A CHECK LIST OF NORTH AMERICAN AMPHIBIANS AND REPTILES

BY

LEONHARD STEJNEGER

AND

THOMAS BARBOUR

FIFTH EDITION

PRINTED FOR THE UNIVERSITY
CAMBRIDGE, MASS., U.S.A.

Mrs. Gaige suggests the following changes:

Dear Sir:

It has just been called to my attention that, by some unexplainable oversight the entry of *Sceloporus undulatus undulatus* has been omitted from the Checklist. The final citation should be to the paper by H. M. Smith in Occ. Papers, Mus. Zool., Univ. of Mich., no. 387, Oct. 31, 1938, p. 7. Type locality: Charleston, South Carolina. Range: Coastal areas from southeastern Louisiana across the basal half of the Florida Peninsula to central South Carolina.

Very truly,
T. B.

24, 1938: 624.

132. *Coluber taeniatus ruthveni:* San Luis Potosi & Michoacan. Smith, Journ. Wash. Acad. Sci., 39 (9), 1941: 388–98.

145. *Lampropeltis alterna:* Coahuila. Smith. Copeia (2). 1941: 12.

Dear Sir:

Mr. Roger Conant calls to my attention another oversight, the omission of *Agkistrodon piscivorus leucostoma* (Troost), Gloyd and Conant, Bull. Chicago Acad. Sci., Vol. 7, No. 2, 1943, p. 164. Type locality: Western Tennessee. Range: The valley of the Rio Grande (Mouth of Devil's River and Eagle Pass) and the Gulf Coastal Plain of Texas, Louisiana, and Mississippi, eastward at least to the vicinity of Mobile, Alabama; north in the Mississippi Valley through western Tennessee to southern Illinois, and west as far as Miller County, Missouri, and eastern Oklahoma.

Very truly,
T. B.

Mrs. Gaige suggests the following changes:

ge

12. Range of *Ambystoma t. tigrinum* in need of revision.

13. *Ambystoma tigrinum slateri* Dunn = *A. t. melanostictum* (Baird). Bishop, Copeia (4), 1942: 256.

44. Authority for *Bufo woodhousii fowleri* should be Hinckley. (References reversed in press (in errore).)

54. Authority for *Rana areolata circulosa* should be Rice and Davis, according to Goin & Netting.

60. Range of *Rana sylvatica cantabrigensis* should be revised.

61. *Gastrophryne olivacea:* Peña Blanca Spr., Santa Cruz Co., S. Arizona (Campbell, Occ. Pap. Mus. Zool., Univ. Mich., 289, 1934: 6–7) and Noria, Sonora (Morrow Allen, *ibid.*, 1933: 3). Taylor also reports it from Coahuila & Durango.

68. *Crotaphytus collaris baileyi:* Lassen Co., n. e. California. Fitch, Herpetologica, 1 (6), 1939: 151–2.

78. *Sceloporus jarrovii jarrovii.* See Smith, Kans. Univ. Sci. Bull., 24, 1938: 624.

132. *Coluber taeniatus ruthveni:* San Luis Potosi & Michoacan. Smith, Journ. Wash. Acad. Sci., 39 (9), 1941: 388–98.

145. *Lampropeltis alterna:* Coahuila. Smith, Copeia (2), 1941: 12.

154. *Sonora occipitalis occipitalis* (Hallowell): *California*, Riverside, San Bernardino, Los Angeles, Kern, Inyo Cos.: *Nevada*, Clark Co.: *Arizona*, Mohave & Maricopa Cos.

S. o. annulata (Baird): *California*, Imperial & San Diego Cos.: *Arizona*, Maricopa Co.

S. o. klauberi, n. subsp.: *Arizona*, Pima & Pinal Cos., type loc. Tucson. Stickel, Bull. Chi. Acad. Sci., 6 (7), 1941: 135–140, Pls. appeared too late for inclusion.

168. *Thamnophis macrostemma* (Kennicott) has precedence over *megalops* Smith, Zool. Ser. Field Mus. N. H., 24, 1939: 15–35.

177. *Tantilla nigriceps nigriceps:* Rio Santa Maria, near Progreso, Chihuahua, & *T. n. fumiceps:* Mier, Tamaulipas. Smith, Zoologica, 27 (7), 1942: 38–9.

Errata found by T. Barbour

page

vi. Seventh line from bottom: Substitute "of" for "or."

18. *Plethodon idahoensis* Slater and Slipp: Type locality should be Kootenai Co.

44. *Bufo woodhousii fowleri* Bailey and Bailey: Add Jan. 1941 to reference.

90. Streptosaurus: "(Genera)" should be "(Genus)."

114. *Neoceps reynoldsi* Stejneger: Range: "Alochua" should be "Alachua."

143. *Pituophis melanoleucus ruthveni* Stull: Type locality: Substitute "Parish" for "County."

163. Footnote: Substitute "taeniata" for "fasciata."

218. Ambystoma: "*Californiense*" should be "*californiense*."

Postscript

T. Barbour

A message received but an hour ago tells me that since February 28th Leonhard Stejneger has gone and left but the shadow of his great name. He was the knightly heir of a hardy and virile race; a viking in the great tradition. This is no place to set forth his magnificent record of achievement, the simplicity of his character nor the versatility of his agile mind. It is but to say that for me a new and sadder day has dawned which will only close when I close my own eyes for the last time.

Coconut Grove, Florida

INTRODUCTION TO FIFTH EDITION

THE senior author feels that "Reviewing genera has lately become a fashion and when carefully and competently done is a good fashion. Many of the modern revisionists have become infected with the nazi formenkreis or rassenkreis idea, and that may not be such a bad fashion either if the search for true relationship and affinity is carried out in its legitimate field which is phylogeny and not taxonomy. Speculating about phylogeny of an aggregation of so-called species and subspecies is an interesting occupation and has often been of great profit to the taxonomist. But when the phylogenists begin to play with the nomenclature and want to express their (often very tenuous, sometimes fantastic) ideas in the names, then goodbye to stability of nomenclature which we have been sweating for all these years. Smith's nomenclature in the *Sceloporus disparilis* group is a shining example.

"Now that may be all right in special papers over their own signatures. They are responsible for their own ideas and have a right to express them, but the case is entirely different with a *check-list*.

"A check-list should not be made the means of *propaganda* for anybody's phylogenetic imaginations. Its object is to give its users a key to the normal taxonomic status of the named forms and their geographic distribution. And for this purpose a name is a name and its main function is to give a handle to the form (species, subspecies, race) we are talking about. And for that purpose, in my opinion *Sceloporus disparilis* is just as good as *Sceloporus m. disparilis* or *Sceloporus g. disparilis*, so why not leave it that way until others but J. and S. agree about the *m.* and the *g*? For if in such a case J. and S. *agree* does that of necessity follow that Nature agrees?

"With regard to Smith's notes about the distribution of *S. graciosus* and *biseriatus* I have no data to the contrary. Blanchard identified some specimens which Dr. Mearns collected at Ft. Hancock, Texas as *biseriatus*, but as far as I can see they are *consobrinus*."

I am glad to have this opportunity to quote from a letter which says so concisely just what my own opinion long has been though I have never expressed it so well.

The only reason for bringing out a new edition of the Checklist now is the fact that there has been an increase in herpetological activity apparently in some degree activated by the appearance of each edition of this list and that was certainly never more true than when the fourth edition appeared. The number of additions and rectifications have been so great as to necessitate practically making the list de novo. For doing a vast deal of work in this connection I have to thank Miss H. M. Robinson who has devoted an enormous amount of painstaking care to this task. Many others have also been very helpful. As usual Mrs. F. M. Gaige has contributed a list of suggested changes or range and a number of details I had not caught myself. Messrs. M. B. Mittleman and A. B. Grobman have also supplied a great number of welcome details. Doctor A. F. Carr, Jr. and Mr. Coleman Goin have given me a vast amount of information regarding new data on ranges in Florida. All these have my warmest and deepest thanks.

T. B.

INTRODUCTION TO FOURTH EDITION

We have, in the previous introductions, at least been candid in trying to set forth the manner in which we have made these check lists and it is for that reason that we reprint them.

There are obviously three methods of making a check list.

1. The first method is that which has been used by Gerrit S. Miller, which follows published information without exercising personal judgment. This is certainly a defensible method.

2. The American Ornithologists' Union Check List is prepared another way altogether. Here a committee, in some instances quite a large committee, has met from time to time and sat in judgment on all kinds and conditions of cases, with more or less success.

3. The third method is that which we have followed. A friend writes, "You get no criticism in the first method. I don't know what happens in the second. But you get a — of a lot of criticism by your method." I suppose that we should feel worried about this and perhaps very penitent, but we don't. While there is perhaps no reason to doubt that the welkin is ringing with curses on our evil ways, our friends have been kind and have generally pointed their loud speakers away from both Washington and Cambridge. So we have simply made the best list which we know how to make. There is, by our method, also inevitably a good deal of give and take, for naturally no two authors see quite eye to eye on every point. We have had, however, no friction between ourselves and, as might be expected, the junior author has usually acquiesced to the preferences of the senior author, except in cases where he really cared and in those the senior author has been very patient and pliant. Being

especially familiar with the forms involved, the senior author has kindly assumed direct responsibility for the section concerning the *Testudinata*.

An unusual number of colleagues have given us help in restating ranges, in many cases having gone to very great pains and lengths to set forth their ideas. We express our deepest gratitude to Mrs. Helen T. Gaige, Doctor Tracy I. Storer, Doctor George S. Myers, Mr. L. M. Klauber, Doctor Emmett Reid Dunn, Doctor Howard K. Gloyd, Doctor Raymond B. Cowles, Doctor Karl P. Schmidt, Mr. Roger Conant, Doctor Albert H. Wright, Mr. M. Graham Netting, Doctor Edward H. Taylor, Mr. E. Ross Allen, Mr. Archie F. Carr, Jr., Mr. Hobart M. Smith, Mr. Benjamin Shreve and Mr. Arthur Loveridge.

T. B.

INTRODUCTION TO THIRD EDITION

The second edition of the Check List, which appeared in 1923, is now out of print, and the great volume of additions to our knowledge of American reptiles and amphibians has been used in preparing this third edition.

Many colleagues have aided us with helpful criticism and suggestions. It is impossible to mention the names of all with whom we have corresponded, but some have been of such great and constant assistance that they should be especially remembered. Our hearty thanks are particularly due to Mrs. H. T. Gaige, Professor E. R. Dunn, Mr. L. M. Klauber, Mr. K. P. Schmidt, and Dr. Frank N. Blanchard, and also to Messrs. C. L. Walker, O. C. Van Hyning, and M. G. Netting.

It may perhaps be well to restate here the spirit by which we have been guided in preparing this list. In general we have been inclined to admit all forms described since the last list unless they have been shown publicly to be untenable or unless we have a decisive opinion of our own or some other sufficient reason for rejecting them. Doubtful names may be included in the Check List for debate or as an index to literature. In the use of binominals and trinominals we feel inclined to exercise our own discretion. We are opposed to mixing the biological idea of a subspecies with the convenience or inconvenience of a trinominal designation. We hold a subspecies to be a form which is manifestly descended from another form. If they are still forms connected by intergrades we accept trinominals unless the percentage of intergrades is so large that it becomes unprofitable so to do. But if there is reason to believe that the connection between two forms has once been broken and that the intergrades now recorded are either the result of hybridization or individual reversion, we see no gain in treating them trinominally, particularly in those cases where each form may, in its own turn, normally intergrade with other trinominals. We feel inclined to conserve the status of the names of the old list except when absolutely compelled by the facts to make a change.

In some respects we may seem over-inclined to be thus conservative. Dr. Dunn has recently proposed that the genus Tropidoclonion be merged with Thamnophis. But since the monotypic form is obviously more different from any species of Thamnophis than any of the species in that genus are one from another we prefer still to recognize the peculiar genus for this single species. Considering, as we do, that genera are groups for inconvenience, that no two people are ever likely to agree for long on generic limitations, we feel that any means of breaking up large genera by setting off particularly well differentiated species or groups of species is justifiable and praiseworthy. The recent attempt of Myers (Proc. Biol. Soc. Wash., Vol. 43, March 12, 1930, p. 61) to set up the name Bufo canagicus (Pallas) for Bufo boreas has not seemed to us in the least convincing, and we are entirely in agreement to ignore this name since it is impossible from Pallas' description to know whether he had a Bufo or a Rana in hand.[1]

Our hearty thanks are due to Mr. and Mrs. R. E. Bowen and Miss H. M. Robinson for their care in verifying references and assisting in the preparation of the manuscript.

T. B.

---

[1] It appears at the last minute, after printing of the text has been completed, that two names have been inadvertently omitted:

Elaphe lindheimeri Stejneger and Barbour (Check List No. Amer. Amph. Rept., 2nd Ed., 1923, p. 92) should appear as a synonym of *Elaphe obsoleta confinis*, p. 99.

Chilomeniscus ephippicus Stejneger and Barbour (Check List No. Amer. Amph. Rept., 2nd Ed., 1923, p. 102) should appear as a synonym of *Chilomeniscus cinctus*, p. 114.

INTRODUCTION TO SECOND EDITION

The first edition of the Check List seems to have been useful. Great changes have come in our knowledge of the North American fauna since it was written, so great indeed that there has been a general request for a revised edition. This we have attempted in as impartial a manner as possible. Probably no one will agree with all our conclusions. The reason for issuing this revision now is that the present seems to be as good a time as any later date, in view of the fact that the last word will not be said for years to come.

Recent writers have often erred egregiously in the use of accents in Spanish place names. We confess it is difficult to satisfy the puristic conventions. Our general rule is to accent all Spanish words in which the last syllable is stressed and which end in a vowel.

