but is in the region of the developing pharynx (pl. 9, fig. 5). In this figure, the anterior end is to the right. Figure 40 (plate 15) is a section in which the anterior end lies to the left and shows the pharynx fairly well formed (pl. 9, fig. 17). Figure 37 (plate 14) is again a section similar to figures 35 and 36 and represents what is found at the anterior tip on the fourth day (pl. 9, fig. 5).

The conditions found in the naked tip of the tail piece (pl. 9, fig. 2) a few hours after its separation from the head piece, are represented by the sagittal section shown in figure 35 (plate 13). Dorsally, the formative cells (*s*) are seen to lie in the parenchyma and to be more numerous than elsewhere. They are quite prominent because of their large size and their nucleoli. At the exposed part of the parenchyma, there are a considerable number of these cells, but not enough to indicate their special multiplication at this place previous to the fission. The approximation of the dorsal and ventral sides sufficiently accounts for the slight massing of parenchyma and formative elements at this point. The ectoderm (*ec*) has been broken and shows rough edges and the parenchyma is left exposed. This may be compared with any of the figures of the outside at this stage (pl. 9, fig. 2; pl. 10, fig. 21; pl. 11, fig. 25). This section just passes through the inner side of one gut ramus (*g*). It is at once evident that one could not distinguish such a section from one of a worm which had been artificially cut in two and furthermore that there are now no signs of any histological changes which may have preceded the fission. The formative cells both dorsally and ventrally are actively dividing, as is shown by their numerous mitotic figures (*k*), but the amount of division at the exposed tip is no more extensive than can often be found in a space of the same size anywhere in the dorsal region (pl. 14, fig. 38). In fact the neighboring sections showed more cell division going on in the dorsal and ventral regions some distance back of the exposed tip, as is shown by the right half of figure 35 (plate 13), than at the tip itself where the new ectoderm is to form.

Flexener ('98), in studying the histological changes occurring in the regeneration after an artificial cut similar to this normal one of fission, says (p. 340), "At the end of the first twelve hours and about equally at the conclusion of eighteen hours, active cell proliferation in the divided end is going on. The evidences for this are found in the rich mitosis encountered as well as in the accumulation of small immature cells at the injured extremity. The most active division is found in the tissues immediately adjacent to the epidermal. . . . . At the end of twenty-four hours cell division in the regenerating end is quite over. Long and painstaking search is required to discover a single karyokinetic figure."

The artificial cutting seems therefore to have stimulated in Flexener's *P. maculata*[1] a special production of new cells near the cut

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[1] The worm which Flexener calls *Planaria torva* and which is the subject of his paper, came from the localities where I have collected my specimens and is incorrectly called *torva*, as I have identified it as *P. maculata.*

end during the first twenty-four hours. There is certainly no very well marked period of extremely active cell division after normal fission, and this I account for by the fact that an asexually reproducing *P. maculata* always has an excess of the formative cells in all parts of the parenchyma and particularly along the dorsal side, and that there is no need for any marked increase of cells at the exposed end nor would there be if the worm divided itself at any other point. There is perhaps a slight increase in the amount of cell division among the formative cells at the exposed tip, but not enough to be readily noticed. It is the same process which Flexener observed, only the animal is prepared for its fission by the increased number of formative cells. These cells are always dividing in all parts of the body no matter what stage of regeneration is examined. Their increase would seem sufficient to account for the continual increase in bulk of the whole body and they are present at the normally cut surface ready to make good the loss. I have often wondered if there were not some actual migration of the large formative cells from the more distant portion (see the right side of fig. 35, pl. 13) toward the exposed end for they seem to lie free in the parenchyma proper and are dividing more actively a short distance behind than just at the cut surface, where in the third and fourth days (pl. 14, fig. 37; pl. 15, fig. 42) there is more increase in the number of small nuclei than seems to be accounted for by the division at the tip end itself.

On the second day (pl. 13, fig. 36) the outermost of the large formative cells have begun to make the new ectoderm (*ec′*) and back of this there is an increasing bulk of syncytial parenchyma with small, close set nuclei. As only the large cells divide, and their reconstructing nuclei are exactly like these, this collection of nuclei has presumably originated from the division, and so reduction in size, of the large cells. A considerable number of large cells still remain near the tip, and mitotic figures are to be found among them. On following the section posteriorly, the formative cells are as numerous as ever and their divisions as frequent, though this does not happen to appear in the section drawn (pl. 13, fig. 36).

There is no change in the old ectoderm (*ec*) except possibly the loss of some cells at the edge between the new tissue and the old. At the exposed surface, the arrangement of the larger formative cells shows at once that they are producing the new ectoderm (*ec′*).

This section cuts through a considerable portion of one of the still unfused gut rami (pl. 9, fig. 3).

The third day (pl. 15, fig. 42) shows an increase in the number of small nuclei evidently arising by further division of the large, formative cells so that the latter are found in considerable numbers only some distance back. The ectoderm at the exposed tip (*ec′*) is now definitely formed and save for the absence of rhabdites, the boundary between the old and the new ectoderm could not be distinguished. The killing fluids often produced clefts between the new ectoderm cells, as shown in the figure, a phenomenon which I have frequently observed in the delicate ectoderm of embryos killed when about ready to leave the egg capsule.

On the fourth day (pl. 9, figs. 5, 17) a similar section through the head (pl. 14, fig. 37) shows approximately the mature organization of the parenchyma in this region, there being many small nuclei and the larger cells being entirely absent until a point opposite the gut is reached. This is a section of the anterior end of a tail piece considerably smaller than the others and as it is drawn to the same scale, it might at first glance indicate more elongation and flattening of the new tissue than occurs. There is, however, on the third and fourth days, a flattening and elongation which does change the shape of the regenerating end as the outlines of the figures show. The commissure (*ne*) connecting the two halves of the new brain is now seen for the first time.

The formative cells at the exposed tip seem to form the new ectoderm as above described, and the large number of small nuclei of the adult head parenchyma to all appearances come from the division of the nuclei of formative cells, the cytoplasm of which becomes continuous with that of the parenchyma syncytium (pl. 15, fig. 41, *sn*).

For as much as twenty-four hours after the fission there is no discoverable change in the parenchyma at the point where the new pharynx is to form. During the second day, there appears in this region an irregular massing together of large, formative cells. Dorsal and ventral to this mass of cells, the mitotic figures are abundant, but are not so frequent in the mass itself. The appearance of so many large cells all at once suggests again that some have migrated from the dorsal mass of formation cells. By the third day (pl. 15, fig. 39) these irregularly directed oval and spindle-shaped cells have almost all become oriented alike and so closely packed that in sections 5 μ in thickness they are sometimes two or three cells deep. This mass of cells (*ph′*) covers the extent of the new pharynx and there can be no doubt as to what cells are responsible for this organ. Between the anterior end of this mass and the gut rami which have now united (pl. 9, fig. 5), are fewer cells also markedly spindle-shaped and drawn out in the longitudinal axis of the animal (pl. 15, fig. 39, *phl′*). Apparently the fibers of the parenchyma about these are also drawn out, for they appear different from those surrounding them and this differentiation marks out the future lumen connecting gut with pharynx. Where it meets the gut (*g*), there is such an intimate association between the gut and the formative cells (*s*) that one is forced to the conclusion that these are being added on to the gut. This apparent fusion of the formative cells with parts of the gut will be taken up in detail later. The mass of closely packed cells extends about twice as far back as is shown in figure 39. The cavities of the pharynx lumen and its sheath have not yet appeared. The cavity of the sheath appears a little before the cavity of the lumen, being first evident as a split around the periphery of the posterior two thirds of the mass of formative cells (pl. 15, fig. 39), then the lumen begins to appear by a separating of the individual cells in the center.

Figure 40 (plate 15), in which the anterior end of the animal lies to the left, represents a stage in which the lumen (*phl′*) of the pharynx is forming and is not connected with the gut (*g*) nor does it open on the free end of the pharynx. The pharyngeal sheath is formed, but the mouth has not broken through. The mass of formative cells of the third day (pl. 15, fig. 39) is here represented by many rounded cells in the rudiment of the pharynx. Many of these show plainly their cell outline and a nucleus with the characteristic nucleolus of the formative cell. In the center they have separated for the beginning of the lumen (*phl′*) the epithelial lining of which is just beginning to form, and over this area the parenchymatous matrix has disappeared. The epithelium of the pharyngeal pocket is already formed, but some of its nuclei still show the characteristic nucleolus of the formative cell. Just anterior to the pharynx in this figure are to be seen what are unquestionably formative cells which are within the gut cytoplasm (*g*) and in the neighboring sections this approaches almost to the diminutive lumen (*phl′*).

The change from this to the adult pharynx is the completion of the lumen and the breaking through of the mouth. The formative cells which have built the young pharynx lose their identity as such and their nuclei change during the next day or two into the smaller nuclei of the adult pharynx, some of them still retaining nucleoli such as are always present in the formative cells and often in the other cells of the body excepting the ectoderm.

The changes in the nervous system have been described by Bardeen (:01) and Flexener ('98). I have nothing to add to their observations.

Regarding the close association between the formative cells and the gut, which was mentioned in the stage represented by figure 39 (plate 15), I have these additional observations. At the anterior end of the gut in tail pieces where the median ramus grows out (pl. 9, figs. 5, 17), sections show a very intimate connection between the formative cells and the cells of the gut. The gut (pl. 13–15, fig. 35–42, *g*) in well fed worms has, as is commonly known, the appearance of a syncytium enclosing vacuoles (*v*) and masses of digesting food. The outlines of the cells are difficult of demonstration. Figure 41 (plate 15) represents a sagittal section through the anterior tip of the gut (see pl. 9, fig. 16). The anterior end is to the right and the magnification is Zeiss $\frac{1}{12}$ x 2. The parenchyma syncytium (*sn*) with its own nuclei (*np*) and also scattered formative cells, are shown. Some of the last are removed from the gut, but there are many which are closely applied to it as in the lower half of the figure and even extend up some distance into the gut mass. There are still others which are entirely surrounded by the gut cytoplasm and in their own cytoplasm show small vacuoles, a thing I have never observed in formative cells anywhere else and which seems additional proof that they are being added on to the gut by their cytoplasm fusing with the gut cytoplasm. Many of the gut nuclei show a nucleolus exactly like that of the formative cell, but since nucleoli are sometimes found in nuclei of various sorts in the adult and normal worms, one must not make too much of this. The cases where the formative cells, cytoplasm and all, are within the gut are the strongest link (see also pl. 15, fig. 39, *g* and *s*). I have observed formative cells seemingly quite surrounded by gut cytoplasm at other places than the anterior and posterior faces of the new median ramus. This is not so remarkable since many small branches are everywhere growing out from the main rami at this time and it would not be strange if the process occurred elsewhere, but I have never seen any such number of formative cells so intimately connected with the gut as at the anterior tip of the new median ramus. As there is no other place where the gut is being remodeled to such a marked degree, this is what might be expected.

That the formative cells of the parenchyma become added on to the gut in some places would seem a remarkable thing. The entire absence of observed cases of mitotic figures among gut nuclei during the time when the animal was growing so rapidly and the gut, of course, was likewise increasing, would be something at least in favor, if not evidence, of such a possibility. If it should be objected that neither had mitosis been seen in the ectoderm, I can call attention to the way in which the rhabdites obscure many ectodermal nuclei while the nuclei of the gut are readily seen. It is a difficult case to prove, but I can only believe from such instances as are shown in figures 39 and 41 (plate 15) that where the new anterior ramus develops, some formative cells are added on and become gut cells. The intimate association of the two seems to admit of no other interpretation and if this is the case one must ascribe a remarkable versatility to the formative cells when their whole history in regeneration is considered.

Whether the stages intermediate between parenchyma and formative cells represent parenchyma originating from formative cells or the reverse, I leave an open question. That the formative cells which always occur in *P. maculata* in some numbers and in very great numbers during the season of fission are the basis for the regeneration following normal fission, there can be no question. The existence of these cells and their rôle in regeneration in many other planarians and Rhabdocoeles have been recorded as shown in my review of the subject. The latter have been thoroughly described in Rhabdocoeles, but not figured at all or thoroughly studied in the Triclads. My observations on the existence and rôle of such cells in *P. maculata* do not therefore stand alone.

Starting with these formative cells which are continually increasing their number (see mitotic divisions in the figures), we get ectoderm, parenchyma, tissue of adult head, according to Flexener ('98) ganglion cells, pharynx, and probably parts of the gut. As far back as we can go, *viz.*, to the many self-sustaining and multiplying formative cells, everything is to be referred to these scarcely differentiated cells which may become almost anything. There is nothing in the process, as I have seen it, to indicate the degeneration of a highly specialized adult tissue into something simpler and from this the building of new organs. I regret exceedingly that I have not had the opportunity to study and compare what occurs in specimens artificially cut in two at just the place where fission normally occurs. From Flexener's description ('98) of *P. maculata* and from Keller's statements ('94) as to the forms he studied, I can hardly see how there can be any different processes carried on in the regeneration after artificial cutting except that the excess of formative cells in animals which are multiplying asexually may make the process easier to follow.

A structure which I have found to a varying extent in almost all the specimens examined from localities where fission is in progress, is shown at x in a number of the figures (pl. 13, fig. 35; pl. 14, fig. 37). There are lying in the parenchyma, mostly in the dorsal region, masses of large cells the outlines of which are not always easily discernible. They are not connected with the gut in any way nor do they resemble any structures which I have ever found described for the Planaria. They can best be characterized by saying that they have the appearance of gut cells without any vacuoles for their nuclei are very much like those of the gut and their cytoplasm stains in the same way, but they are not found connected with the gut in any way. They are, furthermore, not at all like the first beginnings of the reproductive organs and although I have held many theories as to their significance, I cannot offer even a plausible conjecture as to their meaning. My reason for mentioning them is that they are usually a striking feature of animals from an asexual locality.

THE ANATOMY OF THE FULLY DEVELOPED REPRODUCTIVE ORGANS.