It is not the real province of a Check List to initiate changes in usage except where nomenclature does not conform to the International Code. We admit new species and subspecies as they are proposed, except where their validity is definitely contra-indicated. As to the various more fundamental changes in classification which have been proposed we can only say that we are inclined to consider them very sympathetically, but they have not as yet stood the test of time. We have, however, omitted the term Eublepharidae most willingly. But Pseudacris and Manculus, which some would suppress, are convenient names for apparently natural associations of species, and, therefore, who would ask more reason for their retention in the ranks of valid genera? It is to be hoped that American herpetology may not fall into the unhappy condition now seen in our ornithology with its overmultiplied monotypic genera: still, however, any reasonable efforts to break up the great unwieldy genera are certainly welcome.

Thus without special aim to be consistent we have taken up the various problems presented by recent workers, feeling generally that it is our duty to record established custom rather than to initiate or to follow hastily each proposed change.

Thanks are due to several of our North American co-workers for advice and assistance. We would mention especially Dr. Emmett Reid Dunn, Dr. Alexander G. Ruthven, and Mr. Karl P. Schmidt.

T. B.

INTRODUCTION TO FIRST EDITION

A CHECK LIST of North American Amphibians and Reptiles has long been wished for by all students of American herpetology. This list has been prepared generally upon the lines of the American Ornithologists' Union Check List of Birds, and, following that example, it has included the species and subspecies which the authors deem valid[1] and of certain occurrence in North America, north of the Rio Grande, and in Lower California, Mexico. Miller's List of North American Land Mammals (Bull. U. S. Nat. Mus., No. 79, 1912) has also been a valued guide.

This volume is the result of lists begun some years ago independently by both authors. The arrangement is on the following system: The higher groups and genera are in systematic sequence, the species are in alphabetic order. No attempt is made to give synonyms. Species not listed are believed to be invalid. The citation of original appearance of names is given for all except such (e.g., family names) as are formed automatically. Following the citation of the original description of each species comes the place of first appearance of the name in its present combination — accurate in so far as we have been able to determine. References are added to Cope's North American Batrachia and to his Crocodilians, Lizards, and Snakes of North America. Both are frequently erratic and inaccurate, but large and excellent portions of both works are to a great extent from the pen of S. F. Baird, as painstaking an investigator as this

---

[1] By this statement it is not meant that the authors in all cases have verified the status of a number of more recently established forms by critical study. The judgment of reliable workers has been accepted where no special reason appeared to contra-indicate the validity of the form. As for the admission of subspecies — or rather trinominal designation — for certain forms no special attempt has been made at consistency, the authors on principle leaning towards binominals in all cases where the need of trinominals has not been clearly established.

country has produced. These monographs are in widespread use, and constitute the most recent attempts toward complete lists. In the case of the difficult genus Thamnophis references are given to Ruthven's excellent review. Common names for reptiles and amphibians are in great confusion, and are often of generic rather than of specific application. No attempt is made to recognize any except those which are in well-established usage. The host which have been recently coined by various writers are frequently inapt and almost surely unlikely to survive. It is entirely possible that some vernacular names really often used have escaped our notice, since many are in restricted local use. The type localities are as nearly exact as it is possible to determine. This cannot be said regarding the ranges. Many are obviously faulty, but a sincere attempt has been made to collect records of authentic captures; however, with a literature so extensive and so scattered, records have almost surely been overlooked. In many cases, our knowledge does not warrant drawing hard and fast lines delimiting a form's occurrence, and we often state ranges in purposely general terms. There still is opportunity for valuable field work to determine the precise distribution of many of our most common species. An example is the recent discovery that *Virginia valeriae* is far from rare in parts of New Jersey.

Our hearty thanks are due to many for information and advice, especially to Samuel Henshaw, John Van Denburgh, and Alexander G. Ruthven.

G. K. Noble has assisted considerably in verifying references and searching literature, and for this assistance he has our grateful remembrance.

T. B.

CONTENTS

AMPHIBIA (*CLASS*)

Linné, Syst. Nat., Ed. 10, Vol. 1, 1758, p. 194

CAUDATA (*ORDER*)

Oppel, Ordn. Rept., 1811, p. 72

PROTEIDA (*SUBORDER*)

Cope, Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 6, 1866, p. 102

NECTURIDAE (*FAMILY*)

Necturus (*GENUS*)

Rafinesque, Journ. Phys. Chim. Hist. Nat., Vol. 88, June, 1819, p. 418
TYPE: *maculatus* = maculosus

Necturus alabamensis Viosca

Necturus alabamensis Viosca
Copeia, 1937, No. 2, Aug. 18, p. 121.

TYPE LOCALITY: Black Warrior River, Tuscaloosa, Alabama.

RANGE: Type locality and southern West Virginia.

Necturus beyeri Viosca

Necturus beyeri Viosca
Copeia, 1937, No. 2, Aug. 18, p. 123.

TYPE LOCALITY: Upper Calcasieu River near Oakdale, Louisiana.

RANGE: Southern Louisiana, southern Mississippi, southern Alabama and northwestern Florida.

Necturus lewisi (Brimley)

Necturus maculosus lewisi Brimley
Journ. Elisha Mitchell Sci. Soc., Vol. 40, Dec. 1924, p. 167.

Necturus lewisi VIOSCA
Copeia, 1937, No. 2, Aug. 18, p. 127.

TYPE LOCALITY: Neuse River, near Raleigh, North Carolina.

RANGE: Tar River and upper courses of the Neuse River, North Carolina.

Necturus lödingi VIOSCA

Necturus lödingi VIOSCA
Copeia, 1937, No. 2, Aug. 18, p. 126.

TYPE LOCALITY: Eslava Creek, near Mobile, Alabama.

RANGE: Region about Mobile, Alabama.

Necturus louisianensis VIOSCA

Necturus louisianensis VIOSCA
Proc. Biol. Soc. Wash., Vol. 51, Aug. 23, 1938, p. 51.

TYPE LOCALITY: Big Creek, near Pollock, Louisiana.

RANGE: Area about the type locality.

Necturus maculosus maculosus (RAFINESQUE)

MUDPUPPY, WATERDOG

Sirena maculosa RAFINESQUE
Amer. Month. Mag. Crit. Rev., Vol. 4, No. 1, Nov. 1818, p. 41.
Necturus maculosus RAFINESQUE
Ann. Nat., Lexington, No. 1, March 22, 1820, p. 4.
Necturus maculatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 23, fig. 3.
Necturus maculosus maculosus BISHOP
Occ. Papers, Mus. Zool., Univ. Mich., Nov. 1941, 451, p. 9.

TYPE LOCALITY: Found in the Ohio River.

RANGE: Tributaries of the Great Lakes, the Mississippi River system, the upper Hudson River, and Lake Champlain. Rivers of North and South Carolina, Georgia, and Alabama.

Necturus maculosus stictus BISHOP

Necturus maculosus stictus BISHOP
Occ. Papers, Mus. Zool., Univ. Mich., Nov. 1941, 451, pp. 9–12.

TYPE LOCALITY: Lake Winnebago, Wisconsin.

RANGE: Lake Winnebago, Wisconsin and adjacent Upper Peninsula of Michigan.

Necturus punctatus (GIBBES)

Menobranchus punctatus GIBBES
Proc. Amer. Assoc. Adv. Sci., Charleston, 1850, p. 159.
Necturus punctatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 27, fig. 4.

TYPE LOCALITY: Dr. Schoolbred's plantation on the South Santee River, a few miles from its mouth, South Carolina.

RANGE: Fresh waters of North and South Carolina, east of the mountains, and De Bruce, Richmond County, Georgia.

MUTABILIA (*SUBORDER*)

MERREM, Syst. Amph., 1820, p. 166

AMPHIUMIDAE (*FAMILY*)

Amphiuma (*GENUS*)

GARDEN, Smith's Correspondence of Linnaeus, Vol. 1, 1821, p. 599
TYPE: *means*

Amphiuma means means GARDEN
BLIND EEL, CONGO EEL, CONGO SNAKE

Amphiuma means GARDEN
Smith's Correspondence of Linnaeus, Vol. 1, 1821, p. 599. (descr. p. 333).
Amphiuma means COPE
Bull. U. S. Nat. Mus., No. 34, 1899, p. 216.
Amphiuma means means GOIN
Herpetologica, I (5), Dec. 30, 1938, p. 128.

TYPE LOCALITY: Not stated, but from the context evidently either Charleston or East Florida.

RANGE: From Virginia and McCracken County, Kentucky, south through peninsular Florida and west to Louisiana.

Amphiuma means tridactylum CUVIER

Amphiuma tridactylum CUVIER
Mém. Mus. Hist. Nat. Paris, Vol. 14, 1827, p. 7, pl. 1, figs. 4–6, pl. 2, figs. 9–18.
Amphiuma means tridactylum GOIN
Herpetologica, I (5), Dec. 30, 1938, p. 128.

TYPE LOCALITY: New Orleans, Louisiana.

RANGE: Northern Florida to southern Mississippi and the alluvial plains of the Mississippi Valley from Louisiana at least as far as Missouri and Kentucky.

CRYPTOBRANCHIDAE (*FAMILY*)

Cryptobranchus (*GENUS*)

Leuckart, Isis, 1821, Lit. Anz., p. 259
TYPE: *gigantea* = alleganiensis

Cryptobranchus alleganiensis (Daudin)
HELL-BENDER

Salamandra alleganiensis Daudin
Hist. Nat. Rept., Vol. 8, 1803, p. 231.
Cryptobranchus alleghaniensis Van der Hoeven
Tijdschr, Nat. Geschied. Physiol., Vol. 4, 1837, p. 384.
Cryptobranchus terassodactylos Wellborn
Zool. Anz., Vol. 114, Pt. 34, Apr. 15, 1936, p. 63.
Cryptobranchus allegheniensis Cope
Bull. U. S. Nat. Mus., No. 34, 1899, p. 38, fig. 5.

TYPE LOCALITY: Allegheny Mountains in Virginia.

RANGE: Western New York and Susquehanna River; Ohio River and tributaries, and southward to Georgia and Louisiana.

Cryptobranchus bishopi Grobman

Cryptobranchus bishopi Grobman
Occ. Pap. Mus. Zool., Univ. Mich., No. 470, 1942, p. 6.

TYPE LOCALITY: Current River at Big Spring Park, Carter County, Missouri.

RANGE: Southeastern Missouri in rivers draining into the southward flowing Black River, of Missouri and Arkansas.

SALAMANDRIDAE (*FAMILY*)

Triturus (*GENUS*)

Rafinesque, Anal. Nat., 1815, p. 78
TYPE: *cristatus*

Triturus granulosus granulosus (Skilton)

Salamandra (Triton) granulosa Skilton
Amer. Journ. Sci. Arts., Ser. 2, Vol. 7, 1849, p. 202, pl. 1.

Triturus granulosus Fitch
Copeia, 1938, No. 3, Sept. 24, p. 148.
Triturus granulosus granulosus Bishop
Occ. Pap. Univ. Mich., Mus. Zool., 451, 1941, p. 18.

TYPE LOCALITY: Oregon.

RANGE: Northern California, Western Oregon and Washington.

Triturus granulosus mazamae Myers

Triturus granulosus mazamae Myers
Copeia, 1942, No. 2, July 10, pp. 80–81.

TYPE LOCALITY: Crater Lake on the higher slopes of Mt. Mazama, Crater Lake National Park, Klamath County, Oregon.

RANGE: The slopes of Mt. Mazama, Crater Lake National Park, Oregon.

Triturus granulosus similans Twitty

Triturus granulosus simulans Twitty
Copeia, 1935, No. 2, July 16, pp. 76–80.
Triturus granulosus granulosus Stejneger and Barbour
Check List N. Amer. Amph. Rept. Ed. 4, 1939, p. 4.
Triturus granulosus similans Myers
Copeia, 1942, No. 2, July 10, p. 79.

TYPE LOCALITY: Robinson Creek, Ukiah, Mendocino County, California.

RANGE: Mendocino County north through the coast ranges and Sierra at least to the Klamath River and the Siskiyous.

Triturus granulosus twittyi Bishop

Triturus granulosus twittyi Bishop
Occ. Papers, Mus. Zool., Univ. Mich., No. 451, 1941, pp. 16–18.

TYPE LOCALITY: Saratoga, California.

RANGE: South of San Francisco Bay, in Santa Clara and Santa Cruz Counties, California.

Triturus meridionalis (Cope)

Diemyctylus miniatus, subsp. *meridionalis* Cope
Bull. U. S. Nat. Mus., No. 17, 1880, p. 30.

Triturus meridionalis Dunn
Bull. Mus. Comp. Zool., Vol. 62, 1918, p. 452.
Diemyctylus viridescens meridionalis Cope
Bull U. S. Nat. Mus., No. 34, 1889, p. 211, fig. 54.

TYPE LOCALITY: Matamoros, Tamaulipas, Mexico. . . . "tributaries of the Medina River and southward."

RANGE: Texas and Tamaulipas.

Triturus perstriatus Bishop

Triturus perstriatus Bishop
Occ. Papers, Univ. Mich., Mus. Zool., No. 451, 1941, pp. 3–6.

TYPE LOCALITY: Dedge Pond, 2 miles east of Chesser's Island, Charlton County, Georgia.

RANGE: Southeastern Georgia, northern and central Florida.

Triturus rivularis Twitty

Triturus rivularis Twitty
Copeia, 1935, No. 2, July 16, p. 73.

TYPE LOCALITY: Gibson Creek, Ukiah, California.

RANGE: Mendocino County, California.

Triturus sierrae Twitty

Triturus sierrae Twitty
Copeia, 1942, No. 2, July 10, pp. 65–66, pl. 1, 4.

TYPE LOCALITY: Cherokee Creek, above Chico, Butte County, California.

RANGE: Western Sierran slope, from Butte County southwards to Fresno County, California.

Triturus torosus torosus (Rathke)

Triton torosus Rathke (in Eschscholtz)
Zoöl. Atlas, Pt. 5, 1833, p. 12, pl. 21, fig. 15.
Notophthalmus torosus Baird
Journ. Ac. Nat. Sci. Phila., Sr. 2, Vol. 1, 1849, p. 284.
Diemyctylus torosus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 204, fig. 51.

TYPE LOCALITY: Surroundings of the Bay of San Francisco, California.

RANGE: California north to Alexander Archipelago.

Triturus torosus klauberi (Wolterstorff)

Taricha torosa klauberi Wolterstorff
Blätt. Aquar. Terrarienk., Vol. 46, No. 8, Aug. 1935, p. 183.

TYPE LOCALITY: Boulder Creek, San Diego County, California.

RANGE: Extreme southern California.

Triturus viridescens viridescens (Rafinesque)

COMMON NEWT (aquatic form), RED EFT or EBBET (terrestrial form)

Triturus viridescens (Rafinesque)
Ann. Nat., Lexington, No. 1, March 22, 1820, p. 5.
Notophthalmus viridescens Baird
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, p. 284.
Diemyctylus viridescens Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 207, figs. 52–53.

TYPE LOCALITY: Lake George, Lake Champlain.

RANGE: Eastern North America, northern Ontario (Severn River) and the height of land in Quebec, to Southeastern Michigan, northern Illinois and Georgia.

Triturus viridescens dorsalis (Harlan)

Salamandra symmetrica Harlan
Journ. Ac. Nat. Sci. Phila., Vol. 5, 1825, p. 157.
Notophthalmus viridescens vittatus Stejneger and Barbour
Check List N. Amer. Amph. Rept., ed. 1, 1917, p. 8.
Triturus dorsalis Dunn
Bull. Mus. Comp. Zool., Vol. 62, 1918, p. 452.
Triturus viridescens symmetrica Schmidt
Copeia, 1924, No. 132, July 15, p. 67.
Triturus viridescens dorsalis Bishop
Occ. Papers, Mus. Zool., Univ. Mich., 451, 1941, pp. 1–3.

TYPE LOCALITY: Near Camden, South Carolina.

RANGE: Harnett and Onslow Counties in North Carolina south to Kershaw and Georgetown Counties, South Carolina.

Triturus viridescens louisianensis (Wolterstorff)

Diemyctylus viridescens louisianensis Wolterstorff
Abh. Mus. Nat. Heimatk. Magdeburg, Vol. 2, Pt. 4, 1914, p. 383.

TYPE LOCALITY: New Orleans, Louisiana.

RANGE: Texas and southern Louisiana northward to Wisconsin; eastward to Florida and South Carolina.

AMBYSTOMIDAE (*FAMILY*)

Dicamptodon (*GENUS*)

STRAUCH, Mém. Acad. Sci. St. Pétersb., Ser. 7, Vol. 16, No. 4, 1870, p. 68
TYPE: *ensatus*

Dicamptodon ensatus (ESCHSCHOLTZ)

Triton ensatus ESCHSCHOLTZ
Zool. Atlas, Pt. 5, 1833, p. 6, pl. 22.
Dicamptodon ensatus STRAUCH
Mém. Ac. Sci. St. Pétersb., Ser. 7, Vol. 16, No. 4, 1870, p. 69.
Ambystoma tenebrosum STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 11.
Dicamptodon aterrimus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 7.

TYPE LOCALITY: California, environs of Bay of San Francisco.

RANGE: From extreme southwest corner of British Columbia and Idaho to Santa Cruz County, California.

Rhyacotriton (*GENUS*)

DUNN, Proc. N. Engl. Zoöl. Club, Vol. 7, 1920, p. 56
TYPE: *olympicus*

Rhyacotriton olympicus (GAIGE)

Ranodon olympicus GAIGE
Occ. Papers Mus. Zool. Univ. Mich., No. 40, May 30, 1917, p. 2, pl. 1,
Rhyacotriton olympicus DUNN
Proc. N. Engl. Zoöl. Club, Vol. 7, 1920, p. 56.
Ranodon olympicus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 13.

TYPE LOCALITY: Lake Cushman, Washington.

RANGE: Western Washington south to Del Norte County, California.

Ambystoma (*GENUS*)

TSCHUDI, Mém. Soc. Sci. Nat. Neuchatel, 1838, p. 92
TYPE: *subviolacea* = maculatum

Ambystoma annulatum COPE

Amblystoma annulatum COPE
Proc. Amer. Philos. Soc., Vol. 23, 1886, p. 525.

Linguaelapsus annulatus COPE

Bull. U. S. Nat. Mus., No. 34, 1889, p. 115, fig. 25.

TYPE LOCALITY: Unknown.

RANGE: Arkansas and Missouri.

Ambystoma cingulatum COPE

Amblystoma cingulatum COPE

Proc. Ac. Nat. Sci. Phila., 1867, p. 205.

Chondrotus cingulatus COPE

Bull. U. S. Nat. Mus., No. 34, 1889, p. 100, p. 455, fig. 116.

TYPE LOCALITY: Grahamville, South Carolina.

RANGE: South Carolina to northern Florida and Alabama.

Ambystoma decorticatum COPE

Amblystoma decorticatum COPE

Proc. Amer. Philos. Soc., Vol. 23, 1886, p. 522.

Chondrotus decorticatus COPE

Bull. U. S. Nat. Mus., No. 34, 1889, p. 107, fig. 22.

TYPE LOCALITY: Port Simpson, British Columbia.

RANGE: Coastal region of southeastern Alaska and British Columbia to the Olympic Peninsula in Washington.

Ambystoma gracile (BAIRD)

Siredon gracilis BAIRD

Pacif. R. R. Rep., Vol. 10, Williamson's Route, Pt. 4, No. 4, 1859, p. 13, pl. 44, fig. 2.

Ambystoma paroticum STEJNEGER and BARBOUR

Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 6.

Ambystoma gracile DUNN

Copeia, 1926, No. 154, May 20, p. 136.

Chondrotus paroticus COPE

Bull. U. S. Nat. Mus., No. 34, 1889, p. 105, fig. 21.

TYPE LOCALITY: Cascade Mountains, Oregon, lat. 44° N.

RANGE: From southwestern British Columbia, including Vancouver Island, through Oregon, south to Ukiah, Mendocino County, California.

Ambystoma jeffersonianum (GREEN)

Salamandra jeffersoniana GREEN

Contr. Maclur. Lyc., Vol. 1, No. 1, Jan. 1827, p. 4, pl. 1, fig. 1.

Amblystoma jeffersoniana Baird
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, p. 283.
Amblystoma jeffersonianum Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 89, figs. 15–16.

TYPE LOCALITY: Near Jefferson College, Cannonsburg, Pennsylvania.

RANGE: Ontario and New England, southward to Virginia, westward to Wisconsin, Illinois, mountains of southwestern Virginia, and Kentucky.

Ambystoma mabeei Bishop

Ambystoma mabeei Bishop
Journ. Elisha Mitchell Sci. Soc., Vol. 43, No. 3–4, 1928, p. 157.

TYPE LOCALITY: Low grounds of the Black River near Dunn, North Carolina.

RANGE: Restricted areas in North and South Carolina.

Ambystoma macrodactylum Baird

Ambystoma macrodactyla Baird
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, p. 292.
Ambystoma epixanthum Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 9.
Amblystoma macrodactylum Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 95, fig. 17.

TYPE LOCALITY: Astoria, Oregon.

RANGE: Northern California, south to central California and north into British Columbia and Alberta, Idaho and Montana, eastward to, and probably into Iowa.

Ambystoma maculatum (Shaw)

SPOTTED SALAMANDER

Lacerta maculata Shaw
Gen. Zool., Vol. 3, Pt. 1, 1802, p. 304.
Ambystoma maculatum Stejneger
Proc. Biol. Soc. Wash., Vol. 15, Dec. 16, 1902, p. 239.
Amblystoma punctatum Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 56, fig. 9.

TYPE LOCALITY: Carolina (based on Catesby, Nat. Hist. Carolina, Ed. 1, Appendix, 1748, pl. 10, fig. 10).

RANGE: The Gaspé Peninsula and Nova Scotia westward through Canada to Wisconsin, southward to Georgia, Florida, and Texas.

Ambystoma opacum (GRAVENHORST)

MARBLED SALAMANDER

Salamandra opaca GRAVENHORST
Vergl. Uebers. Zool. Syst., 1807, p. 431.
Ambystoma opaca BAIRD
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, p. 283.
Amblystoma opacum COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 54, fig. 8.

TYPE LOCALITY: New York.

RANGE: From New Hampshire to northern Florida, west to Louisiana, Oklahoma, and Texas, Mississippi basin north to Arkansas, Missouri, India, and Illinois.

Ambystoma talpoideum (HOLBROOK)

MOLE SALAMANDER

Salamandra talpoidea HOLBROOK
N. Amer. Herp., Ed. 1, Vol. 3, 1838, p. 117, pl. 29.
Ambystoma talpoideum GRAY
Cat. Batr. Grad. Brit. Mus., 1850, p. 36.
Amblystoma talpoideum COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 52, fig. 7.

TYPE LOCALITY: Sea Islands on the border of South Carolina.

RANGE: South Atlantic and Gulf States and Oklahoma, North Carolina to Louisiana and northward to Illinois.

Ambystoma texanum (MATTHES)

Salamandra texana MATTHES
Allg. deutsche naturh. Zeitschr., N. S., Vol. 1, 1855, p. 266.
Amblystoma texanum BAIRD
U. S. Mex. Bound. Surv., Vol. 2, 1859, Rept., p. 29, pl. 35, fg. 15.
Chondrotus texanus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 104, fig. 20.

TYPE LOCALITY: "Das erste Exemplar fand ich . . . im Urwalde am Rio Colorado, das zweite ebenfalls . . . im Cumming's Creeck [sic] Bottom, Fayette County."

RANGE: Nebraska, south to Texas, Mississippi, east to Ohio, West Virginia, North Carolina and Georgia.

Ambystoma tigrinum tigrinum (GREEN)
TIGER SALAMANDER

Salamandra tigrina GREEN
Journ. Ac. Nat. Sci. Phila., Vol. 5, 1825, p. 116.
Ambystoma tigrina BAIRD
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, p. 284.
Amblystoma tigrinum COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 68, figs. 12–13.
Ambystoma tigrinum tigrinum DUNN
Copeia, 1940, No. 3, Nov. 14, p. 156.

TYPE LOCALITY: Near Moorestown, New Jersey.

RANGE: Widely distributed from Long Island and the Atlantic Coastal Plain to Florida, Texas, and Mexico; interior lowlands to Michigan and southern Ontario; western Plains to Manitoba, Saskatchewan, Alberta, British Columbia, Idaho, Wyoming, Colorado, New Mexico, Arizona, Washington and extreme northern Oregon; the interior valley of California; the Plateau of Mexico. Absent from New England, Delaware, Nevada, and West Virginia.

Ambystoma tigrinum californiense GRAY

Ambystoma Californiense GRAY
Proc. Zool. Soc. Lond., 1853, p. 11, pl. 7.
Ambystoma californiense STORER
Univ. Calif. Publ. Zool., Vol. 27, 1925, p. 60, pl. 1, fig. 1; pl. 7, figs. 15–17; pl. 8, fig. 18; text fig. U.
Ambystoma tigrinum californiense DUNN
Copeia, 1940, No. 3, Nov. 14, pp. 157–158.

TYPE LOCALITY: Monterey, California.

RANGE: Central California.

Ambystoma tigrinum diaboli DUNN

Ambystoma tigrinum diaboli DUNN
Copeia, 1940, No. 3, Nov. 14, pp. 160–161.

TYPE LOCALITY: Devil's Lake, North Dakota.

RANGE: North Dakota (north and east of Altamount Moraine) into Alberta and Saskatchewan.

Ambystoma tigrinum mavortium BAIRD

Ambystoma avortiam BAIRD
Journ. Acad. Nat. Sci. Phila., (2), 1: 284, 292.

Ambystoma tigrinum mavortium DUNN
Copeia, 1940, No. 3, Nov. 14, p. 158.

TYPE LOCALITY: New Mexico.

RANGE: Kansas, Oklahoma, central and western Texas, eastern Colorado, eastern and central New Mexico.

Ambystoma tigrinum nebulosum HALLOWELL

Ambystoma nebulosum HALLOWELL
Proc. Acad. Nat. Sci. Phila., 6, p. 209.
Ambystoma tigrinum nebulosum DUNN
Copeia, 1940, No. 3, Nov. 14, p. 158.

TYPE LOCALITY: San Francisco Mt., Arizona.

RANGE: Interior Basin and Colorado Plateau in Utah, western Colorado, Northwestern New Mexico, northern Arizona.

Ambystoma tigrinum slateri DUNN

Ambystoma tigrinum slateri DUNN
Copeia, 1940, No. 3, Nov. 14, p. 159.

TYPE LOCALITY: Five miles southeast of Coulee Dam, Grant Co., Washington.

RANGE: British Columbia, Alberta, Washington, Oregon, Idaho, Montana, Wyoming, North and South Dakota, Nebraska.

PLETHODONTIDAE (*FAMILY*)

Desmognathus (*GENUS*)

BAIRD, Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, pp. 282, 285
TYPE: *fuscus*

Desmognathus fuscus fuscus (RAFINESQUE)

Triturus fuscus RAFINESQUE
Ann. Nat., Lexington, No. 1, March 22, 1820, p. 4.
Desmognathus fuscus BAIRD
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, p. 285.
Desmognathus fusca fusca COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 194, fig. 48.

TYPE LOCALITY: Northern parts of State of New York.