During the summer of 1898, while at the Marine biological laboratory, Woods Holl, Mass., I became interested in studying some very large specimens (15 to 20 mm. in length) of *Planaria maculata.* These were found in the ponds near Falmouth and with them large numbers of eggs which they lay during May and early June.

Reproductive organs were of course fully developed in these specimens and I studied their anatomy casually while endeavoring to ascertain new facts regarding the function of the uterus, penis, etc., during the egg laying. At this juncture I was surprised to read in a recent paper by Woodworth ('97) the following sentence: "*Planaria maculata* is the commonest of our fresh-water planarians and was the first one to be described (Leidy, 1848); however, nothing has been published regarding its sexual organs, and I am unable to offer anything in this regard; not one of the hundreds of specimens that came under my observation was sexually mature."

Since the anatomy of the most complex system of organs in this common species is entirely unknown, or at least unrecorded, I have availed myself of the opportunity to study them in their fully developed state and I shall describe the main features of their structure, although there is nothing strikingly different from what has been found in closely related forms. The relative position of the different parts may be seen from figure 56 (plate 19), though this represents them in an immature condition. The atrial organs are shown by dorsal and lateral views (pl. 12, figs. 33, 34). From figure 56 it is seen that the testes are numerous and extend from the region of the ovaries almost to the tail. Although a few large follicles are to be found extending up between the gut lobes, the rest are packed closely together in the ventral region and are never found dorsal to the gut. Their lateral extent is seen in a transverse section of the animal (pl. 18, fig. 60) to be from a point about halfway between the lateral margin and the nerve cord to within a short distance of the median line. In front of the pharynx and behind the genital atrium, each nerve cord divides the testes of its side in such a way that in whole preparations there often appear two irregular rows on either side while in the region of the pharynx and genital atrium the inner row of either side is lost. Everywhere they are close together and from the ovaries to the tail hardly a transverse section can be found that does not cut a half dozen or more. In longitudinal sections they are found closely following one another, there being about seventy-five on either side.

The testicular canals (vasa efferentia) are everywhere found connecting one testis with another or the testes with the vasa deferentia. It has seemed to me, in studying these fine canals, that there is no reason for doubting that each testis has a definite connection either directly or through intervening testes with the vas deferens of its side. In species with a smaller number of testes it is not difficult to discover the connection of each testis with the vas deferens. In *Planaria maculata*, the testes communicate with one another or with the vas deferens in the same way and it is only their great number which makes the exact connection impossible to establish in many cases.

During the egg laying season the vasa deferentia (pl. 12, figs. 33, 34, *vd*) may be found as very fine tubes extending from the most anterior testes and everywhere receiving testicular canals. Their diameter increases in the region of the pharynx where, swollen with spermatozoa, they become the seminal vesicles as in other Planaria. In the live worm, they may be seen through the ventral surface as two whitish masses on either side in the region of the pharynx. Posteriorly, the seminal vesicles narrow suddenly and the smaller tubes thus formed turn with a sharp angle, mount dorsally, and then turn ventrally to the base of the penis where each opens into an enlargement (*en*) of the penis lumen. This lumen is of considerable size and has a blind anterior end, but is drawn out posteriorly into a finer tube and opens by a small aperture on the free end of the penis (*p*). The penis (pl. 12, figs. 33, 34, *p*) is short and thick, closely invested by the walls of its cavity and pointing downward and backward at an angle of about 45°. Along its median posterior face it joins the atrium by a thin mesentery-like fold so that a sagittal section (pl. 12, fig. 34) shows as though there were only a shallow furrow around the penis posteriorly. The outline of such a sagittal section is given in figure 34 and the depth of the atrium immediately on either side of this is indicated by a dotted line. Behind this anterior part which contains the penis, the atrium is narrowed abruptly. It is worth noting that the longitudinal axis of the penis does not point in the direction of this opening (pl. 12, fig. 34), but downward and backward as above described and thus the free end of the penis lies somewhat below the opening through which it must pass when protruded. The contraction of muscle fibers in the mesentery-like fold may perhaps aid in guiding the penis out posteriorly. The narrow portion of the atrium soon widens abruptly by sending a larger branch ventrally and slightly backward to communicate with the outside at the genital pore (*gp*). At the upper posterior angle of the main atrial cavity the vagina (*va*) extends dorsally and posteriorly. This short canal, which I designate as vagina, reaches almost to the basal membrane on the dorsal side, before it splits into the stalk of the uterus running anteriorly and the common oviduct running posteriorly on the midline (pl. 12, figs. 33, 34). The atrial cavity extends posteriorly a short distance beneath the vagina and is here thrown into one or two large folds which run lengthwise. These folds are glandular and are perhaps homologous with the "musculo-drüsen" organs mentioned by Ijima ('84) in his description of *Polycelis tenuis*, though they are not constant in shape or occurrence and the cavity of the atrium is no further complicated than by the division into an anterior portion containing the penis and a posterior which receives the female elements. Besides the secretions of the unicellular glands which surround the atrium and enter the vagina, the epithelial lining of the atrium seems to be actively at work producing a secretion which appears as spherical masses detaching themselves from the cells and covering the surface several layers deep.

The stalk of the uterus, as above mentioned, extends forward from the vagina along the midline as a small tube which in many sections shows indications of contraction, for the outline of its lumen is folded. In front of the penis it expands into a spherical uterus such as is found in many planarians (pl. 12, figs. 33, 34, *u*). During the egg laying season, this cavity when seen in transverse section is as large as the pharyngeal pocket and extends right up to the dorsal and ventral basal membranes. Within the uterus I have found what were unquestionably masses of spermatozoa since they had the same appearance as the spermatozoa found in the seminal vesicles. In some instances I also found what appeared to be the egg capsules in process of formation. Almost every live specimen when seen from the ventral side shows a reddish brown mass in the position of the uterus, as though the uterus contained one of the brown egg capsules. This color must, however, be due to the color of the uterus itself, for it shows exactly the same when there is no trace of a capsule.

The ovaries (pl. 19, fig. 56, *o*) lie about one fourth the entire length of the animal from its anterior end and are in the usual ventral position just inside the nerve cord. They are of considerable size, often more in diameter than one half the dorso-ventral thickness of the specimen. Figure 52 (plate 17) represents a transverse section through an ovary and also cuts a part of the oviduct (*o*). The ova in the sexual season are of all sizes, but the majority of them are very large and toward the center the largest ones are found entirely free and within the head of the oviduct. Around the periphery are considerable numbers of small nuclei (*ctn*), whose cytoplasm has apparently gone to form a syncytial framework which extends throughout the ovary and in which the ova are imbedded.

There is nothing like a parovarium in the mature worm or at any stage which I have seen of the developing reproductive organs and the ovary is compact without irregular lobes extending into the parenchyma.

The oviducts lead from the outer side of either ovary and extend posteriorly just above the nerve cord. Their walls consist of but a single layer of cells. In some particularly good preparations I am quite sure that I have detected posteriorly directed cilia in the lumen. Back of the atrium the oviducts converge and mount to the dorsal side, and as they approach the midline, turn forward to unite as the common oviduct, the relation of which to the uterus and the vagina has been pointed out.

The mature yolk glands are connected with the oviduct everywhere along its length. Only one kind of cell is to be found in the ripe yolk glands and these cells are loose in the cavity like so many enormous spermatids in a testis. The yolk glands extend everywhere, filling the space on the dorsal side and between the gut lobes so completely that there seems little room left for parenchyma. As they are kept out of the ventral region by the numerous testes, the result is that they are dorsally placed. They do not have any definite position like the testes, which remain in that part of the parenchyma where they first appear, but seem rather to have grown in and taken all the space that was left. Anteriorly they extend only a short distance in front of the ovary, but like the testes, extend back almost to the tail.

THE DEGENERATION OF THE ADULT REPRODUCTIVE ORGANS.

After the egg laying, stages in the degeneration of the reproductive organs may be readily found. The table shown below represents these stages as I have found them. After knowing the development *de novo* of the organs in small specimens, these stages will

A TABLE TO SHOW THE ORDER OF DEGENERATION OF THE REPRODUCTIVE ORGANS IN *Planaria maculata* (see explanation in text).

Specimen.	Date.	Ovaries.	Oviducts.	Yolk glands.	Atrial organs.	Vasa deferentia.	Testes.	Remarks.
1	June	present	present	present	present	present	present	Large specimens at the time when the egg laying season has just passed its height.
2	June	present	present	present	present	both traced almost to level of ovaries	absent	Unless a chance mutilation, this specimen has undergone normal fission just back of the atrium.
3	Aug. 15th	present but small	extending back as far as mouth	absent	found as disconnected parts (see pl. 19, fig. 61)	absent	absent	
4	early Sept.	each with only about 12 ova (see pl. 17, fig. 50)	extending back to region of the pharynx	absent	small collection of nuclei	absent	absent	
5	early Sept.	very few ova	found on one side only	absent	small collection of nuclei	absent	absent	
6	early Sept.	3 or 4 ova at position of one ovary	absent	absent	small collection of nuclei	absent	absent	Formative cells collected in small irregular masses along the region above either nerve cord (see pl. 16, fig. 46).

be seen to represent something quite different from the developmental stages; and when the months of the year at which they occur are noted, they cannot signify anything but the stages of degeneration. Out of a considerable number of cases I have selected six as showing all that is necessary, and these with the month at which they were found are indicated in the first column. In the columns following, the presence or absence of the ovaries, yolk glands, atrial organs, vasa deferentia, and testes, is indicated and peculiar cases are pointed out by some comment.

The testes by about the tenth of June, although still large, have a much smaller number of spermatozoa and fewer mother cells in their walls. They seem to become exhausted by the using up of all the germ cells so that nothing remains but a cleft in the parenchyma which then collapses. Contrary to Chichkoff's view ('92, p. 522) that portions of the testes in the forms he studied remain and produce the new testes of the next year, I cannot find that in *Planaria maculata* any sign of the old testes remains. The disappearance of the testes is therefore the first stage in the degeneration. This may be compared with Woodworth's ('91) mention of what occurs in *Phagocata gracilis.* He says (p. 30), "While the yolk glands are still in an early stage of development, spermatogenesis has been completed, the testes have disappeared and the spermatozoa are found filling the vasa deferentia"; and again (p. 31), "after the spermatozoa have found their way through the vasa deferentia all traces of the testes disappear." In *Planaria maculata* the vasa deferentia persist for some time after the disappearance of the testes and are to be found reaching almost to the ovaries as in specimen 2 of the table.

The third case in the table is the most important. Testes, vasa deferentia, and yolk glands have disappeared. The ovaries with their oviducts, which extend back as far as the atrium, remain intact, but in the region of the atrium are found only the remains of the atrial organs. Figure 61 (plate 19) represents what several consecutive longitudinal sections show in this region. There are some structureless masses at the position of the uterus (*u*), a cavity (*c*) at the place where the penis would be normally found, and a small pit in the ventral surface (*ap*) which represents the atrial pore, but there is no connection between these portions. The further degeneration as illustrated by specimens 4, 5, and 6 of the table shows the reduction of the atrium to a mere collection of nuclei, the disappearance of the oviducts, and the reduction of the ovaries to insignificant masses containing only a few ova (pl. 17, fig. 50). The collection of nuclei at the position of the atrium has the appearance of forty or fifty small parenchyma nuclei such as are shown in figures 42 (plate 15) and 43 (plate 16) at *np*, which surround, and are imbedded in the edges of a small area that takes a good deal of any plasma stain and is more dense than the cytoplasm of the surrounding parenchyma. The normal fission begins at stages of degeneration when the old ovaries and oviducts and some trace of the atrium still remain (specimen 3 in the table), and since the plane of fission is just in the region of the disappearing atrium, some cases in which the atrium had entirely disappeared much sooner than in others, may be attributed to the early occurrence of the fission.

The table traces the stages of degeneration down to a condition where very small rudiments of the ovaries remain and sometimes some nuclei to mark the old atrium. There can be no mistaking an old ovary (pl. 17, fig. 50) for one just developing (pl. 17, fig. 49), although the number and size of the ova may be about the same in a single section, and this condition is hardly questionable as the last stage in the degeneration of the sexual organs. The normal fission, which sets in about this time, by cutting off tail pieces makes many good sized worms which have no sign of the old organs, and the young of the same year have increased in size to such an extent that they can be no longer distinguished from the worms resulting from the fission of the adults. Specimen 6 shows, however, that the production of the new reproductive organs, as fall approaches, does to a certain extent overlap the degeneration of the old. In such cases, while portions of the old organs still remain, there are cords of cells appearing in the parenchyma above either nerve cord which later give rise to the testes. Such a cord is shown in plate 16, figure 46. The origin and later history of these cords and masses of cells will be taken up under the development of the organs in small worms. Whether the old ovary in original head ends in which it exists, ever develops into the new one, I cannot tell, as the original head pieces are of course like all the other worms externally and none of the specimens sectioned showed anything to give a clue. The majority of the individuals not being original head ends with the remains of an old ovary, must of course develop all their organs anew in the fall. This development of the reproductive organs in small worms collected from sexual localities in the early fall is what I described in a preliminary paper last year and will here follow through more in detail.

THE DEVELOPMENT OF THE REPRODUCTIVE ORGANS IN SMALL WORMS.

Lang's statement ('81) that the sex cells of planarians arise from the epithelium of the gut has, so far as I know, never been confirmed, and I think we may set it down as an error in the interpretation of his data. Beyond this and the mere statements that the testes are at first solid and that the oviduct begins as a solid rod of cells, he says nothing of the development.

The description of the development given by Ijima ('84) seems to be correct as far as it goes, and he indicated the essential parts of the process quite correctly. He says that the development of the atrium and the penis is like a repetition of the process by which the pharyngeal pocket and pharynx are formed, since it begins as a cleft among a mass of mesoderm cells from the anterior wall of which cleft the penis grows out. Ijima also described the sex cell and the yolk glands as developing *in situ* from individual cells of the mesoderm.

Woodworth ('91) describes the yolk glands of *Phagocata gracilis* as originating by outgrowths from the parovarial masses found in that species and disputes Ijima's description of their origin *in situ.* Chichkoff ('92) inclines to Woodworth's view although with no observations of his own.

Since none of the foregoing works offers a complete description of the development of the sexual organs, I submit the description of this process as follows. I must preface this account by saying that I do not know whether the stages I am describing are from egg-embryo worms or from worms which have been reduced to a small size by a period of asexual multiplication. A reference to the section at the beginning of this paper upon the life history of *Planaria maculata* in different localities will explain this statement. In the locality numbered 1 (page 517) it will be seen that after the eggs are laid, the reproductive organs disappear and the process of fission soon reduces the adults to such proportions that they are indistinguishable from the rapidly growing young. Presumably, the end products of asexual multiplication, being otherwise indistinguishable from the embryos of any year, will develop their reproductive organs in the same way, but until the two have been isolated and reared there is of course no way of certainly ascertaining this. The following description is based upon specimens taken from sexual localities in the fall, and I have no way of telling what has been the previous history of any of them. However, the study of some twenty-five or thirty specimens which had been cut into serial sections did not bring to light anything which led me to suspect two courses of development, one for the egg-embryo worms and another for those which are the end products of a season of asexual multiplication.

In September, of 1899, I collected small specimens from 5 to 8 mm. long in the vicinity of Baltimore, which upon examination showed their reproductive organs just developing. These stages have since been supplemented by specimens from the same locality and from the Falmouth ponds in the fall of 1900.

The first indication of the developing reproductive organs is the appearance in the parenchyma, along a line just above either nerve cord, of rounded or cord-like masses of cells. Formative cells such as have been previously described (pl. 15, fig. 41; pl. 16, fig. 43, *s*) are abundant in this region and their frequent mitotic figures show that they are multiplying rapidly. Such a mass or cord of cells is shown in figure 46 (plate 16) as it lies surrounded by the parenchyma. At this early stage there can be no question that these masses are made up of formative cells. At a slightly later stage, when one can distinguish the incipient testes (pl. 16, fig. 47) from the cords which are to form the yolk glands (pl. 16, fig. 44), the cell outlines are no longer visible, and although the general shape of the nuclei with the characteristic nucleoli (pl. 16, fig. 44–47) is the same as that found in the formative cells (pl. 16, fig. 43; pl. 15, fig. 41), this alone would not be sufficient to establish the origin of the male and female elements from the formative cells. It is the abundance of such stages as figure 46 (plate 16) represents which demonstrates beyond question the origin of the testes and yolk glands from the formative cells of the ventral region.

The stages by which the solid rudiments of the testes (pl. 16, figs. 47, 48) produce the mature organs by the division of the cells lying toward the center (fig. 48) have been repeatedly mentioned by other workers. When the testis first becomes distinct as such (fig. 47), the cell outlines cannot be satisfactorily made out except in the dividing or reconstructing cells (fig. 48) toward the center. It is the same in the case of the incipient yolk glands, but these from the time they can be distinguished as yolk glands are found with two kinds of nuclei (pl. 16, fig. 44). In the yolk gland rudiments it is as though the cytoplasm of the smaller cells were making a stroma in which to swing the large nuclei. A similar condition is noticed in the adult ovary (pl. 17, fig. 52). At the time the testes are distinguishable as many spheres of cells (pl. 16, figs. 47, 48) lying along on either side of the body (pl. 18, fig. 53) the ovary can be distinguished just in front of the most anterior testis and is quite characteristic in its appearance (pl. 17, fig. 49). I believe that the ova arise from formative cells though they show their characteristic nuclei so early that their origin is not as evident as in the case of the testes and yolk glands (pl. 16, fig. 46). At the stage shown in figure 49 (plate 17) there are already, among the young ova, smaller nuclei (*ctn*) and these I consider homologous with the smaller nuclei found throughout the connective tissue framework of the adult ovary (pl. 17, fig. 52, *ctn*).

The development of the different elements of the reproductive system in relation to one another is shown by the diagrammatic figures, 53, 54, 55 (plate 18), 56 (plate 19). Figure 53 represents a stage at which the ovaries (*o*) and the testes (*t*) can be distinguished. There is as yet no sign of any atrium. At a stage slightly older than the above (fig. 54) there appears in the region of the genital atrium a cleft in the parenchyma (pl. 19, fig. 57; pl. 16, fig. 45). This is preceded by a noticeable collecting of parenchyma nuclei at this spot (pl. 16, fig. 45, *n*), but I have not found stages which establish the origin of these from formative cells. Lining the cleft, an epithelium is formed. In this stage there is present along the line of the future oviduct, a long cord of cells a portion of which is shown in figure 44 (plate 16). This extends from the region of the ovary backward above the nerve cord past the beginning of the atrium and well down into the tail. There are at this time no other cell cords of this sort in any part of the worm except close alongside and connecting with this main stem in places where it is double for a short distance. Such a stage might be represented by a diagram like figure 54 (plate 18).

Following this, there are to be found along the line of each oviduct (pl. 18, fig. 55) many cords of cells seeming to have grown out from the original one ; at any rate they are connected with it. I can only conjecture how the oviduct is formed as I have not found any interpretable stages. The occurrence of the cord of cells such as is shown in figures 44 (plate 16) and 54 (plate 18), in just the position where the oviduct subsequently appears, suggests that this cell cord is in some way transformed into the oviduct. It has occurred to me that such a thing might come about by the migration of the large cells (pl. 16, fig. 44) out from the main axis leaving the smaller nuclei embedded in their own fused cytoplasm, which subsequently becomes hollowed out to form the oviduct. The masses of larger cells would then remain connected with this as the finger-like processes of the young yolk glands (pl. 18, fig. 55) are later connected with the newly formed oviducts. In *Planaria simplissima*, I showed (:00a) that the yolk glands originated as outgrowths from the oviducts, and this makes more plausible the origin of the oviduct in *P. maculata* in the manner I have just suggested.

While I have not succeeded in ascertaining the histological processes by which the oviducts are formed, they are laid down close to, if not exactly along, the main axes of the cell cords shown in figure 54 (plate 18) during the time that the young yolk glands (pl. 18, fig. 55, *y*) are appearing. An unquestionable oviduct is found in the stage which figure 55 represents, and posterior to the rudiments of the atrium this newly formed oviduct is continuous with a cord of cells such as in the earlier stage (pl. 18, fig. 54) extended from the ovary to the tail. The original cords of cells are no longer found in the area occupied by the oviducts. This suggests that the cord of cells shown in figure 54 has in some way been transformed into the oviduct over most of its length. In figure 55, the atrium is found far enough developed to have the different parts clearly marked.

In the next figure (pl. 19, fig. 56), which is practically adult, there remains, stretching down into the tail upon either side, a branching rod of cells which is destined to become the yolk glands of the posterior end. It can be readily traced with its branches as indicated in the diagram and becomes continuous with the oviduct where the latter bends inward to reach the common oviduct. The cavity of the uterus has increased in size, the lumen of the penis opens to the outside and the atrial pore has appeared. This is the adult condition, save that the vasa deferentia are not connected with the penis lumen. The yolk glands are much larger than before and at frequent intervals pass from the oviduct up between the gut lobes. No mention has been made in the above of the condition of the ovaries and testes, for they have not changed greatly. Both are larger than at first, the ovaries with more large ova, the testes with their cavities containing spermatids of all sizes. Connecting the vasa deferentia with the penis, the adult condition is reached (pl. 12, figs. 33, 34).

The stages in the development of the atrial organs can be best shown by a series of diagrams representing them as seen from the side. Figure 57 (plate 19) shows at *a* the primary cavity in the parenchyma lined with epithelium (pl. 16, fig. 45). This cavity takes on the shape shown in figure 58 (plate 19) in which the uterus (*u*) is indicated and the position of the penis (*p*) shown by an irregular fold. The portion which will later connect with the outside is also seen. The cavity (pl. 19, fig. 59) assumes more and more the contour of the adult atrium by the further development of the penis, in which a lumen appears, and the development of the common oviduct (*co*). In later stages the developing oviduct of each side grows out to unite with the common oviduct, as shown in figure 56 (plate 19), and the penis lumen opens on the free end of the penis, but the connection of the vasa deferentia with the penis does not occur until considerably later.

The development of these organs shows that there are two distinct parts, (1) the germ cells and (2) the accessory organs about the atrium. The two originate separately and later become connected with one another. There are laid down two cords of cells extending from the ovaries well back into the tail. Anteriorly, in the position of these cords, the oviducts appear, while back of the atrium the cords remain the same and become yolk glands. So far as I can make out, the yolk glands arise as outgrowths of this primary rod of cells. The organs of the atrium begin as a cleft in the parenchyma which gradually becomes differentiated into the several parts. The testes, ovaries, and oviducts with the connecting yolk glands arise in the same place that they occupy in the adult, save that with their increasing size the yolk glands extend up between the gut lobes and so take possession of the dorsal region. So far as I can see, there is no particular area from which the yolk glands develop, as is the case, according to Woodworth's description, in *Phagocata gracilis.*

A Note on the Earlier Embryology of *Planaria maculata.*

In following through the earlier embryology of *P. maculata*, I have not found that it offers any important difference from the descriptions of other species given by Ijima ('84) and Hallez ('79) save in one particular. This relates to the development of the pharynx and is explained in figure 51 (plate 17). This figure represents an embryo which has taken up all the available yolk cells through its embryonic pharynx and larval mouth (*ph'* and *lmo*). This yolk (*yo*) is seen within as a mass of disintegrating cells with nuclei. When the taking up of the yolk is just completed, the embryo is spherical with its embryonic pharynx at one side, a stage which text book figures have made familiar to every one. The definite endodermal layer, which could at first be distinguished, can no longer be made out and the wall of the embryo seems to consist of a greatly flattened ectoderm (*ec*) and, closely applied to the inner side of this, scattered mesenchyme cells representing the endoderm and mesoderm. This spherical embryo of *P. maculata* flattens down as is shown in figure 51, and the inner cells increase in number along what is destined to become the ventral side of the adult. Posteriorly a mass (*ph'*) of these cells is especially noticeable and this becomes the adult pharynx by the process which has been often described. It will be seen that the lower flat side of the embryo of figure 51 represents the ventral surface of the adult and that the larval mouth (*lmo*) which leads through the larval pharynx into the gut cavity is on the future dorsal surface. This point has seemed to me worth noting, since from the descriptions of Ijima and Hallez the larval pharynx seems to open on that side of the embryo which becomes the ventral side of the adult and to have its longitudinal axis correspond to the vertical axis of the adult. Ijima's figure 28 of plate 23 is a diagrammatic representation of almost the same stage as my figure 51, save that his figure shows a mass of ento-mesoderm cells over the area covered in my figure by the embryonic pharynx. As he especially states that all trace of the embryonic pharynx disappears before the adult pharynx begins, I think it not unlikely that he may have been mistaken in supposing that the place of the new pharynx was identical with that of the embryonic one, and that the embryonic pharynx of *Dendrocoelum lacteum* may lie at the point indicated by the mass of cells in Ijima's figure, which is identical with the point at which it is found still persisting in *P. maculata.*

The exact position would be hard to establish in *Dendrocoelum lacteum* since the first pharynx disappears before the second can be distinguished, but in *P. maculata* where both occur together, their relative positions can be at once determined, and since it would be rather strange to have such an entirely different relation in forms so nearly alike in all their general structure as the planarians, I believe the mass of cells indicated at this position in Ijima's figure may also mark the location of the embryonic pharynx in *Dendrocoelum lacteum.*

SUMMARY.

Specimens of this planarian collected from several localities and resembling each other so closely that one can hardly believe they are even different varieties of *Planaria maculata*, show considerable differences in their life histories. In some localities the species seems to have reproduced exclusively, so far as the observations go, by fission, in others only by the sexual process, while there are still others where both processes occur at different seasons. A possible explanation of this is that the reproduction by fission may replace the sexual reproduction for a term of years though the time (three years) over which my observations extended is not sufficient to establish this fully.

The characteristic feature of the normal fission occurring in this form is that it takes place without the previous appearance of any furrow at the place of division and without any previous development of the new organs necessary for two complete planarians. Hence there is produced the same appearance as in a specimen artificially cut in two at a definite point behind the pharynx.

From a study of the histological details in the regeneration after the normal fission I can find no evidence that the new parts develop by the transformation of highly organized cells to a simpler type which produces the new organs. My whole evidence would rather indicate that there exist in the parenchyma certain individual cells which can be distinguished from the parenchyma proper and that these are responsible for the new parts in regeneration and also for the sex cells of the reproductive organs. The exact nature of the histological changes concerned in the regeneration is, however, an extremely difficult one upon which to obtain absolutely unquestionable data.

The structure of the mature reproductive organs of this planarian is here described for the first time.

The development of the reproductive organs is also described, the facts of which are summarized in the paragraph on page 554.

A note is given on a stage in the embryology of this form to show that the adult pharynx does not originate at the place where the embryonic pharynx degenerates.

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EXPLANATION OF PLATES.

Abbreviations.

a. atrium.
aep′. epithelium of young atrium.
c′. cavity lined with epithelium at position of old atrium.
co. common oviduct.
ct. connective tissue stroma of ovary.
ctn. nuclei of this stroma.
ds. zone of formative cells in the dorsal region.
ec. ectoderm.
ec′. young ectoderm.
ep. epithelium.
g. gut.
gl. gland cells.
gp. genital pore.
k. mitotic figure.
lm. larval mouth.
m. mouth.
mf. muscle fiber.
n. nuclei.
ne. nerve.
np. nuclei of the parenchyma proper.
o. ovary.
od. oviduct.
oy. cord of cells along line of future oviduct.
p. penis.
pa. parenchyma.
ph. pharynx.
ph′. young pharynx.
phl′. pharyngeal lumen.
pl. penis lumen.
ps. pharyngeal sheath.
r. rhabdites.
s. formative cells, ("Stammzellen" of Keller).
t. testes.
u. uterus.
v. vacuole.
va. vagina.
vd. vas deferens.
x. masses of cells found principally in dorsal region.
y. yolk glands.
yo. yolk within embryo.

PLATE 9.