RANGE: St. John's River, New Brunswick, to northwestern Florida, Mississippi, and Illinois. Manitoba?

Desmognathus fuscus auriculatus (HOLBROOK)

Salamandra auriculata HOLBROOK
N. Amer. Herp., Ed. 1, Vol. 3, 1838, p. 115, pl. 28.
Desmognathus fusca auriculata COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 195, fig. 49.
Desmognathus auriculatus BAIRD
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, p. 286.

TYPE LOCALITY: Riceborough, Georgia.

RANGE: Lowlands from Virginia to Florida, west to Mississippi in the coastal plain.

Desmognathus fuscus brimleyorum (STEJNEGER)

Desmognathus brimleyorum STEJNEGER
Proc. U. S. Nat. Mus., Vol. 17, May 11, 1895, p. 597.
Desmognathus fuscus brimleyorum DUNN
Plethodontidae, Northampton, 1926, p. 101.

TYPE LOCALITY: Hot Springs, Arkansas.

RANGE: Arkansas, Texas, and Oklahoma.

Desmognathus ochrophaeus ochrophaeus (COPE)

Desmognathus ochrophaea COPE
Proc. Ac. Nat. Sci. Phila., 1859, p. 124.
Desmognathus ochrophaea COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 191, fig. 47.
Desmognathus ochrophaeus ochrophaeus DUNN
Proc. U. S. Nat. Mus., Vol. 53, 1917, p. 415.

TYPE LOCALITY: Susquehanna County, Pennsylvania.

RANGE: Clinton County, New York, to Garrett County, Maryland, and Virginia west to Columbus, Ohio (except the southern, unglaciated plateau of that state) in the Allegheny Plateau and the Appalachian Valley.

Desmognathus ochrophaeus carolinensis DUNN

Desmognathus ochrophaea carolinensis DUNN
Proc. Biol. Soc. Wash., Vol. 29, April 4, 1916, p. 74.

TYPE LOCALITY: Mt. Mitchell, North Carolina, over 6500 feet.

RANGE: Virginia to Gwinnett County, Georgia (in the mountains).

Desmognathus phoca (MATTHES)

Salamandra phoca MATTHES
Allg. deutsche naturh. Zeitschr., N. S., Vol. 1, 1855, p. 273.
Desmognathus phoca DUNN
Proc. N. Engl. Zoöl. Club., Vol. 8, Feb. 27, 1923, p. 39.

TYPE LOCALITY: Taylor's Creek near Newport, Kentucky.

RANGE: Appalachian Mountain ranges from Pennsylvania southward to Toccoa, Georgia, and Newport, Kentucky.

Desmognathus quadramaculatus quadramaculatus (HOLBROOK)

Salamandra quadra-maculata HOLBROOK
N. Amer. Herp., Ed. 1, Vol. 4, 1840, pl. 26 misprinted 27. (The text, p. 121, reads *maculo-quadrata*).
Desmognathus quadrimaculata STEJNEGER
Proc. U. S. Nat. Mus., Vol. 26, Jan. 29, 1903, p. 557.
Desmognathus quadramaculatus quadramaculatus BISHOP
Occ. Papers, Mus. Zool., Univ. Mich., 451, 1941, pp 12–14.

TYPE LOCALITY: Georgia and the Carolinas.

RANGE: Virginia to Georgia, in the mountains, 2000–6000 feet.

Desmognathus quadramaculatus amphileucus BISHOP

Desmognathus quadramaculatus amphileucus BISHOP
Occ. Papers, Mus. Zool., Univ. Mich., 451, 1941, pp. 12–14, pl. 1, fig. 3.

TYPE LOCALITY: Demorest, Habersham County, Georgia.

RANGE: Same as type locality.

Desmognathus wrighti KING

Desmognathus wrighti KING
Herpetologica, Vol. 1, No. 2, Dec. 30, 1936, p. 57, pl. 5.

TYPE LOCALITY: Mt. Le Conte, Sevier County, Tennessee.

RANGE: Spruce-fir forests of the Great Smoky Mountains, north to White Top Mountain, Virginia.

Leurognathus (*GENUS*)

MOORE, Proc. Ac. Nat. Sci. Phila., 1899, p. 316
TYPE: *marmorata*

Leurognathus marmorata marmorata (MOORE)

Leurognathus marmorata MOORE
Proc. Ac. Nat. Sci. Phila., 1899, p. 316.

TYPE LOCALITY: South Slope Grandfather Mountain, North Carolina, 3500 feet.

RANGE: Grandfather and Roan Mountains in North Carolina.

Leurognathus marmorata intermedia POPE

Leurognathus marmorata intermedia POPE
Amer. Mus. Nov., No. 306, April 14, 1928, pp. 1-19.

TYPE LOCALITY: Davis Gap, Waynesville, North Carolina.

RANGE: Lee Mountain, North Carolina.

Plethodon (*GENUS*)

TSCHUDI, Mém. Soc. Sci. Nat. Neuchâtel, 1838, p. 92
TYPE: *glutinosus*

Plethodon cinereus cinereus (GREEN)

REDBACKED SALAMANDER, DUSKY SALAMANDER (NAMES FOR THE TWO COLOR PHASES)

Salamandra cinerea GREEN
Journ. Ac. Nat. Sci. Phila., Vol. 1, Pt. 2, Sept. 1818, p. 356.
Plethodon cinereus TSCHUDI
Mém. Soc. Sci. Nat. Neuchâtel, 1838, p. 92.
Plethodon cinereus cinereus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 134, fig. 30.

TYPE LOCALITY: New Jersey.

RANGE: Gaspesia and Cape Breton Island west to Fort Williams, Ontario, Ontario, south to Dallas, Georgia, Missouri and Arkansas.

Plethodon cinereus dorsalis COPE

Plethodon cinereus dorsalis COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 138.
Plethodon dorsalis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 15.
Plethodon cinereus dorsalis BLANCHARD
Papers Mich. Acad. Sci., Arts and Let., 5, 1925, pp. 368–369.

TYPE LOCALITY: Louisville, Kentucky.

RANGE: Western Pennsylvania, southern Ohio, southern Indiana, central Kentucky, Tennessee, and Alabama.

Plethodon clemsonae Brimley

Plethodon clemsonae Brimley
Copeia, 1927, No. 164, July-Sept., p. 73.
Plethodon clemsonae Bishop
Occ. Papers Mus. Zool., Univ. Mich. 451, 1941, p. 20.

TYPE LOCALITY: Jocassee, S. C.

RANGE: Same as type locality.

Plethodon dunni Bishop

Plethodon dunni Bishop
Proc. Biol. Soc. Wash., Vol. 47, Oct. 2, 1934, p. 169.

TYPE LOCALITY: Portland, Oregon.

RANGE: Western Oregon south to the Lower Rogue River.

Plethodon elongatus Van Denburgh

Plethodon elongatus Van Denburgh
Proc. Calif. Ac. Sci., Ser. 4, Vol. 6, No. 7, May 12, 1916, p. 216.

TYPE LOCALITY: Requa, Del Norte County, California.

RANGE: Del Norte County, California, and the Rogue River Basin, southwestern Oregon.

Plethodon glutinosus glutinosus (Green)
SLIMY SALAMANDER

Salamandra glutinosa Green
Journ. Ac. Nat. Sci. Phila., Vol. 1, Pt. 2, Sept. 1818, p. 357.
Plethodon glutinosus Tschudi
Mém. Soc. Sci. Nat. Neuchâtel, 1838, p. 92.
Plethodon glutinosus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 139, fig. 31.
Plethodon glutinosus glutinosus Bishop
Occ. Papers, Mus. Zool., Univ., Mich., 451, 1941, pp. 18–19.

TYPE LOCALITY: Not mentioned but obviously Princeton, New Jersey. Here Green lived, and he mentions finding the creature often under stones.

RANGE: Southern New York to Wisconsin, south to central Florida, the Gulf States to Texas and to Missouri.

Plethodon glutinosus shermani (Stejneger)

Plethodon shermani Stejneger
Proc. U. S. Nat. Mus., 30, 1906, p. 559, fig. 1.

Plethodon glutinosus shermani Bishop
Occ. Papers, Mus. Zool., Univ., Mich., 451, 1941, pp. 18–19.

TYPE LOCALITY: Wayah Bald Mountain, North Carolina.

RANGE: Southwestern North Carolina (Nantahala Mountains).

Plethodon hardii Taylor

Plethodon hardii Taylor
Proc. Biol. Soc. Wash., 54, July 31, 1941, p. 77.

TYPE LOCALITY: Cloudcroft, N. Mex. Sacramento Mts., alt. 9000 ft.

RANGE: The type locality.

Plethodon idahoensis Slater and Slipp

Plethodon idahoensis Slater and Slipp
Occ. Papers Dept. Biol., Univ. of Paget Sound, No. 8, Sept. 25, 1940, p. 38, fig. 1–3.

TYPE LOCALITY: N. E. corner of Coeur d'Alene Lake, Kootenae Co., Idaho. Alt. 2160 ft.

RANGE: Same as type locality.

Plethodon jordani Blatchley

Plethodon jordani Blatchley
25 Ann. Rep. Dept. Geol. Indiana. 1900 (1901), p. 762.

TYPE LOCALITY: Mt. Collins and Indian Pass, 3000–5000 feet altitude, Sevier County, Tennessee.

RANGE: Tennessee and North Carolina (Great Smoky Mountains).

Plethodon metcalfi Brimley

Plethodon metcalfi Brimley
Proc. Biol. Soc. Wash., Vol. 25, Dec. 4, 1912, p. 138, pl. 6, figs. 1, 2, 4, 7–11.

TYPE LOCALITY: Sunburst, Haywood County, North Carolina.

RANGE: Southwestern Virginia south through western North Carolina, northern Georgia and northeastern Alabama. It apparently occupies all the ranges of the Southern Blue Ridge except the Great Smokies and the Nantahalas.

Plethodon nettingi GREEN

Plethodon nettingi GREEN
Ann. Carn. Mus., Vol. 27, Dec. 14, 1938, p. 295.

TYPE LOCALITY: Barton Knob, Randolph County, West Virginia.

RANGE: Known only from Cheat Bridge and Barton Knob, Randolph County, West Virginia.

Plethodon ouachitae DUNN and HEINTZE

Plethodon ouachitae DUNN and HEINTZE
Copeia, 1933, No. 3, Oct. 15, p. 121.

TYPE LOCALITY: Ouachita National Forest, Polk County, Arkansas.

RANGE: The type locality.

Plethodon richmondi NETTING and MITTLEMAN
RAVINE SALAMANDER

Plethodon richmondi NETTING and MITTLEMAN
Ann. Carn. Mus., Vol. 27, Dec. 8, 1938, p. 288, pl. 30, fig. 1.

TYPE LOCALITY: Huntington, Cabell County, West Virginia.

RANGE: From Pennsylvania, West Virginia, Ohio and Kentucky.

Plethodon vandykei VAN DENBURGH

Plethodon vandykei VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 3, Zool., Vol. 4, March 14, 1906, p. 61.

TYPE LOCALITY: Paradise Valley, Mt. Rainier Park, Washington.

RANGE: Western Washington (Cascade and Olympic Mountains).

Plethodon vehiculum (COOPER)

Ambystoma vehiculum COOPER
Rep. Expl. Surv. Mississippi River to Pacific Ocean, Vol. 12, Pt. 2, 1860, p. viii (list of illustr.), pl. 31, fig. 4.
Plethodon vehiculus BISHOP
Proc. Biol. Soc. Wash., Vol. 47, Oct. 2, 1934, p. 171, pl. 1, fig. 2.

TYPE LOCALITY: Astoria, Oregon.

RANGE: Southwestern British Columbia, including Vancouver Island, southward to Salem, Oregon.

Plethodon wehrlei Fowler and Dunn

Plethodon wehrlei Fowler and Dunn
Proc. Ac. Nat. Sci. Phila., Vol. 69, 1917, p. 23, pl. 4.

TYPE LOCALITY: Two Lick Hills, Indiana County, Pennsylvania.

RANGE: Western New York, Pennsylvania, West Virginia and southern Ohio. Northern section of Appalachian Plateau.

Plethodon welleri Walker

Plethodon welleri Walker
Proc. Junior Soc. Nat. Sci., Cincinnati, Vol. 2, July 31, 1931, p. 48.

TYPE LOCALITY: Grandfather Mountain, above 5000 ft., near Linville, North Carolina.

RANGE: The type locality and White Top Mountain, Virginia.

Plethodon yonahlossee Dunn

Plethodon yonahlossee Dunn
Bull. Amer. Mus. Nat. Hist., Vol. 37, Oct. 13, 1917, p. 598.

TYPE LOCALITY: Near the Yonahlossee Road, about 1½ miles from Linville, North Carolina, altitude 4200 feet.

RANGE: Wooded mountains near Linville, North Carolina, and in southwestern Virginia and northeastern Tennessee.

Ensatina (*GENUS*)

Gray, Cat. Batr. Grad. Brit. Mus., 1850, p. 48
TYPE: *eschscholtzii*

Ensatina croceater (Cope)

Plethodon croceater Cope
Proc. Ac. Nat. Sci. Phila., 1867, p. 210.
Ensatina croceater Dunn
Proc. N. Engl. Zoöl. Club, Vol. 8, Feb. 27, 1923, p. 39.
Plethodon croceater Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 150.

TYPE LOCALITY: Fort Tejon, California.

RANGE: Southwestern California from Kern County to San Diego County.

Ensatina eschscholtzii eschscholtzii Gray

Ensatina eschscholtzii Gray
Cat. Batr. Grad. Brit. Mus., 1850, p. 48.
Plethodon oregonensis Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 148, fig. 35.
Ensatina eshscholtzii eschscholtzii Wood
Univ. Calif. Publ. Zool., Vol. 42, No. 10, 1940, p. 425–427.