(The figures on this plate were drawn from the live specimens increased 20 diameters. They have been reduced three fourths in the reproduction.)

Figs. 1, 2. A tail piece of *P. maculata* from the dorsal aspect a few hours after the normal fission. Figure 1 shows the anterior end drawn together as it is when the animal is at rest. Figure 2 shows the condition when the piece is moving actively about. The pigment flecks are shown only at the anterior end and also the outline of the gut.

Fig. 3–7. Represent the same specimen as figure 2 on the five days following the day of fission. In figure 4 the eyes are beginning. In figure 5 the gut rami have united anteriorly and the rudiment of the pharynx can be distinguished. In figure 6 the development of the new median anterior gut ramus has progressed quite far but the gut is not shown in the posterior end of the specimen. In figure 7 the head is well formed, but the pharynx, which is shown without the gut, is still too far forward.

Fig. 8. A worm developed from a tail piece like figure 2, as it appeared the 8th day after the normal fission.

Figs. 9, 10. A tail piece of *P. maculata* the third day after its normal fission and again on the 19th day to show the change of proportions. In figure 10 the gut is not shown.

Fig. 11. The outline of the posterior end of a head piece of *P. maculata* on the day of normal fission and drawn over this the outlines (2, 3, 4, 5, 6, 7) on the six succeeding days.

Fig. 12. A tail piece on the day after the normal fission, showing a peculiar condition of the right gut ramus.

Figs. 13, 14. A tail piece on the day after fission and again on the third day after, to show remodeling of the gut.

Fig. 15. The anterior end of a tail piece on the day after normal fission as it appears when fully expanded.

Fig. 16–18. The same tail piece on the 3d, 4th, and 5th days after normal fission.

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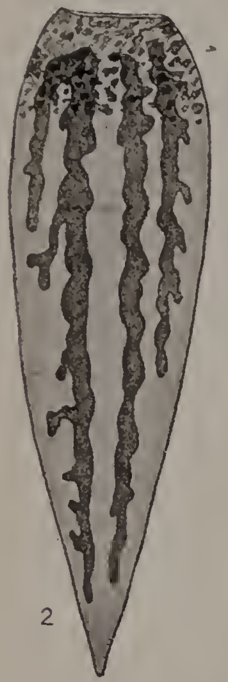

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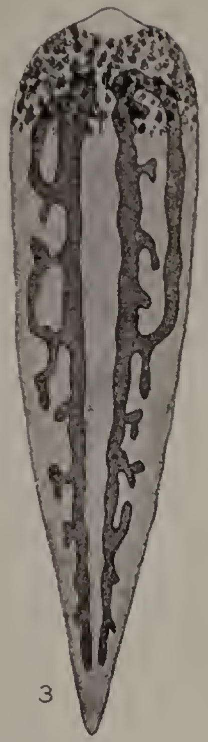

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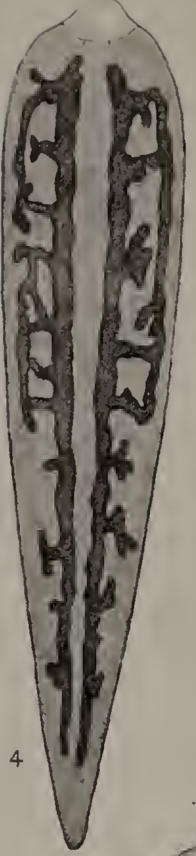

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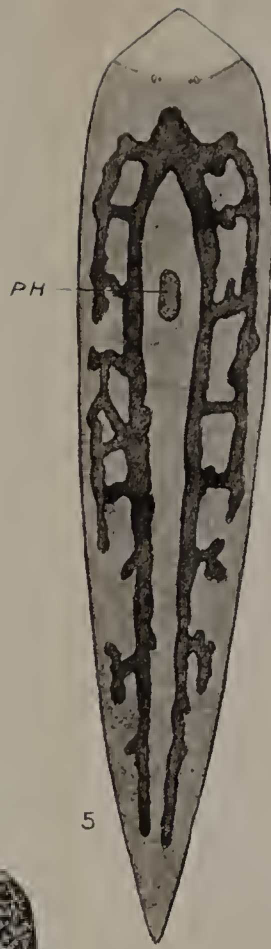

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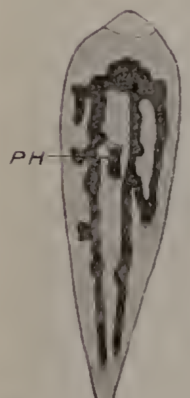

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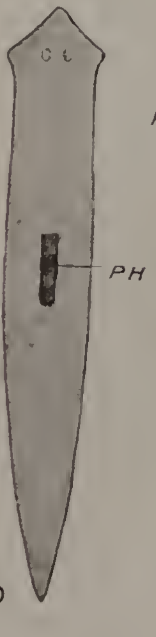

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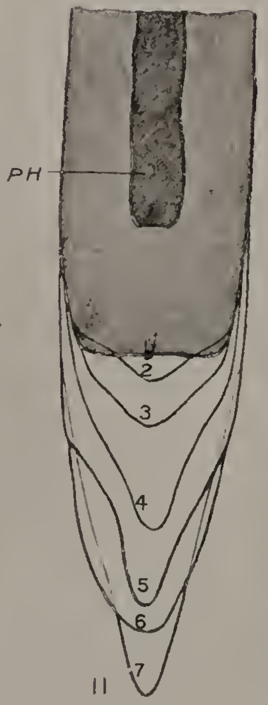

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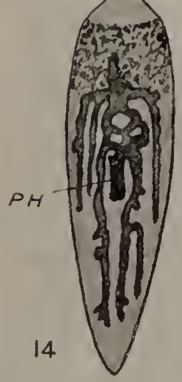

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PLATE 10.

(All the figures are again from living specimens drawn increased 20 diameters but are reduced two thirds in the reproduction.)

Fig. 19. A head piece of *P. maculata* a few hours after normal fission, showing the cut expanded as it is when the animal moves about. The gut is shown only in the region of the pharynx.

Figs. 20, 21. The same specimen as is shown in figure 2–7 redivided on the eighth day after the condition shown in figure 2.

Fig. 22. A normally proportioned *P. maculata* just before normal fission.

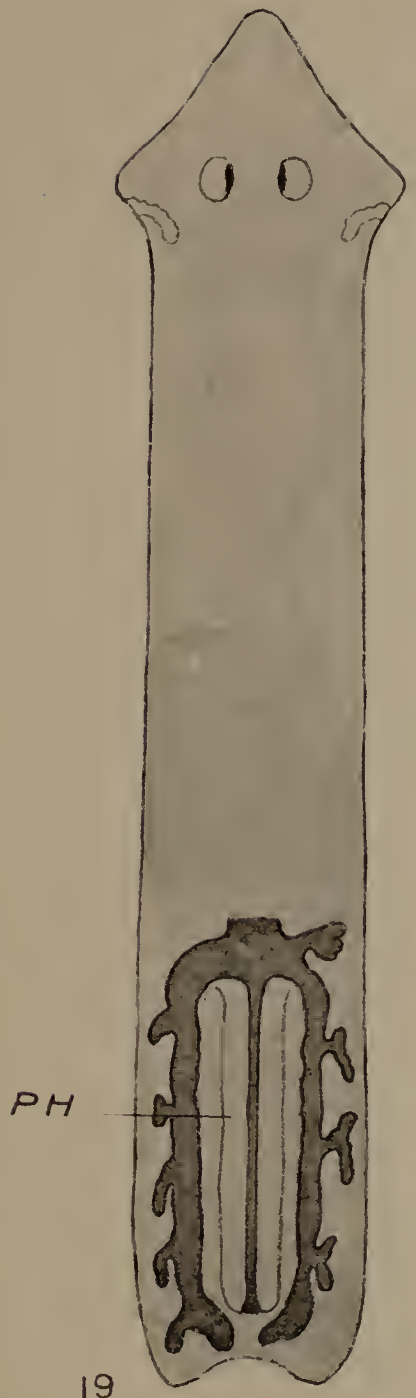
Fig. 23. A specimen to show bizarre branching of the gut.

Fig. 26. The posterior end of figure 19 as it appears contracted when the animal is at rest.

Fig. 27. The posterior end of a head piece on the day after normal fission.

Fig. 28. The posterior end of the same specimen as shown in figure 19 on the second day after the fission.

Fig. 29. The same on the 4th day.



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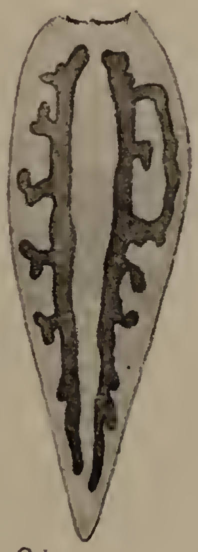

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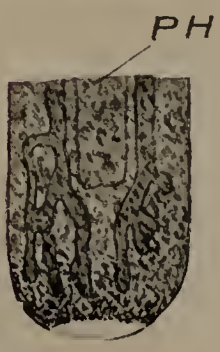

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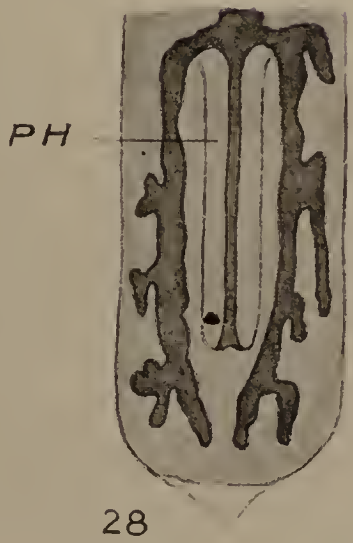

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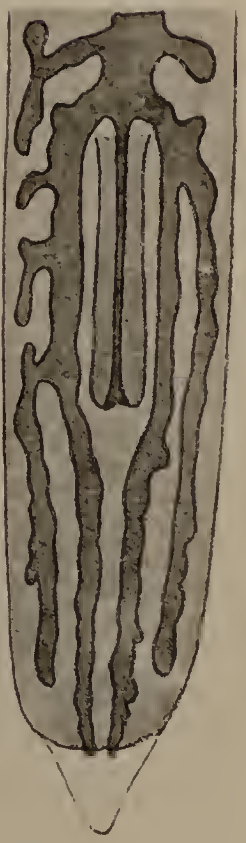

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Heliotype Co, Boston.

PLATE 11.

(All the figures of this plate are drawn from the living specimens increased 20 diameters, but are reduced two thirds in the reproduction.)

Figs. 24, 25. Represent the specimen shown in figure 22, just after it divided two hours later. In figure 24 the gut is shown only in the region of the pharynx.

Fig. 30. The same specimen as shown in figure 19 on the 10th day, the gut not being shown.

Fig. 31. A specimen with bizarre branching of the gut.

Fig. 32. The outline of the specimen shown in figures 19, 28, 29, and 30, which 17 days after the condition shown in figure 19 has reached normal proportions. The outline of the gut could not be made out. This figure will also illustrate the outline of a normal *P. maculata.*

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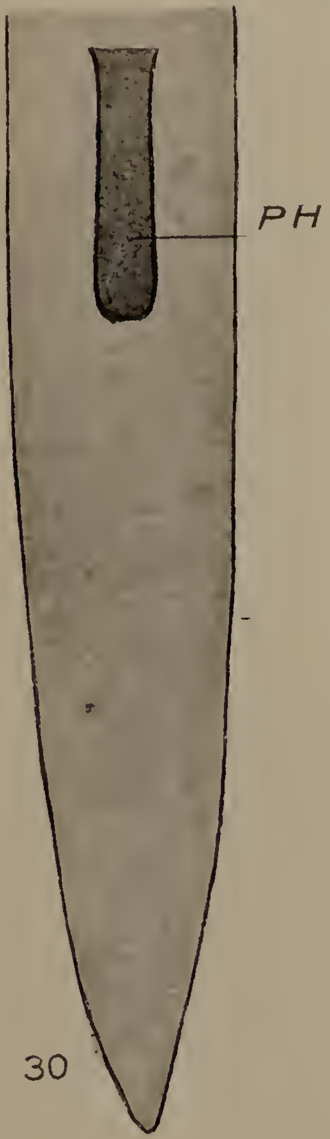

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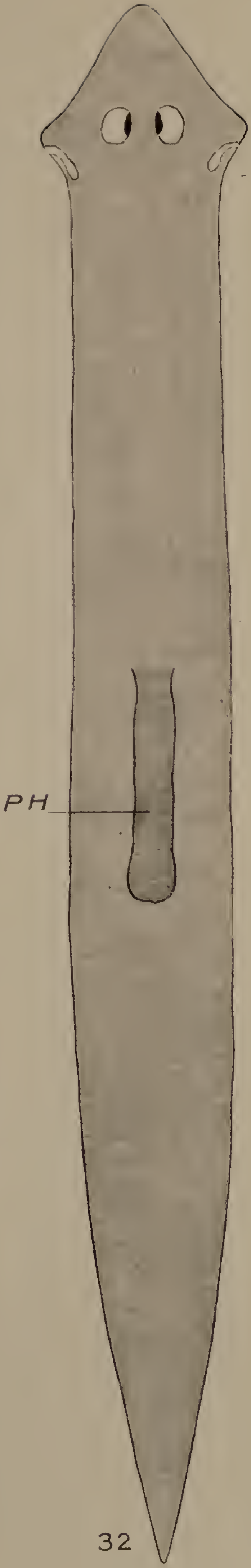