TYPE LOCALITY: California.

RANGE: Southwestern corner of British Columbia to southern Humboldt County, California.

Ensatina eschscholtzii picta Wood

Ensatina eschscholtzii picta Wood
Univ. Calif. Publ. Zool., Vol. 42, No. 10, 1940, pp. 425–427.

TYPE LOCALITY: Klamath, Del Norte Co., California.

RANGE: Coastal area from Humboldt Co., California to Curry Co., Oregon.

Ensatina sierrae Storer

Ensatina sierrae Storer
Univ. of Calif. Publ. Zool., Vol. 30, No. 16, June, 1929, p. 448.

TYPE LOCALITY: Yosemite Valley, 7300 feet altitude, Mariposa County, California.

RANGE: Transition zone of the Sierra Nevada from Tulare to Eldorado Counties, California.

Hemidactylium (*GENUS*)

Tschudi, Mém. Soc. Sci. Nat. Neuchâtel, 1838, p. 94
TYPE: *scutatum*

Hemidactylium scutatum (Schlegel)
FOUR-TOED SALAMANDER

Salamandra scutata Schlegel
Fauna Japonica, Saur. Batr., 1838, p. 119.
Hemidactylium scutatum Tschudi
Mém. Soc. Sci. Nat. Neuchâtel, 1838, p. 94.
Hemidactylium scutatum Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 130, fig. 29.

TYPE LOCALITY: Nashville, Tennessee.

RANGE: Southern Maine, Massachusetts, southern Canada westward to Michigan, south to Georgia and the Gulf States, also Arkansas and Illinois.

Plethopsis (*GENUS*)

BISHOP, Herpetologica, Vol. 1, No. 3, p. 93
TYPE: *wrighti*

Plethopsis wrighti BISHOP

Plethopsis wrighti BISHOP
Herpetologica, Vol. 1, No. 3, 1937, p. 93, pl. 9.

TYPE LOCALITY: 8.7 miles southeast of Sandy, Clackamas County, Oregon.

RANGE: Clackamas and Linn Counties, Oregon.

Batrachoseps (*GENUS*)

BONAPARTE, Iconogr. Fauna Italica, Vol. 2, Fasc. 26, 1839, fol. 131 * * * (not paged)
TYPE: *attenuatus*

Batrachoseps attenuatus attenuatus (ESCHSCHOLTZ)

Salamandrina attenuata ESCHSCHOLTZ
Zool. Atlas, Pt. 5, 1833, p. 1, pl. 21, figs. 1-14.
Batrachoseps attenuatus COOPER
Pacif. R. R. Surv., Vol. 12, Pt. 3, 1858, Zoöl., p. viii, pl. 31, fig. 5.
Batrachoseps attenuatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 127, fig. 28.
Batrachoseps attenuatus attenuatus DUNN
Plethodontidae, Northampton, 1926, p. 224.

TYPE LOCALITY: Environs of Bay of San Francisco, California.

RANGE: Southwestern Oregon, California, to Los Angeles County, and lower western slopes of the Sierra Nevada.

Batrachoseps attenuatus caudatus COPE

Batrachoseps caudatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 126, fig. 27.

Batrachoseps attenuatus caudatus DUNN
Plethodontidae, Northampton, 1926, p. 232.

TYPE LOCALITY: Hassler Harbor, Alaska. (Probably on Anette Island, S. E. Alaska.)

RANGE: Known only from type locality and doubtfully from Yukatat Bay.

Batrachoseps attenuatus leucopus (DUNN)

Batrachoseps leucopus DUNN
Copeia, 1922, No. 109, Aug. 15, p. 60.
Batrachoseps attenuatus leucopus DUNN
Plethodontidae, Northampton, 1926, p. 241.

TYPE LOCALITY: North Island, Los Coronados Islands.

RANGE: Los Coronados Islands; Lower California, and adjacent coast of California.

Batrachoseps pacificus pacificus (COPE)

Hemidactylium pacificum COPE
Proc. Ac. Nat. Sci. Phila., 1865, p. 195.
Batrachoseps pacificus COPE
Proc. Ac. Nat. Sci. Phila., 1869, p. 99.
Batrachoseps pacificus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 129.
Batrachoseps pacificus pacificus BERRY CAMPBELL
Copeia, 1931, No. 3, Oct. 30, p. 133.

TYPE LOCALITY: Santa Barbara, California.

RANGE: San Miguel, Santa Rosa and Santa Cruz Islands off the coast of California.

Batrachoseps pacificus catalinae (DUNN)

Batrachoseps catalinae DUNN
Copeia, 1922, No. 109, Aug. 15, p. 62.
Batrachoseps pacificus catalinae BERRY CAMPBELL
Copeia, 1931, No. 3, Oct. 30, p. 133.

TYPE LOCALITY: Santa Catalina Island.

RANGE: Same.

Batrachoseps pacificus major (CAMP)

Batrachoseps major CAMP
Univ. Calif. Publ. Zool., Vol. 12, No. 12, Apr. 2, 1915, p. 327.

Batrachoseps pacificus major Berry Campbell
Copeia, 1931, No. 3, Oct. 30, p. 133.

TYPE LOCALITY: Sierra Madre, 1000 feet elevation, Los Angeles County, California.

RANGE: Los Angeles, Riverside and Orange Counties, southwestern California.

Aneides (GENUS)

Baird, Iconogr. Encycl., Vol. 2, 1849. Zoöl., p. 257.
TYPE: *lugubris*

Aneides aeneus (Cope)

Plethodon aeneus Cope
Amer. Nat., Vol. 15, 1881, p. 878.
Aneides aeneus Dunn
Proc. N. Engl. Zoöl. Club, Vol. 8, Feb. 27, 1923, p. 39.
Plethodon aeneus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 143, fig. 32.

TYPE LOCALITY: Nickajack Cave, southern Tennessee.

RANGE: Virginia, West Virginia, Ohio, Kentucky, Tennessee, Alabama, South Carolina and Georgia.

Aneides ferreus Cope

Anaides ferreus Cope
Proc. Ac. Nat. Sci. Phila., 1869, p. 109.
Autodax ferreus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 185, fig. 45.

TYPE LOCALITY: Fort Umpqua, Oregon.

RANGE: Vancouver Island, British Columbia, to Mendocino County, California.

Aneides flavipunctatus (Strauch)

Plethodon flavipunctatus Strauch
Mém. Ac. Sci. St. Pétersb., Ser. 7, Vol. 16, No. 4, 1870, p. 71.
Aneides flavipunctatus Storer
Univ. Calif. Publ. Zool., No. 27, 1925, p. 119.

TYPE LOCALITY: New Albion, California [probably in Sonoma County, fide Storer].

RANGE: Santa Cruz County, California, north in the Coast Range to the Klamath and southern Cascades.

Aneides lugubris lugubris (HALLOWELL)

Salamandra lugubris HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 4, 1849, p. 126.
Aneides lugubris BAIRD
Iconogr. Encycl., Vol. 2, 1849, Zoöl., p. 257.
Autodax lugubris COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 183, fig. 44.

TYPE LOCALITY: Monterey, California.

RANGE: Central and southern California west of the Sierras south to San Diego County.

Aneides lugubris farallonensis (VAN DENBURGH)

Autodax lugubris farallonensis VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 3, Zool., Vol. 4, 1905, p. 5, pl. 2.
Aneides lugubris farallonensis GRINNELL and CAMP
Univ. Calif. Publ. Zool., Vol. 17, July 11, 1917, p. 135.

TYPE LOCALITY: South Farallon Island, California.

RANGE: The Farallon Islands.

Stereochilus (*GENUS*)

COPE, Proc. Ac. Nat. Sci. Phila., 1869, p. 100
TYPE: *marginatus*

Stereochilus marginatus (HALLOWELL)

Pseudotriton marginatus HALLOWELL
Proc. Ac. Nat. Sci. Phila., 1856, p. 130.
Stereochilus marginatum COPE
Proc. Ac. Nat. Sci. Phila., 1869, p. 101.
Stereochilus marginatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 152, fig. 36.

TYPE LOCALITY: Liberty County, Georgia.

RANGE: Petersburg and the Dismal Swamp, Virginia, to Liberty County, Georgia, in the coastal plain.

Haideotriton (*GENUS*)

CARR, Occ. Papers, Boston Soc. Nat. Hist.,
Vol. 8, 1939, pp. 333–336
TYPE: *wallacei*

Haideotriton wallacei CARR

Haideotriton wallacei CARR

Occ. Papers, Boston Soc. Nat. Hist., Vol. 8, 1939, pp. 333–336, pl. 11–12.

TYPE LOCALITY: From a 200 foot deep artesian well at Albany, Dougherty Co., Georgia.

RANGE: Same as type locality.

Typhlotriton (*GENUS*)

STEJNEGER, Proc. U. S. Nat. Mus., Vol. 15, 1892, p. 115
TYPE: *spelaeus*

Typhlotriton spelaeus STEJNEGER

Typhlotriton spelaeus STEJNEGER

Proc. U. S. Nat. Mus., Vol. 15, Aug. 2, 1892, p. 115, pl. 9.

TYPE LOCALITY: Rock House Cave, Missouri.

RANGE: Ozark Plateau in Missouri, Kansas and Arkansas, and Adair, Mayes and Cherokee Counties, Oklahoma.

Typhlomolge (*GENUS*)

STEJNEGER, Proc. U. S. Nat. Mus., Apr. 18, 1896, p. 620
TPYE: *rathbuni*

Typhlomolge rathbuni STEJNEGER

Typhlomolge rathbuni STEJNEGER

Proc. U. S. Nat. Mus., Vol. 18, Apr. 15, 1896, p. 620

TYPE LOCALITY: Artesian well 188 feet deep, at U. S. Fish Commission Station, San Marcos, Hays County, Texas.

RANGE: Confined to a few wells near San Marcos, Texas.

Gyrinophilus (*GENUS*)

COPE, Proc. Ac. Nat. Sci. Phila., 1869, p. 108
TYPE: *porphyriticus*

Gyrinophilus danielsi (BLATCHLY)

Spelerpes danielsi BLATCHLEY

25 Ann. Rep. Dept. Geol. Indiana, 1900 (1901), p. 760.

Gyrinophilus danielsi Fowler and Dunn
Proc. Ac. Nat. Sci. Phila., Vol. 69, 1917, p. 19.
Gyrinophilus porphyriticus danielsi Stejneger and Barbour
Check List N. Amer. Amph. & Rept., Ed. 4, 1939, p. 21.
Gyrinophilus danielsi Mittleman
Proc. N. Engl. Zool. Club, 20, 1942, pp. 33–38, text fig. 4.

TYPE LOCALITY: Mt. Collins and Indian Pass, Sevier Co., Tennessee.

RANGE: Altitudes of 4500 feet or higher, of North Carolina and Tennessee.

Gyrinophilus dunni Mittleman and Jopson

Gyrinophilus dunni Mittleman and Jopson
Smithsonian Miscl. Coll. 101, No. 2, July 14, 1941, pp. 1–5, pl. 1.

TYPE LOCALITY: Clemson College, Clemson, Pickens Co., S. Carolina. 700 feet altitude.

RANGE: Southern Applachian uplift below 3,500 feet in North Carolina, South Carolina, Tennessee and Georgia.

Gyrinophilus porphyriticus porphyriticus (Green)

Salamandra porphyritica Green
Contr. Maclur. Lyc., Vol. 1, 1827, p. 3, pl. 1, fig. 2.
Gyrinophilus porphyriticus Cope
Proc. Ac. Nat. Sci. Phila., 1869, p. 108.
Gyrinophilus porphyriticus Cope
Bull. U. S. Nat. Mus., No. 45, 1889, p. 155, fig. 37.

TYPE LOCALITY: French Creek near Meadville, Crawford County, Pennsylvania.

RANGE: Northeastern States as far south at least as northern Virginia, the northern half of West Virginia, and west through Pennsylvania to the adjacent portions of glaciated northeastern and central Ohio.

Gyrinophilus porphyriticus duryi (Weller)

Pseudotriton duryi Weller
Proc. Junior Soc. Nat. Sci., Cincinnati, Vol. 1, 1930, Nos. 5–6, p. [6].

TYPE LOCALITY: Cascade Caves, near Grayson, Carter County, Kentucky.

RANGE: Limestone regions in Kentucky and southern Ohio.

Gyrinophilus porphyriticus inagnoscus Mittleman

Gyrinophilus porphyriticus inagnoscus Mittleman
Proc. New Engl. Zool. Club, 20, Aug. 1942, pp. 27–30, pl. 6, fig. F, text fig. 1.

TYPE LOCALITY: Salt Creek, 4 miles southwest of Bloomingville, Good Hope Township, Hocking County, Ohio.

RANGE: The greater portion of unglaciated Ohio, with the exception of the limestone regions of the southern tier of counties bordering the Ohio River.

Gyrinophilus lutescens (Rafinesque)

Triturus lutescens Rafinesque
Atlantic Jour., 1 (3), 1832, p. 121.
Gyrinophilus lutescens Mittleman
Proc. New Engl. Zool. Club, 20, 1942, pp. 33–35, pl. 5, fig. C.

TYPE LOCALITY: West Kentucky in rocky limestone springs in the barrens or glades.

RANGE: Limestone caves of Kentucky.

Pseudotriton (*GENUS*)

Tschudi, Mém. Soc. Sci. Nat Neuchatel, 1838, p. 60
TYPE: *subfuscus* = *ruber*

Pseudotriton montanus montanus (Baird)

Pseudotriton montanus Baird
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, p. 293.
Spelerpes ruber montanus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 179.
Eurycea montana Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 19.

TYPE LOCALITY: South Mountain, near Carlisle, Pennsylvania.

RANGE: Northern New York to western Georgia and westward to Ohio, Kentucky and Tennessee.

Pseudotriton montanus diastictus Bishop

Pseudotriton montanus diastictus Bishop
Occ. Papers Univ. Mich. Mus. Zool. 351, 1941, p. 14.

TYPE LOCALITY: Cascade Caverns, Carter Co., Kentucky.

RANGE: Unglaciated plateau country of southern Ohio, central and eastern Kentucky, southwestern West Virginia and eastern Tennessee.

Pseudotriton montanus floridanus NETTING and GOIN

Pseudotriton montanus floridanus NETTING and GOIN
Ann. Carnegie Mus. 29, art. 6, 1942, pp. 175–183, pl. 1, fig. 5.

TYPE LOCALITY: A seepage along "C" Creek on University of Florida Campus, Gainesville, Alachua County, Florida.

RANGE: Alachua, Jackson and Seminole Counties, Florida.

Pseudotriton montanus flavissimus (HALLOWELL)

Pseudotriton flavissimus HALLOWELL
Proc. Ac. Nat. Sci. Phila., 1856, p. 130.

TYPE LOCALITY: Liberty County, Georgia.

RANGE: Coastal plain of Georgia to eastern Louisiana, except peninsular Florida.

Pseudotriton ruber ruber (SONNINI)

RED SALAMANDER

Salamandra rubra SONNINI
in Latreille, History. Nat. Rept., Vol. 4, 1802, p. 305.
Pseudotriton ruber ruber DUNN
Proc. Biol. Soc. Wash., Vol. 33, Dec. 30, 1920, p. 133.
Spelerpes ruber COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 172, fig. 43.

TYPE LOCALITY: United States.

RANGE: From Albany County, New York to northern Georgia westward to Ohio, Kentucky, Tennessee, Alabama, and northern Mississippi.

Pseudotriton ruber nitidus DUNN

Pseudotriton ruber nitidus DUNN
Proc. Biol. Soc. Wash., Vol. 33, Dec. 30, 1920, p. 133.

TYPE LOCALITY: White Top Mountain, Virginia, 4000 feet.

RANGE: Area in southwestern Virginia, northwestern North Carolina and northeastern Tennessee bounded by Stone and Iron Mountains to the west, the Blue Ridge to the east, and the Black Mountains to the south; northern plateau of southern Blue Ridge.

Pseudotriton ruber schencki (Brimley)

Spelerpes ruber schencki Brimley
Proc. Biol. Soc. Wash., Vol. 25, Dec. 4, 1912, p. 139, pl. 7, figs. 12, 13, 15, 17, 18, 20–22.
Eurycea rubra schencki Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 20.

TYPE LOCALITY: Sunburst, North Carolina, 3200 feet.

RANGE: Southern Blue Ridge Mountains in southwestern North Carolina and northern Georgia. Reaches 3500 feet in the Balsam Mountains.

Pseudotriton ruber vioscai Bishop

Pseudotriton ruber vioscai Bishop
Boston Soc. Nat. Hist., 5, 1928, p. 247.

TYPE LOCALITY: A spring run 10 miles west of Bogalusa, La.

RANGE: Vicinity of Bogalusa, La., and western Florida.

Eurycea (*GENUS*)

Rafinesque, Kentucky Gazette, Lexington, N. S., Vol. 1, No. 9, Feb. 28, 1822, p. 3, column 6
TYPE: *lucifuga*

Eurycea bislineata bislineata (Green)

Salamandra bislineata Green
Journ. Ac. Nat. Sci. Phila., Vol. 1, Sept. 1818, p. 352.
Eurycea bislineata bislineata Dunn
Proc. Biol. Soc. Wash., Vol. 33, Dec. 30, 1920, p. 134.
Spelerpes bilineatus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 163, fig. 40.

TYPE LOCALITY: By inference Princeton, New Jersey.

RANGE: Quebec, New Brunswick, to Indiana, Tennessee, and Virginia.

Eurycea bislineata cirrigera (Green)

Spelerpes cirrigera Green
Journ. Ac. Nat. Sci. Phila., Vol. 6, 1839, p. 253.
Eurycea bislineata cirrigera Dunn
Proc. Biol. Soc. Wash., Vol. 33, Dec. 30, 1920, p. 135.

TYPE LOCALITY: New Orleans, Louisiana.

RANGE: Lowlands of eastern North Carolina, south to Sewannee River, Florida, west through Alabama and southern Louisiana; western Tennessee.

Eurycea bislineata major TRAPIDO and CLAUSEN

Eurycea bislineata major TRAPIDO and CLAUSEN
Copeia, 1938, No. 3, Sept. 24, p. 118.

TYPE LOCALITY: Ouiatchouan River, Lake St. John County, P. Q., Canada.

RANGE: Extreme eastern Quebec north and south of the St. Lawrence River.

Eurycea bislineata wilderae DUNN

Eurycea bislineata wilderae DUNN
Proc. Biol. Soc. Wash., Vol. 33, Dec. 30, 1920, p. 134.

TYPE LOCALITY: White Top Mountain, Virginia, 4000 feet.

RANGE: The Southern Blue Ridge region from White Top Mountain, Virginia, south through North Carolina, South Carolina, and Tennessee to Rabun and Gilmer Counties, Georgia.

Eurycea griseogaster MOORE and HUGHES

Eurycea griseogaster MOORE and HUGHES
Copeia, 1941, No. 3, Sept. 30, pp. 139–142.

TYPE LOCALITY: Swimmer's Creek, near its junction with the Illinois River, 10 miles northeast of Gore, Sequoyah Co., Oklahoma.

RANGE: Same as type locality.

Eurycea longicauda longicauda (GREEN)

Salamandra longicauda GREEN
Journ. Ac. Nat. Sci. Phila., Vol. 1, Sept. 1818, p. 351.
Eurycea longicauda STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 19.
Spelerpes longicaudus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 168, fig. 41.
Eurycea longicauda longicauda BAILEY
Occ. Papers Mus. Zool. Univ. Mich., No. 364, Dec. 16, 1937, p. 8.

TYPE LOCALITY: New Jersey (probably near Princeton).

RANGE: Central New York to northern Georgia, westward to southern Missouri and northeastern Arkansas.

Eurycea longicauda guttolineata (HOLBROOK)

Salamandra gutto-lineata HOLBROOK
N. Amer. Herp., Ed. 1, Vol. 2, 1838, p. 61, pl. 12.
Eurycea gutto-lineata STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 19.
Spelerpes guttolineatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 170, fig. 42.
Eurycea longicauda gutto-lineata Bailey
Occ. Papers Mus. Zool. Univ. Mich., No. 364, Dec. 16, 1937, p. 8.

TYPE LOCALITY: "Carolina in the middle country."

RANGE: Fairfax County, Virginia, to Liberty County, Georgia, west to Alabama, Mississippi, and Louisiana. Western Tennessee. Region includes southern coastal plain and Piedmont, southern Blue Ridge, and extreme southern part of the Appalachian Valley.

Eurycea longicauda melanopleura (COPE)

Spelerpes melanopleurus COPE
Proc. Acad. Nat. Sci. Phila., 1893, p. 383.
Eurycea melanopleura STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 25.
Eurycea longicauda melanopleura BISHOP
Occ. Papers, Mus. Zool., Univ. Mich., 451, 1941, pp. 19–20.

TYPE LOCALITY: Raley's Creek, White River, Missouri.

RANGE: Franklin and Jasper Counties, Missouri, to Pulaski County, Arkansas. Extends into Texas and Kansas.

Eurycea longicauda pernix MITTLEMAN

Eurycea longicauda pernix MITTLEMAN
Proc. New Engl. Zool. Club 21, 1942, pp. 101–105, pl. 20.

TYPE LOCALITY: Along Jimmie Strahl Creek (tributary of Salt Creek), Brown County State Park, 2.5 miles southeast of Nashville, Indiana.

RANGE: Unglaciated section of Indiana, extreme western Tennessee and eastern Illinois.

Eurycea lucifuga RAFINESQUE

Eurycea lucifuga RAFINESQUE
Kentucky Gaz., Lexington, N.S., 1, No. 9, 1822, p. 3, column 6.
Gyrinophilus maculicaudus COPE
Amer. Nat., Vol. 24, 1890, p. 967.

TYPE LOCALITY: "Caves near Lexington, Kentucky."

RANGE: West Virginia, Tennessee, and northern Alabama westward through Kentucky, and southern Indiana to Missouri and northwestern Arkansas and Oklahoma.

Eurycea multiplicata (COPE)

Spelerpes multiplicatus COPE
Proc. Ac. Nat. Sci. Phila., 1869, p. 106.
Eurycea multiplicata STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 20.
Spelerpes multiplicatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 162, fig. 39.

TYPE LOCALITY: Red River, in eastern Oklahoma.

RANGE: Stone County, Missouri, to Pulaski County, Arkansas, Kansas and the Jemez Mountains, New Mexico. Distribution apparently discontinuous.

Eurycea nana BISHOP

Eurycea nana BISHOP
Occ. Papers Mus. of Zool., Univ. Mich., 451, pp. 6–9, pl. I, fig. 1.

TYPE LOCALITY: Lake at head of the San Marcos River at San Marcos, Hays County, Texas.

RANGE: Same as type locality.

Eurycea neotenes BISHOP and WRIGHT

Eurycea neotenes BISHOP and WRIGHT
Proc. Biol. Soc. Wash., Vol. 50, Sept. 10, 1937, p. 142.

TYPE LOCALITY: Culebra Creek 5 miles north of Helotes, Bexar County, Texas.

RANGE: The vicinity of the type locality.

Eurycea tynerensis MOORE and HUGHES

Eurycea tynerensis MOORE and HUGHES
Amer. Midland Nat., 22, 1939 (3), pp. 696–699.

TYPE LOCALITY: Tyner Creek, trib. for Barron Folk Cr., near Proctor, Adair Co., Oklahoma.

RANGE: Same as type locality.

Manculus (*GENUS*)

COPE, Proc. Ac. Nat. Sci. Phila., 1869, p. 101
TYPE: *quadridigitatus*

Manculus quadridigitatus (HOLBROOK)

DWARF SALAMANDER

Salamandra quadridigitata HOLBROOK
N. Amer. Herp. Ed. 2, Vol. 5, 1842, p. 65, pl. 21.
Manculus quadridigitatus COPE
Proc. Ac. Nat. Sci. Phila., 1869, p. 101.
Manculus quadridigitatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 159, fig. 38.

TYPE LOCALITY: Georgia, South Carolina, and Florida.

RANGE: North Carolina south to southern Georgia and westward through the Gulf States to Texas, and Arkansas to Kansas.

Hydromantes (*GENUS*)

GISTEL, Naturg. Thierr., 1848, p. xi
TYPE: *genei*

Hydromantes platycephalus (CAMP)

Spelerpes platycephalus CAMP
Univ. Calif. Publ. Zool., Vol. 17, Sept. 18, 1916, p. 11.
Hydromantes platycephalus DUNN
Proc. N. Engl. Zoöl. Club, Vol. 8, Feb. 27, 1923, p. 40.
Eurycea platycephala STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 20.

TYPE LOCALITY: Head of Lyell Canon, the Yosemite National Park, California, 10,800 feet altitude.

RANGE: High Sierra Nevada from Tuolumne County and Yosemite National Park south to northern boundary of Sequoia National Park.

MEANTES (*SUBORDER*)

Linné, Syst. Nat., Ed. 12, Vol. 1, Pt. 2, 1766,
sign. Rrrr 5, Addenda (not paged)

SIRENIDAE (*FAMILY*)

Siren (*GENUS*)

Linné, Syst. Nat., Ed. 12, Vol. 1, Pt. 2, 1766,
sign. Rrrr 5, Addenda (not paged)
TYPE: *lacertina*

Siren intermedia intermedia LeConte

Siren intermedia LeConte
Jour. Ac. Nat. Sci. Phila., Vol. 5, Pt. 2, 1827, p. 322.
Siren intermedia Noble and Marshall
Amer. Mus. Nov., No. 532, 1932, p. 1.
Siren intermedia intermedia Goin
Annals Carnegie Mus. 29, 1942, pp. 211–217.

TYPE LOCALITY: "Southern States."

RANGE: Coastal plain from Virginia to the Florida Parishes of Louisiana and south to central Florida.

Siren intermedia nettingi Goin

Siren intermedia nettingi Goin
Annals Carnegie Mus., 29, 1942, pp. 211–217.

TYPE LOCALITY: Imboden, Lawrence Co., Arkansas.

RANGE: Southern Louisiana northward to southern Illinois and Indiana, west and south to Maverick County, Texas and northern Tamaulipas, Mexico.

Siren lacertina Linné

MUD-EEL

Siren lacertina Linne
Syst. Nat., Ed. 12, Vol. 1, Pt. 2, 1766, sign. Rrrr 5. Addenda (not paged).
Siren lacertina Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 226, fig. 57.

TYPE LOCALITY: "Habitat in Carolinae paludosis."

RANGE: District of Columbia south to southern Florida, in the coastal plain.

Pseudobranchus (*GENUS*)

GRAY, Ann. Philos, N. S., Vol. 10, 1825, p. 216
TYPE: *striatus*

Pseudobranchus striatus striatus (LECONTE)

Siren striata LECONTE
Ann. Lyc. Nat. Hist., New York, Vol. 1, Pt. 1, 1824, p. 53, pl. 4.
Pseudobranchus striatus GRAY
Ann. Philos., N. S., Vol. 10, 1825, p. 216.
Pseudobranchus striatus striatus NETTING and GOIN
Ann. Carnegie Mus. 29, art. 6, 1942, pp. 183–193, pl. 1, figs. 3–4.