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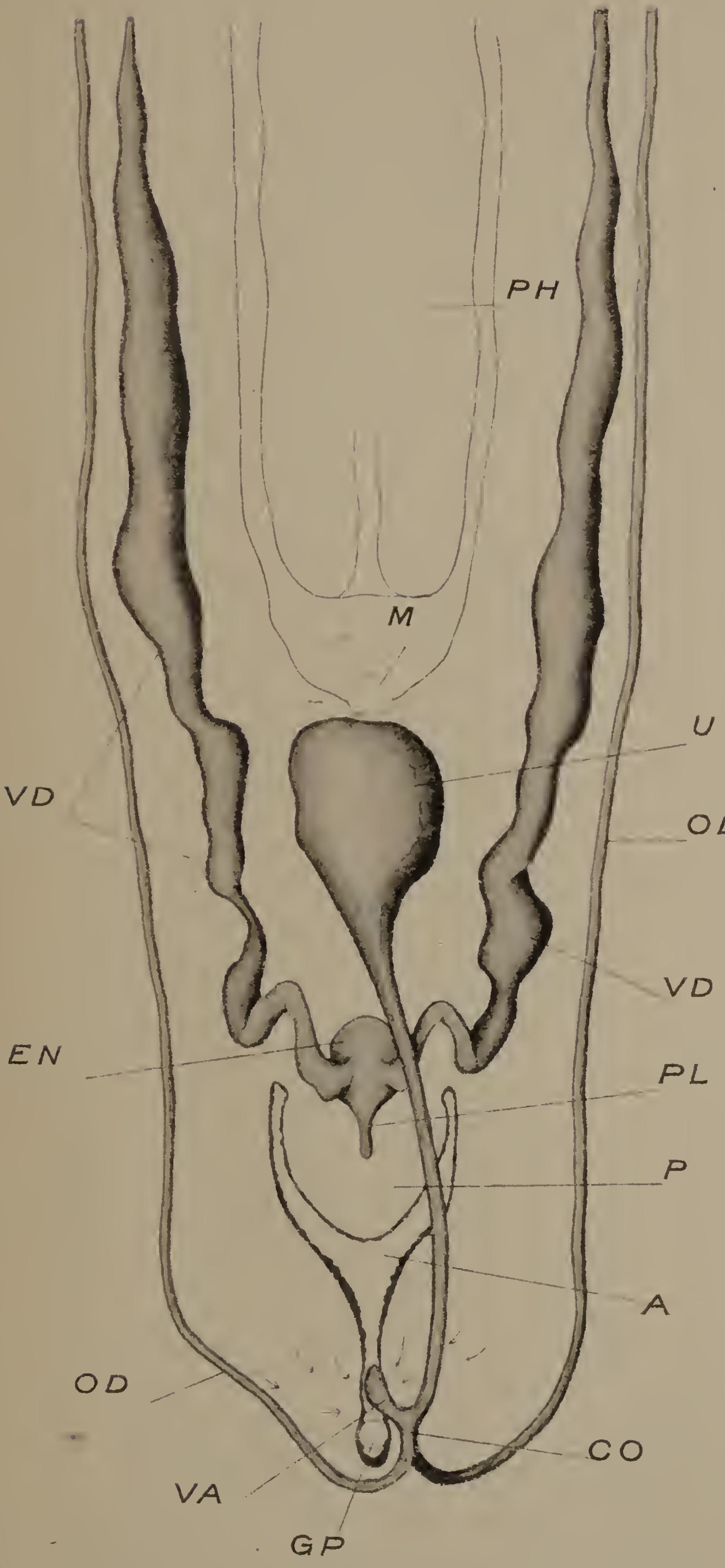
Heliotype Co, Boston.

PLATE 12.

(The figures are drawn from a reconstruction of a series of transverse sections and reduced two thirds in the reproduction.)

Fig. 33. The atrial organs of *P. maculata* and the ducts leading to them, from the dorsal aspect. The pharynx is shown in outline. The unicellular glands leading into the vagina are indicated by the arrows. The oviduct is drawn without its connecting yolk glands. Zeiss A × 2.

Fig. 34. The same from the right side. The oviduct and vas deferens of the left side are omitted. Zeiss A × 2.



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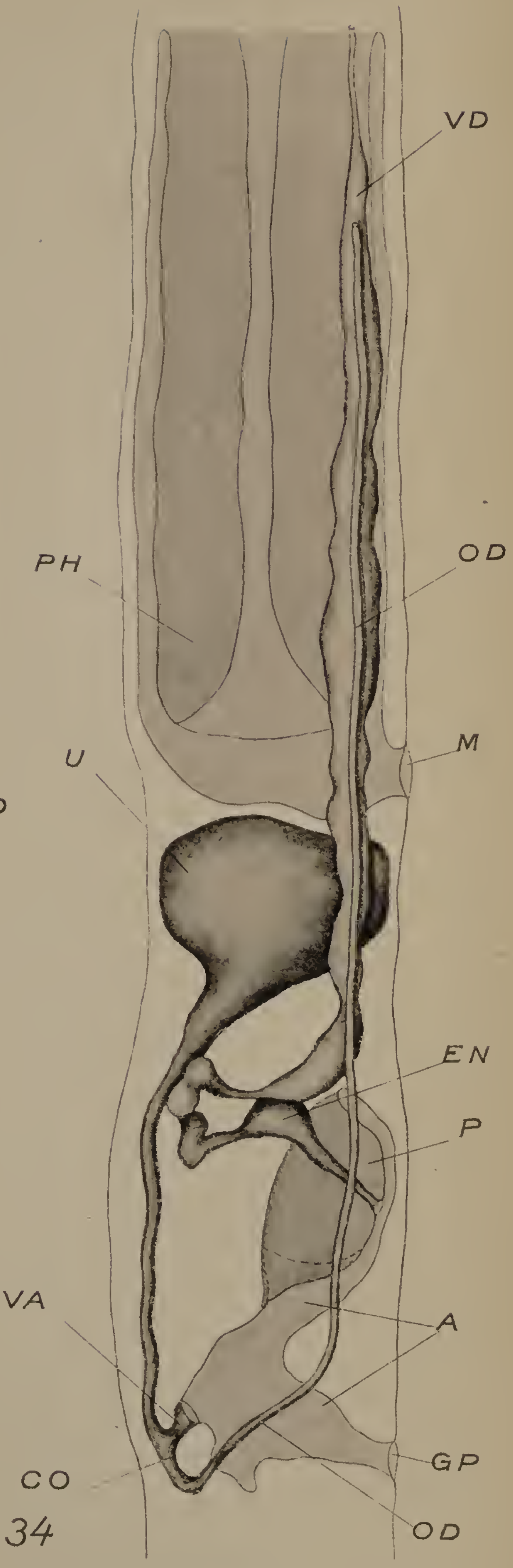

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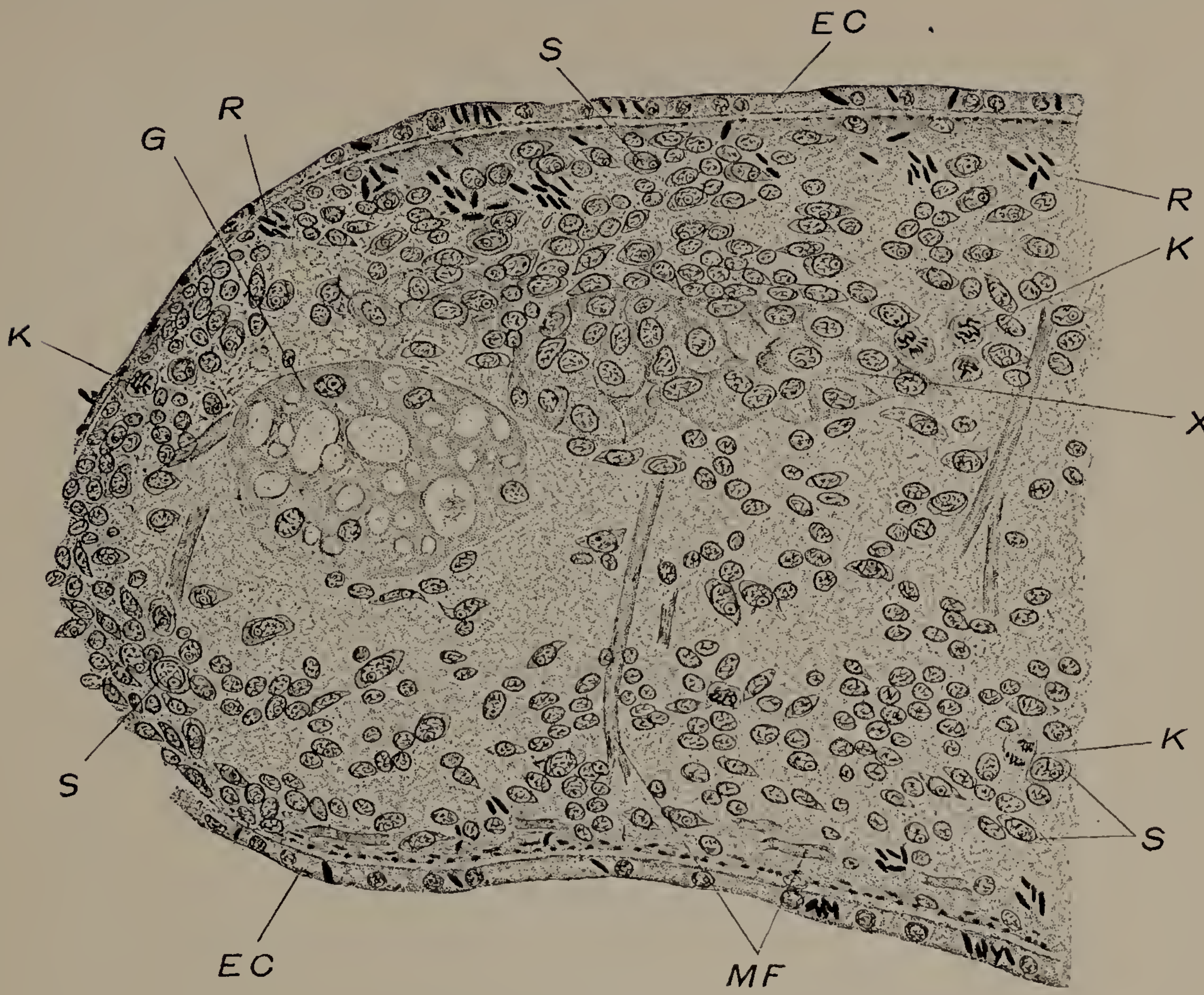
Heliotype Co, Boston.

PLATE 13.

(The figures are from camera lucida outlines of sections and are reduced three fourths in the reproduction.)

Fig. 35. A sagittal section through the anterior portion of a tail piece a few hours after its normal fission (see figure 2 which represents the external features of such a piece). The parenchyma is seen to be naked at the cut surface. The anterior end is to the left. Zeiss D × 2.

Fig. 36. A sagittal section through the anterior end of a tail piece on the day following fission (see figure 3). At the naked end is to be seen what is interpreted as the production of the new ectoderm (*ec′*) by formative cells. The anterior is to the left. Zeiss D × 2.



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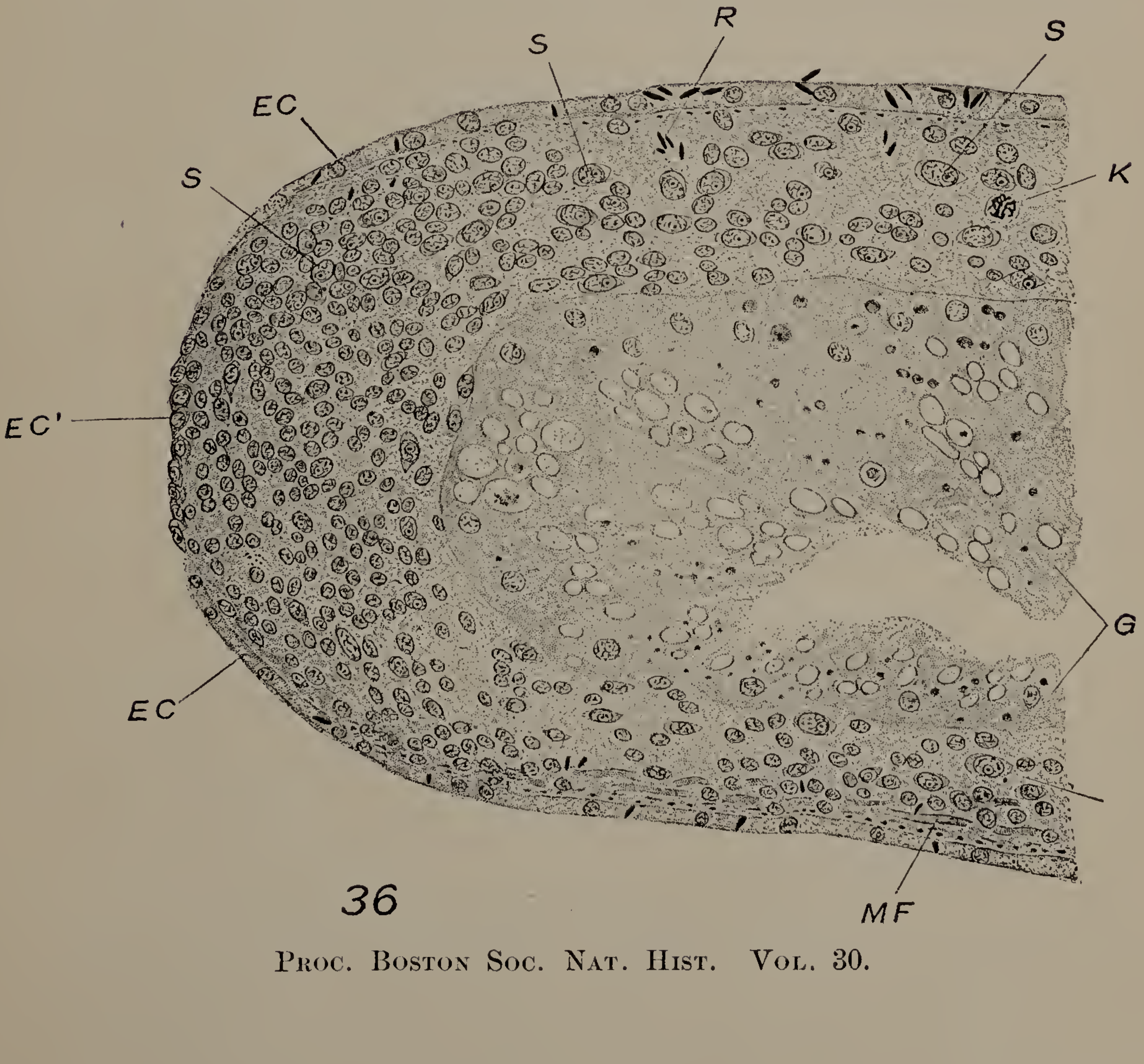

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PLATE 14.