TYPE LOCALITY: Restricted by Harper to Riceborough, Liberty Co., Georgia.

RANGE: Atlantic Coastal Plain from Charleston, South Carolina, south to about the Okefinokee Swamp.

Pseudobranchus striatus axanthus NETTING and GOIN

Pseudobranchus striatus axanthus NETTING and GOIN
Ann. Carnegie Mus., 29, Art. 6, 1942, pp. 183–193, pl. 1, figs. 1, 2.

TYPE LOCALITY: Eastern edge of Payne's Prairie, where Prairie Creek enters River Styx, about 5 miles southeast of Gainesville, Alachua County, Florida.

RANGE: From about the Okefinokee Swamp south throughout peninsular Florida, especially among water hyacinths.

SALIENTIA (*ORDER*)

LAURENTI, Syn. Rept., 1768, p. 24

COSTATA (*SUBORDER*)

LATASTE, Act. Soc. Linn. Bordeaux, Vol. 33, 1879, p. 339

ASCAPHIDAE (*FAMILY*)

Ascaphus (*GENUS*)

STEJNEGER, Proc. U. S. Nat. Mus., Vol. 21, June 20, 1899, p. 899
TYPE: *truei*

Ascaphus truei STEJNEGER

Ascaphus truei STEINEGER
Proc. U. S. Nat. Mus., Vol. 21, June 20, 1899, p. 900, figs. 1–4, pl. 89.

TYPE LOCALITY: Humptulips, Washington.

RANGE: Western Montana, the Cascades, British Columbia and the Siskiyou Mountains, west to the Pacific and south to Humboldt County, California.

LINGUATA (*SUBORDER*)

GRAVENHORST, Thierreich, 1845, p. 43

SCAPHIOPODIDAE (*FAMILY*)

Scaphiopus (*GENUS*)

HOLBROOK, N. Amer. Herp., Ed. 1, Vol. 1, 1836, p. 85
TYPE: *solitarius* = holbrookii

Scaphiopus bombifrons COPE

Scaphiopus bombifrons COPE
Proc. Ac. Nat. Sci. Phila., 1863, p. 53.
Scaphiopus bombifrons SMITH
Amer. Midl. Natl., Vol. 15, Pt. 4, 1934, p. 190.

TYPE LOCALITY: Fort Union on the Missouri River, Platte River, 200 miles west of Fort Kearney, and the Llano Estacado, Texas.

RANGE: Kansas, Nebraska, the Dakotas, south to Oklahoma, northwestern Texas, New Mexico, and Idaho.

Scaphiopus couchii BAIRD

Scaphiopus couchii BAIRD
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 62.
Scaphiopus couchii COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 301, fig. 75.

TYPE LOCALITY: Rio Nasas, Coahuila, and Matamoros, Tamaulipas, Mexico.

RANGE: Oklahoma, Kansas, Nebraska, the Dakotas, south to northwestern Texas, New Mexico, and Idaho.

Scaphiopus hammondii BAIRD

Scaphiopus hammondii BAIRD
Rep. Pacif. R. R. Surv., Vol. 10, Williamson's Route, Pt. 4, 1859, p. 12, pl. 28, fig. 2.

Spea hammondii COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 303, fig. 77.

TYPE LOCALITY: Fort Reading, California.

RANGE: From British Columbia south through Oregon and Idaho to Central Valley of California, around Salinas, Monterey County; throughout Nevada, parts of Arizona, New Mexico and the vicinity of Zion Canyon, Utah.

Scaphiopus holbrookii holbrookii (HARLAN)

SPADEFOOT

Rana holbrookii HARLAN
Med. Phys. Researches, 1835, p. 105.
Scaphiopus holbrookii COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 298.
Scaphiopus holbrookii holbrookii STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 26.

TYPE LOCALITY: South Carolina.

RANGE: Eastern states, Massachusetts to Florida, west to Louisiana, Texas to Arkansas, and as far north as West Virginia and Martin County, Indiana, but not in Ohio.

Scaphiopus holbrookii albus (GARMAN)

Scaphiopus albus GARMAN
Proc. Amer. Assoc. Adv. Sci., Buffalo, 1877, p. 194.
Scaphiopus holbrookii albus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 26.

TYPE LOCALITY: Key West, Florida.

RANGE: Florida Keys and possibly the extreme southern part of the peninsula of Florida.

Scaphiopus hurterii STRECKER

Scaphiopus hurterii STRECKER
Proc. Biol. Soc. Wash., Vol. 23, July 23, 1910, p. 116.
Scaphiopus hurterii SMITH
Herpetologica, Vol. 1, No. 4, Nov. 16, 1937, p. 104, figs. 2, 4, 6.

TYPE LOCALITY: Waco, Texas.

RANGE: Eastern and central Texas, Oklahoma and western Arkansas.

Scaphiopus intermontanus (Cope)

Spea hammondii intermontanus Cope
Proc. Acad. Nat. Sci. Phila., 1883, p. 14.
Scaphiopus intermontanus Tanner
The Great Basin Naturalist, Vol. 1, no. 1, 25 July 1939, p. 13, pl. 1, fig. 9–10, pl. 2, fig. 3, pl. 3.

TYPE LOCALITY: Salt Lake City, Utah.

RANGE: Idaho, Nevada, Utah, Northern Arizona and S. E. Washington.

BUFONIDAE (*FAMILY*)

Bufo (*GENUS*)

Laurenti, Syn. Rept., 1768, p. 25
TYPE: *vulgaris* = bufo

Bufo alvarius Girard

Bufo alvarius Girard
U. S. Mex. Bound. Surv., Vol. 2, 1859, Rept., p. 26, pl. 41, figs. 1–6.
Bufo alvarius Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 265, fig. 62.

TYPE LOCALITY: Valley of the Gila and Colorado Rivers.

RANGE: Colorado River and Imperial Valley, California.

Bufo americanus americanus (Holbrook)
AMERICAN TOAD

Bufo americanus Holbrook
N. Amer. Herp., Ed. 1, Vol. 1, 1836, p. 75, pl. 2.
Bufo lentiginosus americanus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 284, fig. 70.

TYPE LOCALITY: "From Maine through all the Atlantic States."

RANGE: Eastern North America from Hudson Bay to Alberta and Labrador southward. Also eastern Oklahoma.

Bufo americanus copei Yarrow and Henshaw

Bufo americanus copei Yarrow and Henshaw
Rep. Rept. Batr. Calif. Ariz. Nev., 1878, p. 207; reprint p. 4.
Bufo americanus copei Gaige
Copeia, 1932, No. 3, Oct. 7, p. 134.

TYPE LOCALITY: James Bay, Ontario.
RANGE: Northern Ontario.

Bufo boreas boreas (BAIRD and GIRARD)

Bufo boreas BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 174.
Bufo columbiensis COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 267, fig. 63.

TYPE LOCALITY: Columbia River and Puget Sound.

RANGE: Northeastern California south to Mono County; Colorado north and west through western Montana to Puget Sound. Also British Columbia and southwestern Alaska to Prince William Sound.

Bufo boreas halophilus (BAIRD and GIRARD)

Bufo halophila BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1853, p. 301.
Bufo boreas halophilus CAMP
Univ. Calif. Publ. Zool., Vol. 17, No. 9, Feb. 3, 1917, p. 116.
Bufo columbiensis halophilus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 269, fig. 64.

TYPE LOCALITY: Benicia, California.

RANGE: Most of California except the northeastern part, even into the high Sierra Nevada about Lake Tahoe; except about Newberry Spring, San Bernardino County and Victorville on the Mojave River; not found in the desert areas. Also in vicinity of Walker Lake, Western Nevada.

Bufo boreas nelsoni STEJNEGER

Bufo boreas nelsoni STEJNEGER
N. Amer. Fauna No. 7, 1893, pp. 220–221, pl. 3, figs. 4a, 4b.
Bufo boreas nelsoni LINSDALE
Proc. Amer. Acad. Arts & Sc., 73, No. 8, 1940, p. 204.

TYPE LOCALITY: Oasis Valley, Nye County, Nevada.

RANGE: Southern and eastern Nye County and northern Lincoln County, Nevada.

Bufo californicus (CAMP)

Bufo cognatus californicus CAMP
Univ. Calif. Publ. Zool., Vol. 12, April 2, 1915, p. 331.

Bufo californicus Myers
Proc. Biol. Soc. Wash., Vol. 43, March 12, 1930, p. 73.

TYPE LOCALITY: Santa Paula, Ventura County, California.

RANGE: Coastal area of southern California from the Upper Salinas Valley to the northern Sierra San Pedro Martir, Lower California.

Bufo canorus Camp

Bufo canorus Camp
Univ. Calif. Publ. Zool., Vol. 17, No. 6, Nov. 17, 1916, p. 59.

TYPE LOCALITY: Porcupine Flat, Yosemite National Park, California.

RANGE: Wet meadows in the high central Sierra Nevada from Mono and Trolumne Counties to Fresco County, California.

Bufo cognatus (Say)

Bufo cognatus Say
Long's Exp. Rocky Mts., Vol. 2, 1823, p. 190.
Bufo cognatus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 275, fig. 67.

TYPE LOCALITY: Arkansas River, Prowers County, Colorado.

RANGE: West of the Mississippi River from Texas and Arkansas north to Minnesota and North Dakota, west to Wyoming, Utah, Nevada and the Imperial Valley, California.

Bufo compactilis Wiegmann

Bufo compactilis Wiegmann
Isis, 1833, p. 661.
Bufo compactilis Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 272, fig. 65.

TYPE LOCALITY: Mexico.

RANGE: Northern Mexico, Texas, Oklahoma, New Mexico, Arizona and southeastern Nevada.

Bufo debilis Girard

Bufo debilis Girard
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 87.
Bufo debilis Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 264, fig. 61.

TYPE LOCALITY: Lower part of the valley of the Rio Grande, Texas, and in Tamaulipas, Mexico.

RANGE: Lower Rio Grande Valley and State of Tamaulipas, Mexico.

Bufo exsul MYERS

Bufo exsul MYERS
Occ. Papers Mus. Zool. Univ. Mich., 460, 1942, pp. 1–13, pl. 1–3.

TYPE LOCALITY: Deep Springs, Deep Springs Valley, Inyo County, California.

RANGE: Same.

Bufo hemiophrys COPE

Bufo hemiophrys COPE
Proc. Amer. Philos. Soc. Vol. 23, 1886, p. 515.
Bufo hemiophrys COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 273, fig. 66.

TYPE LOCALITY: Pembina and Turtle Mountains, North Dakota.

RANGE: Alberta, Manitoba, Northwest Territory, and North Dakota.

Bufo insidior GIRARD

Bufo insidior GIRARD
Proc. Ac. Nat. Sci. Phila., 1854, Vol. 7, p. 88.
Bufo insidior TAYLOR
Sci. Bull. Univ. Kansas, Vol. 24, 1936, p. 513.

TYPE LOCALITY: Chihuahua, Mexico.

RANGE: Kansas, Texas, New Mexico, Oklahoma, Chihuahua, Durango and Zacatecas.

Bufo marinus (LINNÉ)

Rana marina LINNÉ
Syst. Nat., Ed. 10, 1758, Vol. 1, p. 211.
Bufo marinus SCHNEIDER
Hist. Amph., Pt. 1, 1799, p. 219.
Bufo marinus BOULENGER
Cat. Batr. Sal. Brit. Mus., 1882, p. 315.

TYPE LOCALITY: America.

RANGE: Entering southern Texas.

Bufo punctatus BAIRD and GIRARD

Bufo punctatus BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 173.
Bufo punctatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 262, fig. 60.

TYPE LOCALITY: Rio San Pedro, tributary of the Rio Grande del Norte, Texas.

RANGE: Kansas, western Texas, Arizona, Utah, Colorado, Nevada, deserts of southeastern California, and Lower California.

Bufo quercicus HOLBROOK

Bufo quercicus HOLBROOK
N. Amer. Herp., Ed. 1, Vol. 4, 1840, p. 109, pl. 22.
Bufo quercicus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 291, fig. 72.

TYPE LOCALITY: Charleston, South Carolina, and Smithville, North Carolina.

RANGE: North Carolina to Alabama and Florida, and west to Louisiana.

Bufo terrestris (BONNATERRE)
SOUTHERN TOAD

Rana terrestris BONNATERRE
Tabl. Encycl. Méth., Erp., 1789, p. 8.
Bufo lentiginosus lentiginosus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 289, fig. 71.

TYPE LOCALITY: "La Caroline."

RANGE: Lowlands of North Carolina south to southern Florida, and west along the Gulf to the Mississippi.

Bufo valliceps WIEGMANN

Bufo valliceps WIEGMANN
Isis, 1833, p. 657.
Bufo valliceps COPE
Bull U. S. Nat. Mus., No. 34, 1889, p. 292, fig. 73.

TYPE LOCALITY: Mexico.

RANGE: Louisiana, New Mexico, Texas south to Costa Rica.

Bufo woodhousii woodhousii GIRARD

Bufo woodhousii GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 86.
Bufo lentiginosus woodhousei COPE
Bull U. S. Nat. Mus., No. 34, 1889, p. 281, fig. 69.
Bufo woodhousii woodhousii BAILEY and BAILEY
Iowa State Coll. Journ. Sci. 15, No. 2, p. 174.

TYPE LOCALITY: "New Mexico"—San Francisco Mountain, Coconino County, Arizona.

RANGE: Texas to Kansas, Nebraska, Missouri, western Iowa, Montana, Idaho, western Washington and eastern Oregon, south to Nevada, Arizona and southeastern California.

Bufo woodhousii fowleri BAILEY and BAILEY
FOWLER'S TOAD

Bufo woodhousii fowleri BAILEY and BAILEY
Iowa State Coll. Journ. Sci. 15, No. 2, p. 174.
Bufo fowleri HINCKLEY
Proc. Boston Soc. Nat. Hist., Vol. 21, 1882, p. 310.
Bufo lentiginosus fowleri COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 279, fig. 68.