(The figures are from camera lucida outlines of sections and are reduced three fourths in the reproduction.)

Fig. 37. A sagittal section through the anterior end of a tail piece on the fourth day (figure 14). The essential structure of the adult head has been reached, there being now almost no formative cells anterior to the brain (*n*). The anterior is to the left. Zeiss D × 2.

Fig. 38. From a sagittal section of a young tail piece (see figure 2). The part of the section drawn lies about in the middle of the animal and shows the excess of formative cells with frequent mitotic figures in the dorsal region. The anterior end is to the left. Zeiss D × 2.

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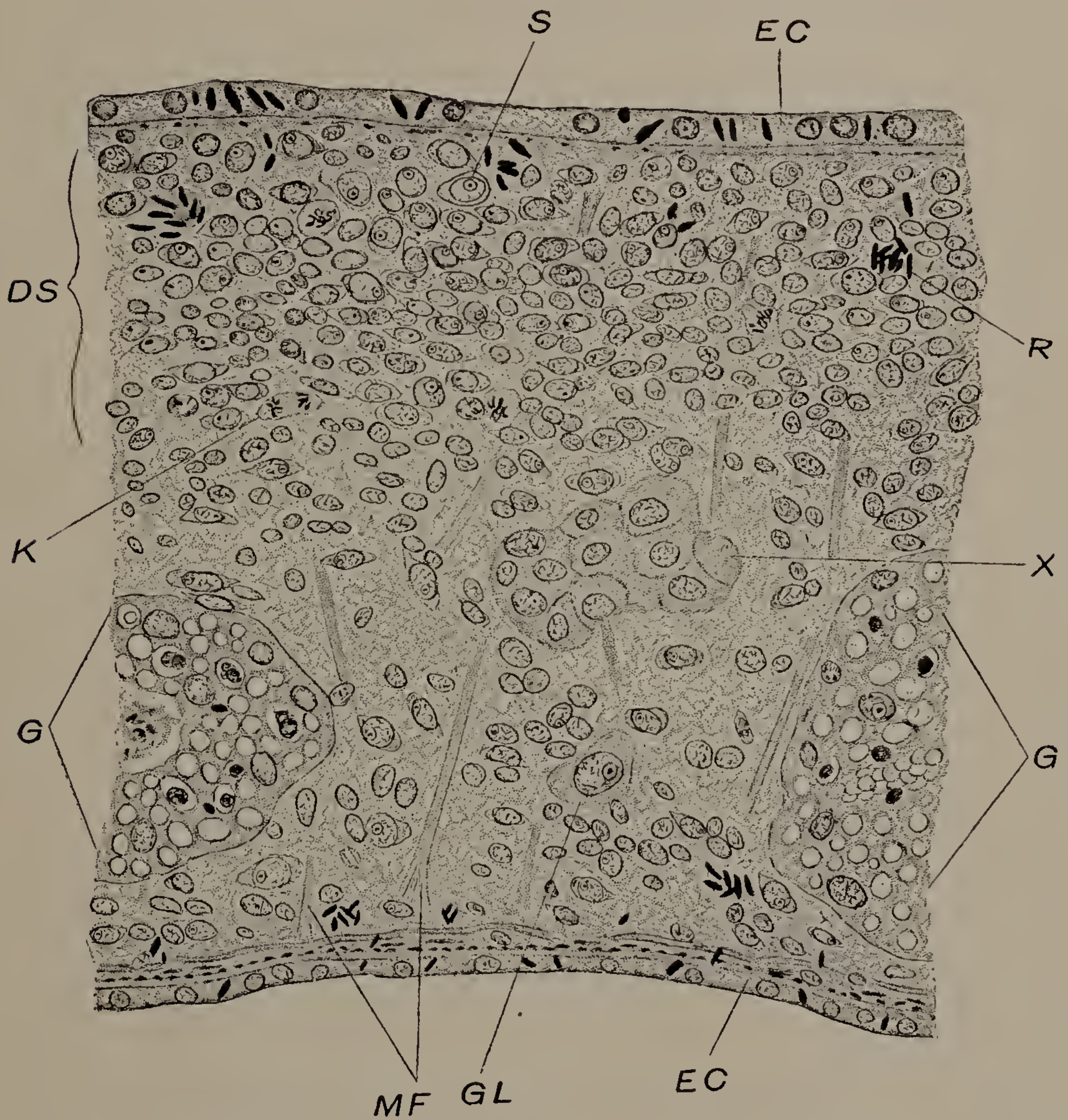

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PLATE 15.

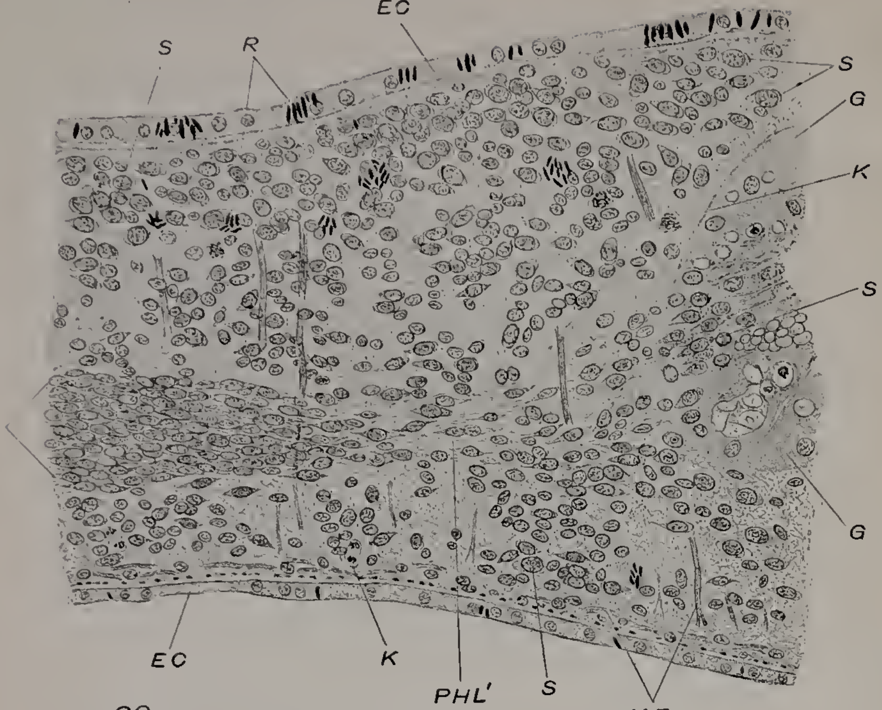
(The figures are from camera lucida outlines of sections and are reduced two thirds in the reproduction.)

Fig. 39. From a sagittal section of a tail piece on the 3d day. The part shown is in the region of the newly formed anterior gut ramus and the rudiment of the pharynx (see figure 5). Only the anterior half of the mass of cells (*ph'*) destined to form the pharynx is shown. The anterior end is to the right. Zeiss D × 2.

Fig. 40. A similar section through the region of the newly formed pharynx. The sheath (*ps*) is formed, but the mouth has not broken through (see figure 19). The lumen of the pharynx (*phl'*) is just appearing. The anterior is to the left. Zeiss D × 2.

Fig. 41. A sagittal section through the anterior tip of the new median gut ramus of a tail piece (see figure 5) to show the close association of the formative cells (*s*) with the gut (*g*) at this point. The anterior is to the right. Zeiss $\frac{1}{12}$ × 2.

Fig. 42. A sagittal section through the tip of new tissue on a tail piece (figure 4) of the 3d day. The new ectoderm is formed and in place of the large formative cells of the first day (figure 35) are found many smaller nuclei with no distinct cytoplasmic outline. The anterior is to the right. Zeiss D × 2.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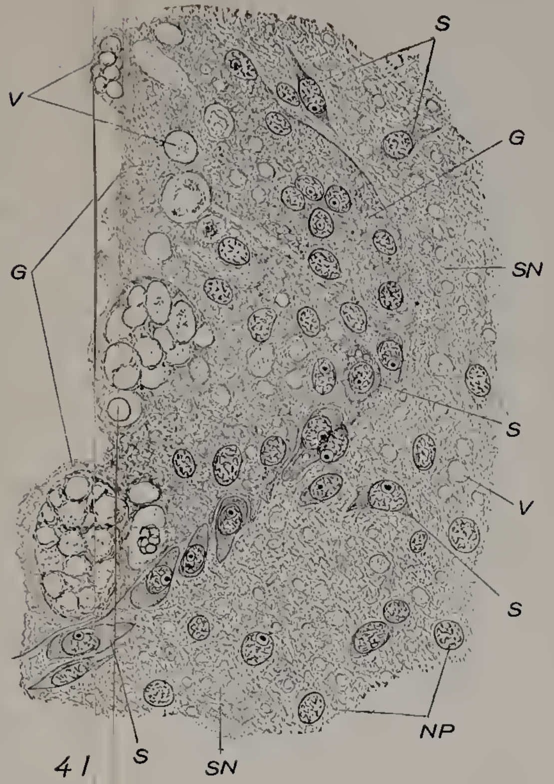
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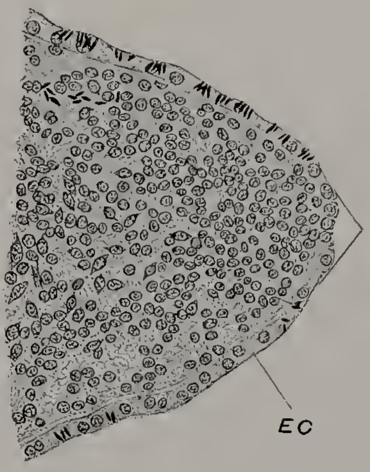
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PLATE 16.

(The figures are from camera lucida drawings of sections reduced five sixths in reproduction.)

Fig. 43. The parenchyma of *P. maculata* showing formative cells (*s*) and the nuclei of the parenchyma proper (*np*). Zeiss $\frac{1}{12} \times 2$.

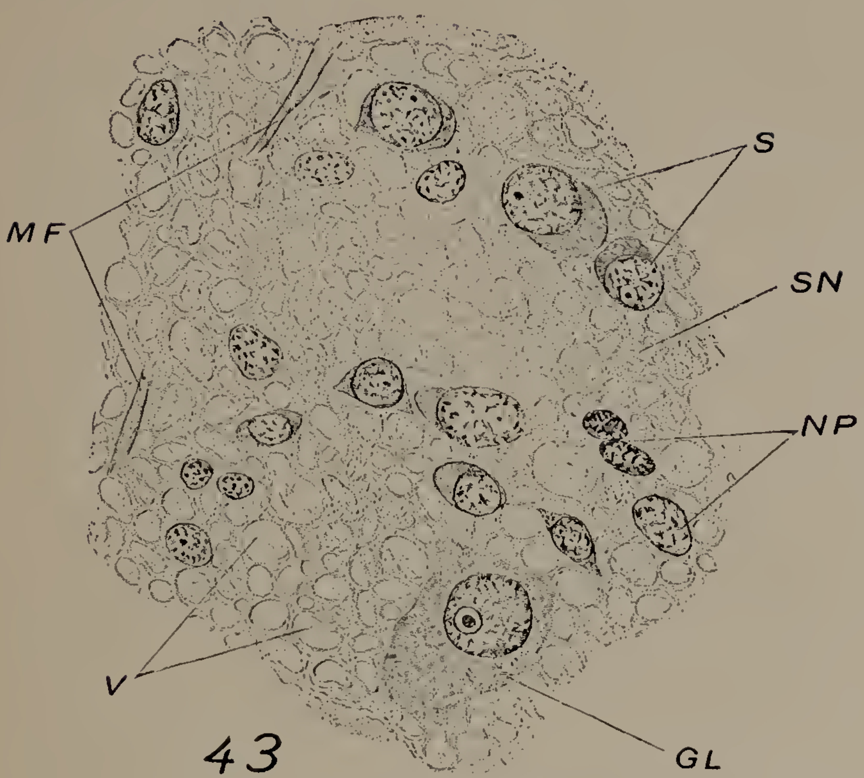
Fig. 44. Portion of the cord of cells which is found lying along above either nerve cord from the ovaries well down into the tail, as in the stage of development represented by figure 54. The surrounding parenchyma is not shown. Zeiss $\frac{1}{12} \times 2$.

Fig. 45. A transverse section through the atrial cavity just after it can be distinguished as such (see figures 54 and 57). The surrounding parenchyma is shown. Zeiss $\frac{1}{12} \times 2$.

Fig. 46. A longitudinal section through one of the short cords of cells which are the first sign of the developing sex cells. The surrounding parenchyma is shown. The cord is evidently composed of formative cells. The reproduction of this figure has made the cytoplasm of these cells less distinct than was intended. Zeiss $\frac{1}{12} \times 2$.

Fig. 47. Section through one of the short cell cords which is now sufficiently advanced to be distinguished as a testis. Zeiss $\frac{1}{12} \times 2$.

Fig. 48. The same at a slightly later stage. Zeiss $\frac{1}{12} \times 2$.



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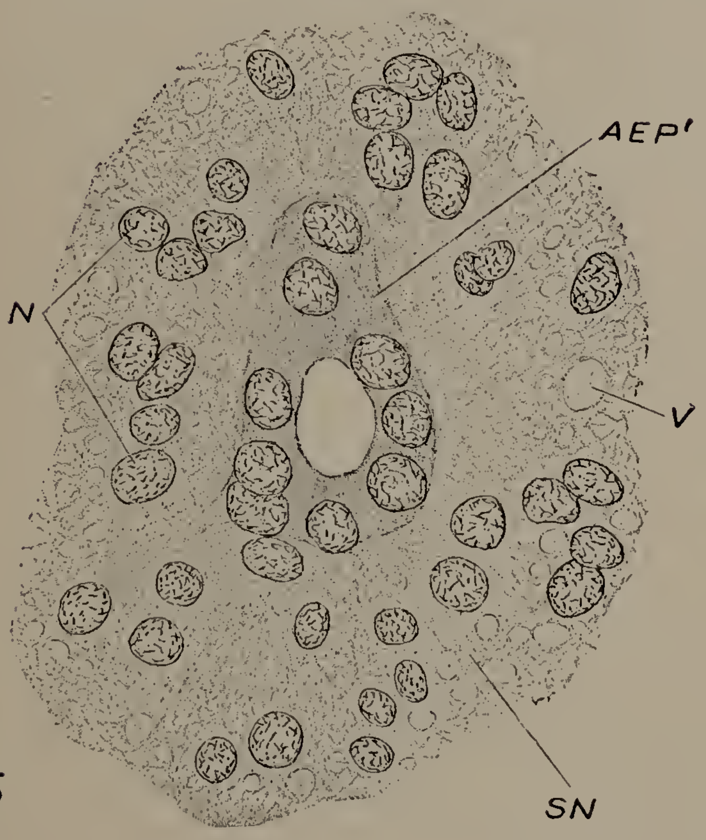

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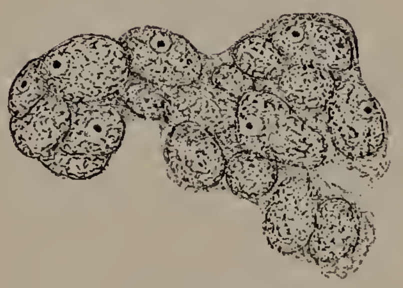

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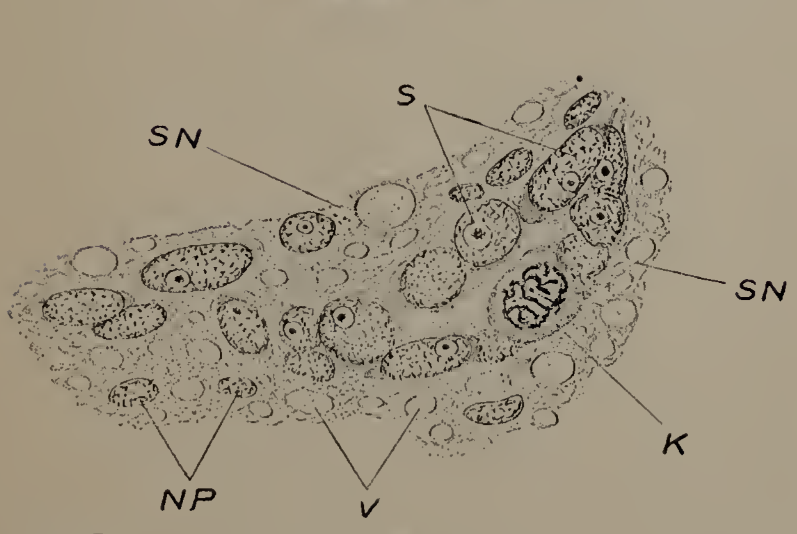

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PLATE 17.

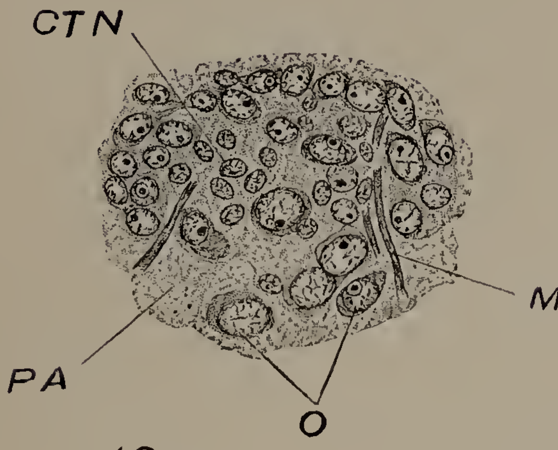
(The figures of this plate are from camera lucida drawings of sections and were not reduced in the reproduction.)

Fig. 49. A section through a young ovary just after it is distinguishable as such (see figure 53). The ova (*o*) are shown surrounded by the parenchyma and among them are nuclei (*ctn*) which are probably homologous with the nuclei of the supporting stroma of later stages. Zeiss D × 2.

Fig. 50. A section through an ovary of an adult worm which has finished its reproductive season and in which all parts of the reproductive organs have disappeared except the ovaries and a remnant of the atrium. Zeiss D × 2.

Fig. 51. A sagittal section through a larva of *P. maculata* at the stage when the adult pharynx (*ph*) is just forming. To show the relation of this to the embryonic pharynx (*ph'*). Zeiss A × 2.

Fig. 52. A section through the adult ovary of a *P. maculata*, showing ripe ova ready to pass into the oviduct, the wall of which is cut through (*od*).



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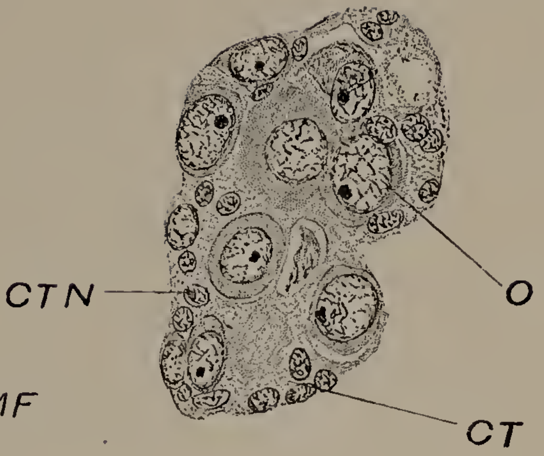

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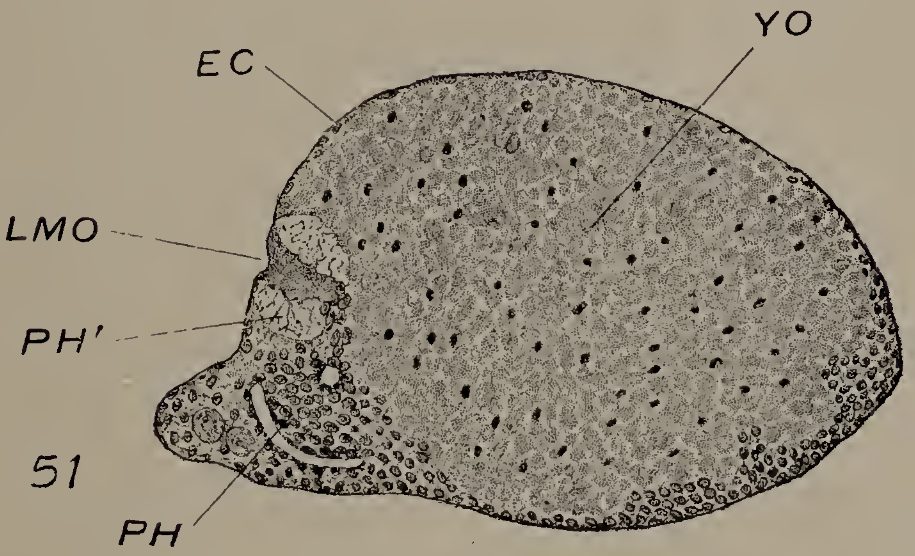

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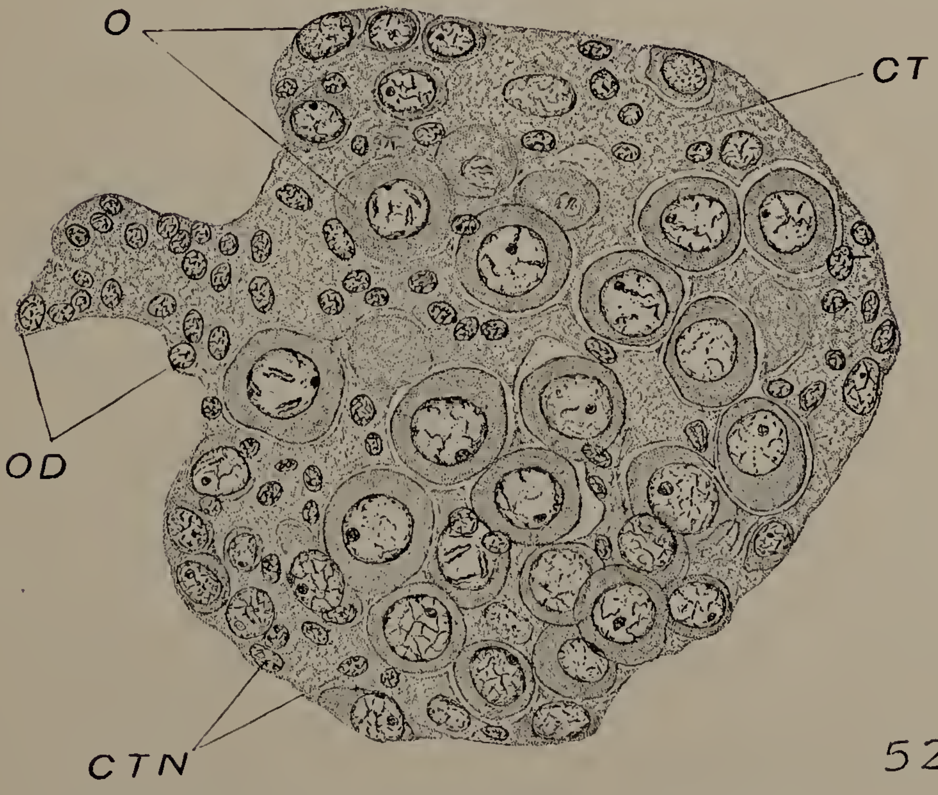

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PLATE 18.

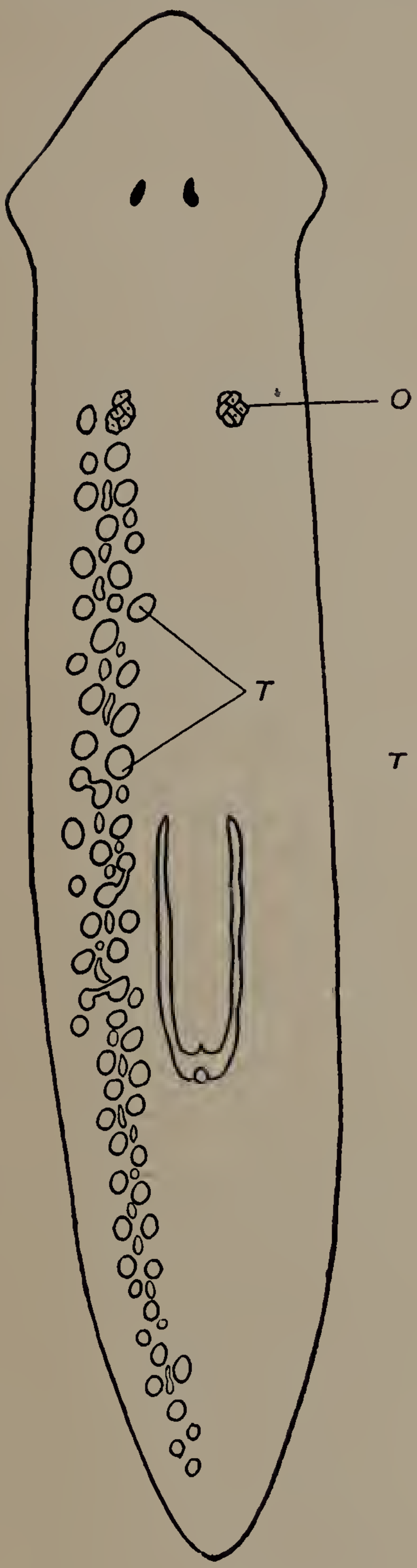
(The figures of this plate are reduced two thirds in the reproduction.)

Fig. 53. A semi-diagrammatic figure of an early stage in the development of the reproductive organs. Outlines of body, ovaries, and testes from a camera drawing of a whole preparation. The testes are only shown on one side. Zeiss A * × 4.

Fig. 54. Semi-diagrammatic figure constructed in the same way as the last, of a stage in which the atrium (*a*) is just appearing and the cord of cells (*oy*) has just appeared along the line of the future oviduct. Zeiss A * × 4.

Fig. 55. Semi-diagrammatic figure like the last, of a stage at which the oviduct has appeared along the line where the cord of cells previously lay, while with it are connected the incipient yolk glands (*y*). The parts of the atrium can be seen and also portions of the vasa deferentia, but the connections of the vasa deferentia and oviducts with the atrium have not been attained. Zeiss A * × 4.

Fig. 60. Outline of the organs appearing in a transverse section of a sexually mature **P.** *maculata*, taken midway between the pharynx and the ovaries to show the lateral and vertical extent of testes and yolk glands. Zeiss A × 1.



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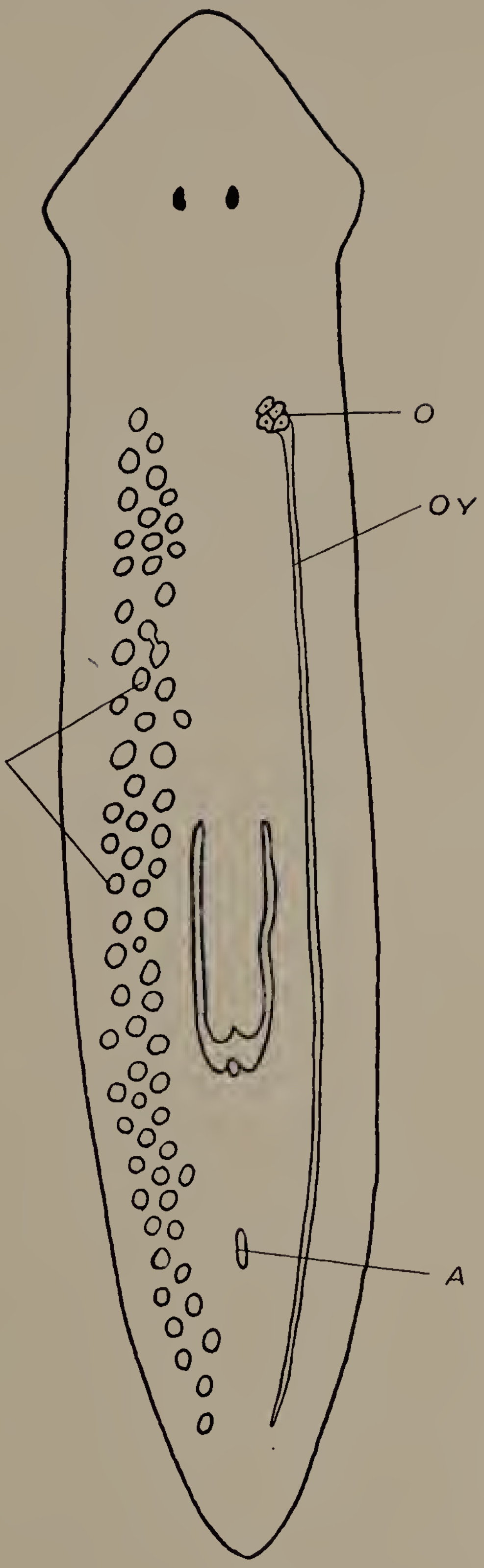

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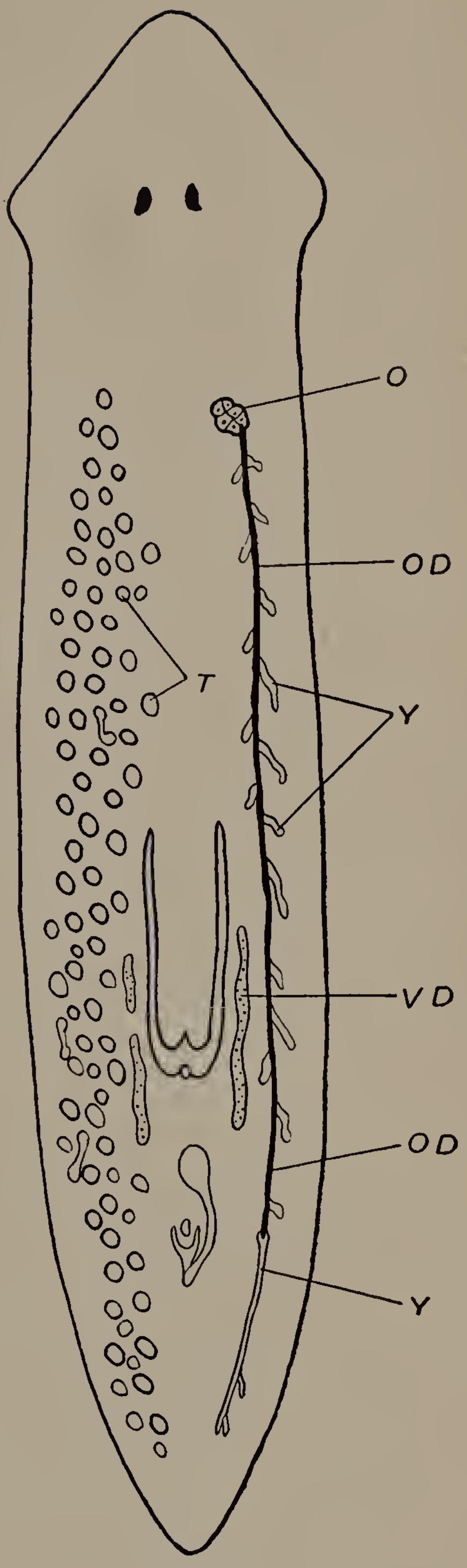

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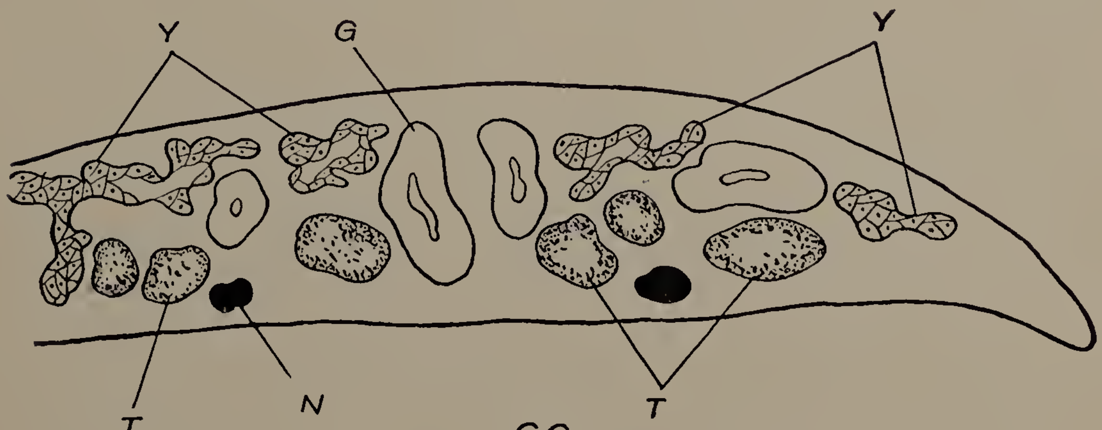

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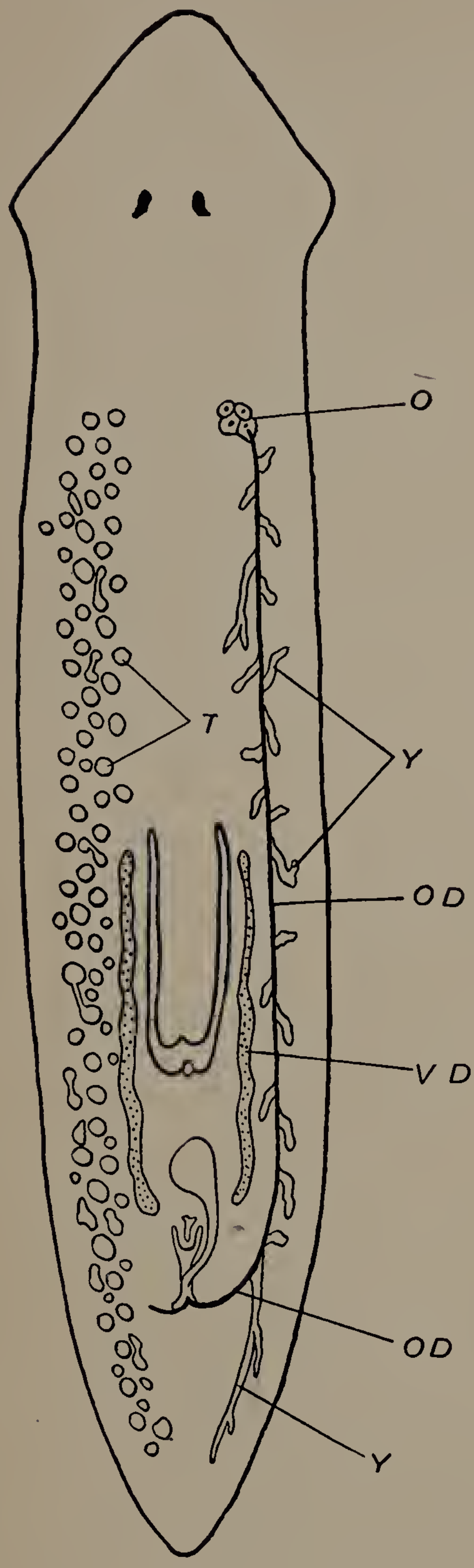
PLATE 19.

(The figures of this plate are reduced two thirds in the reproduction.)

Fig. 56. A semi-diagrammatic figure constructed in the same way as figure 53, of a stage in which the adult condition has been practically attained, save that the vasa deferentia do not connect with the penis. Zeiss A * × 4.

Fig. 57–59. Diagrams to represent the development of the atrial cavity from a simple cleft to a condition which approximates the adult (figure 34). The outline of a sagittal section is drawn in and each figure is from an outline with a camera lucida. Zeiss A × 4.

Fig. 61. The outline of a sagittal section of the region of the mouth and atrium of a large specimen in which the atrial organs were degenerating. The structures found in a number of serial sections are all shown. At the position of the uterus some irregular masses (*u*), farther back a tangle of muscle fibers, a small cavity (*c*), and a pit on the ventral surface (*ap*) at the position of the atrial pore. These parts are entirely disconnected. Zeiss A × 2.



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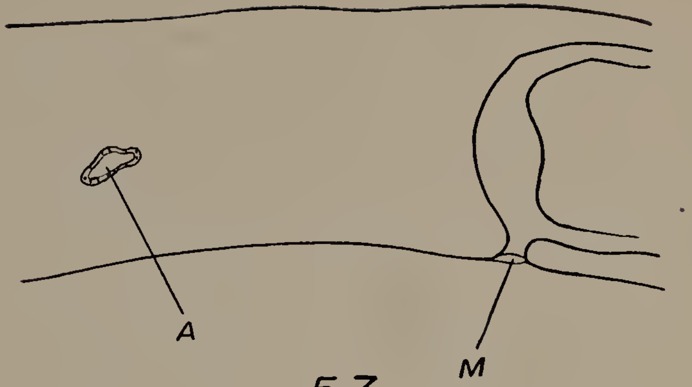

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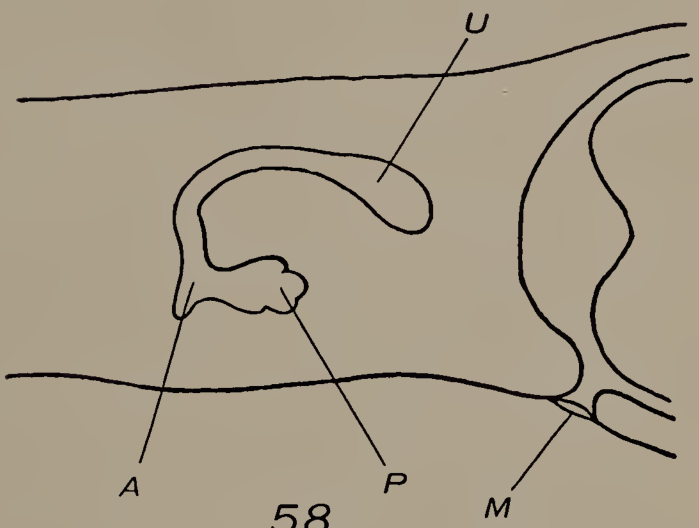

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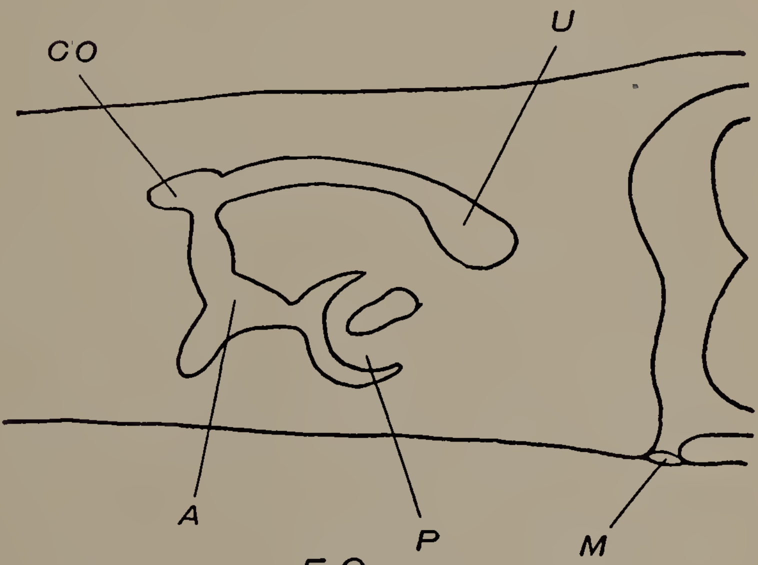

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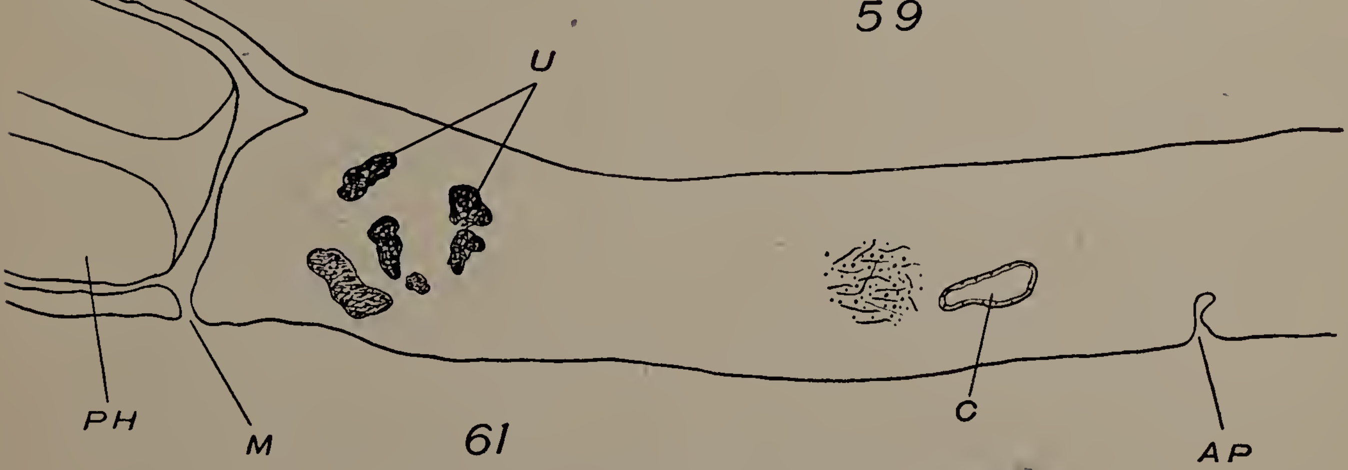

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