TYPE LOCALITY: Milton, Massachusetts.

RANGE: New England and New York, southward to Georgia, west to Michigan, Missouri and southeastern Iowa, but occurring also on the Atlantic and Gulf coastal plain to central Texas. (Not known in peninsular Florida.)

HYLIDAE (*FAMILY*)

Acris (*GENUS*)

DUMÉRIL and BIBRON, Erp. Gén., Vol. 8, 1841, p. 506
TYPE: *gryllus*

Acris crepitans BAIRD

Acris crepitans BAIRD
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 59.

Acris gryllus crepitans COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 326, fig. 82.

TYPE LOCALITY: "Northern states generally."

RANGE: Connecticut to the Canadian northwest, and to Georgia, Louisiana, Texas and Oklahoma, from sea level to 2000 feet.

Acris gryllus (LE CONTE)
CRICKET-FROG
Rana gryllus LE CONTE
Ann. Lyc. Nat. Hist., New York, Vol. 1, Pt. 2, 1825, p. 282.
Acris gryllus DUMÉRIL and BIBRON
Erp. Gén., Vol. 8, 1841, p. 507.
Acris gryllus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 324, fig. 82.

TYPE LOCALITY: Probably Le Conte Plantation, Riceborough, Georgia.

RANGE: Dismal Swamp, Virginia, to Louisiana in the coastal plain.

Pseudacris (*GENUS*)

FITZINGER, Syst. Rept., 1843, p. 31
TYPE: *nigrita*

Pseudacris brachyphona (COPE)
Chorophilus feriarum brachyphonus COPE
Bull. U. S. Nat. Mus., 1889, No. 34, p. 341.
Pseudacris brachyphona WALKER
Ohio Journ. Sci., Vol. 32, No. 4, 1932, p. 379.

TYPE LOCALITY: "West Pennsylvania, near the Kiskiminitas River."

RANGE: Eastern Ohio, West Virginia, western Pennsylvania, western Maryland, eastern Kentucky and western Virginia.

Pseudacris brimleyi BRANDT and WALKER
Pseudacris brimleyi BRANDT and WALKER
Occ. Papers, Mus. Zoöl. Univ. Mich., No. 272, Oct. 31, 1933, p. 2.

TYPE LOCALITY: Washington, North Carolina.

RANGE: Lower coastal plain between the Dismal Swamp, Virginia, and the lower Ogeechee River, northern Georgia.

Pseudacris feriarum (Baird)

Helocaetes feriarum Baird
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 60.
Pseudacris feriarum Cope
Proc. Ac. Nat. Sci. Phila., 1862, p. 157.
Chorophilus feriarum Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 339, fig. 86.

TYPE LOCALITY: Carlisle, Pennsylvania.

RANGE: New Jersey, Pennsylvania, and possibly into South Carolina and northwestern Florida.

Pseudacris nigrita nigrita (Le Conte)

Rana nigrita Le Conte
Ann. Lyc. Nat. Hist., New York, Vol. 1, Pt. 2, 1825, p. 282.
Pseudacris nigrita Günther
Cat. Batr. Sal. Brit. Mus., 1858, p. 97.
Chorophilus nigritus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 337, fig. 85.

TYPE LOCALITY: Not given.

RANGE: North Carolina, south through Florida, west to Mississippi.

Pseudacris nigrita clarkii (Baird)

Helocaetes clarkii Baird
Proc. Ac. Nat. Hist., Phila., Vol. 7, 1854, p. 60.

TYPE LOCALITY: Galveston and Indianola, Texas.

RANGE: Kansas to eastern Texas.

Pseudacris nigrita septentrionalis (Boulenger)

Chorophilus septentrionalis Boulenger
Cat. Batr. Sal. Brit. Mus., 1882, p. 335, pl. 23, fig. 1.
Pseudacris septentrionalis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 31.

TYPE LOCALITY: Great Bear Lake, Canada.

RANGE: Swamps of northwestern Canada.

Pseudacris nigrita triseriata (WIED)

Hyla triseriata WIED
Reise Nord-Amer., Vol. 1, Pt. 4, 1838, p. 249.
Pseudacris triseriata STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 31.
Chorophilus triseriatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 342, fig. 87.

TYPE LOCALITY: Mt. Vernon, Ohio River, Indiana.

RANGE: Oswego, N. Y., west along the southern shore of Lake Ontario, west to northeastern Arizona, Utah, Nevada, Idaho, and south to Arkansas and Louisiana.

Pseudacris nigrita verrucosa (COPE)

Chorophilus verrucosus COPE
Proc. Amer. Philos. Soc., Vol. 17, 1877, p. 87.
Pseudacris nigrita verrucosa BRADY and HARPER
Proc. Biol. Soc. Wash., Vol. 48, May 3, 1935, p. 108.

TYPE LOCALITY: Volusia, probably not on Lake George but the town of National Gardens, in Volusia County, Florida.

RANGE: Peninsular Florida.

Pseudacris ornata (HOLBROOK)

Rana ornata HOLBROOK
N. Amer. Herp., Ed. 1, Vol. 1, 1836, p. 97, pl. 16.
Pseudacris ornata STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, pl. 31.
Chorophilus ornatus COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 333.

TYPE LOCALITY: Between the Cooper and Ashley Rivers, four miles from Charleston, South Carolina.

RANGE: North Carolina to Lake Co., Florida, and extreme southern Louisiana, almost entirely within the coastal plain.

Pseudacris streckeri WRIGHT and WRIGHT

Pseudacris streckeri WRIGHT and WRIGHT
Handbook of Frogs and Toads, 1933, p. 102, pl. 25.
Pseudacris nigrita occidentalis (part) STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 32.

TYPE LOCALITY: Not mentioned.

RANGE: Bell, Bexar, Brazos, Cooke, Dallas, Ellis, Erath, Hays, Hood, Kendall, McCulloch, McLennan, Parker, Travis, and Williamson Counties, Texas.

Hyla (*GENUS*)

LAURENTI, Syn. Rept., 1868, p. 32
TYPE: *viridis*

Hyla andersonii BAIRD
ANDERSON TREE-FROG

Hyla andersonii BAIRD
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 60.
Hyla andersonii COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 365, fig. 91, pl. 83, fig. 1.

TYPE LOCALITY: Anderson, South Carolina.

RANGE: The pine barrens of southern New Jersey (in and near white cedar swamps and cranberry bogs) north almost to the Raritan River; swamps along the lower Peedee-Yadkin system in North Carolina.

Hyla arenicolor COPE

Hyla arenicolor COPE
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 6, July, 1866, p. 84.
Hyla arenicolor COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 369, fig. 93.

TYPE LOCALITY: Northern Sonora, Mexico.

RANGE: Most of the southwestern United States from Utah to the desert regions of southeastern and southwestern California and the California coast from Ventura County southward; east to Texas, and in Mexico south to Guadalajara and Toluca.

Hyla avivoca VIOSCA

Hyla avivoca VIOSCA
Proc. Biol. Soc. Wash., Vol. 41, June 29, 1931, p. 89.

TYPE LOCALITY: Mandeville, Louisiana.

RANGE: Eastern Louisiana north to Tennessee, southern Illinois and Kentucky; east to Florida and Georgia.

Hyla baudinii baudinii (Duméril and Bibron)

Hyla baudinii Duméril and Bibron
Erp. Gén., Vol. 8, 1841, p. 564.
Smilisca baudinii Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 379.

TYPE LOCALITY: Mexico.

RANGE: Central America north to southern Texas.

Hyla cinerea cinerea (Schneider)

Calamita cinereus Schneider
Hist. Amph., Vol. 1, 1799, p. 174.
Hyla cinerea Garman
Bull. Ill. State Lab. Nat. Hist., Vol. 3, 1892, p. 349.
Hyla carolinensis Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 366, fig. 92.

TYPE LOCALITY: "Inhabits Carolina."

RANGE: Tidewater Virginia to Florida along the coast, west to Texas, Oklahoma, and northward up the Mississippi Valley to southern Illinois.

Hyla cinerea evittata (Miller)

Hlya evittata Miller
Proc. Biol. Soc. Wash., Vol. 13, 1899, p. 75.
Hyla cinerea evittata Dunn
Copeia, 1918, No. 53, Jan. 25, p. 21.

TYPE LOCALITY: Four Mile Run, Virginia (near the City of Washington).

RANGE: Upper tidewater Potomac River shores, Virginia.

Hyla crucifer crucifer Wied

SPRING-PEEPER

Hyla crucifer Wied
Reise Nord-Amer. Vol. 1, Pt. 5, 1838, p. 275.
Hyla pickeringii Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 352, fig. 88.
Hyla crucifer Stejneger and Barbour
Check List No. Amer. Amph. and Rept., Ed. 4, 1939, p. 39.
Hyla crucifer crucifer Harper
Notulae Naturae, Ac. Nat. Sci. Phila., No. 27, Sept. 1939, pp. 1–4.

TYPE LOCALITY: Cantonment Leavenworth, "Kansas."

RANGE: Gaspé Peninsula to Manitoba, south to Georgia, Florida, Louisiana, Arkansas, and Kansas.

Hyla crucifer bartramiana HARPER

Hyla crucifer bartramiana Harper
Notulae Naturae, Ac. Nat. Sci. Phila. No. 27, Sept. 1939, pp. 1–4.

TYPE LOCALITY: Near Folkston, Charlton Co., Georgia.

RANGE: Coastal Plain from southern Georgia to Lake County, Florida.

Hyla femoralis LATREILLE

Hyla femoralis LATREILLE
Hist. Nat. Rept., Vol. 2, 1802, p. 181.
Hyla femoralis COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 371, fig. 94.

TYPE LOCALITY: Carolina.

RANGE: Virginia to Florida and west to Texas.

Hyla gratiosa LE CONTE

Hyla gratiosa LE CONTE
Proc. Ac. Nat. Sci. Phila., 1856, p. 146, pl. 4.
Hyla gratiosa COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 377, fig. 96, pl. 83, fig. 5.

TYPE LOCALITY: "Lower country of Georgia," evidently one of the Le Conte plantations in Floyd or Liberty County.

RANGE: South Carolina to Florida, Tennessee, Alabama, Mississippi, and Louisiana.

Hyla regilla BAIRD and GIRARD

PACIFIC TREE-TOAD

Hyla regilla BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 174.
Hyla regilla COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 355, fig. 89.

TYPE LOCALITY: "Sacramento River, in Oregon and Puget Sound."

RANGE: Vancouver Island and British Columbia to Lower California; Idaho, western Montana, and possibly Arizona.

Hyla squirella LATREILLE

Hyla squirella LATREILLE
Hist. Nat. Rept., Vol. 2, 1802, p. 181.
Hyla squirella COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 363, fig. 90.

TYPE LOCALITY: Carolina.

RANGE: Virginia to Florida, west to Texas northward up the Mississippi basin to Indiana.

Hyla versicolor versicolor (LE CONTE)

TREE-TOAD, RAIN-TOAD

Hyla versicolor LE CONTE
Ann. Lyc. Nat. Hist., New York, Vol. 1, Pt. 2, 1825, p. 281.
Hyla versicolor COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 373, fig. 95.

TYPE LOCALITY: "Northern States."

RANGE: Maine, southern Canada, west to Minnesota, south to the Gulf States and to the Ocklawaha swamp in Florida. Oklahoma, Texas and Arkansas in part only.

Hyla versicolor chrysoscelis (COPE)

Hyla femoralis chrysoscelis COPE
Bull. U. S. Nat. Mus., No. 17, 1880, p. 29.
Hyla versicolor chrysoscelis STRECKER
Proc. Biol. Soc. Wash., Vol. 33, 1910, p. 117.

TYPE LOCALITY: Dallas, Texas.

RANGE: Southern Arkansas to east-central Texas.

Hyla wrightorum TAYLOR

Hyla wrightorum TAYLOR
Univ. of Kans. Sci. Bull., Vol. 25, No. 19, June 1, 1938, p. 436.
Hyla eximia STEJNEGER and BARBOUR (part)
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 34.

TYPE LOCALITY: Near Springerville, Apache County, Arizona.

RANGE: Chihuahua, Mexico, New Mexico, and Arizona.

LEPTODACTYLIDAE (*FAMILY*)

Leptodactylus (*GENUS*)

Fitzinger, Neue Classif. der Rept., 1826, p. 38
type: *typhonia*

Leptodactylus labialis (Cope)

Cystignathus labialis Cope
Proc. Amer. Philos. Soc., Vol. 17, 1877, p. 90.
Leptodactylus albilabris Boulenger
Bull. Soc. Zool. France, 1881, p. 33.
Leptodactylus albilabris Taylor
Sci. Bull. Univ. Kansas, Vol. 20, No. 11, 1932, p. 243.
Leptodactylus albilabris Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 36.

type locality: Mexico.

range: Mexico to near Rio Grande City, Texas.

Eleutherodactylus (*GENUS*)

Duméril and Bibron, Erp. Gén., Vol. 8, 1941, p. 620
type: *martinicensis*

Eleutherodactylus augusti (Dugés)

Hylodes augusti Dugés
In Brocchi, Bull. Soc. Philom. Paris, Ser. 7, Vol. 3, 1879, No. 1, p. 21.
Eleutherodactylus augusti Slevin
Copeia, 1931, No. 3, Oct. 30, p. 140.

type locality: Guanajuato, Mexico.

range: Central Mexico north to southern Arizona in the highlands.

Eleutherodactylus latrans (Cope)

Lithodytes latrans Cope
Bull. U. S. Nat. Mus., No. 17, 1880, p. 25.
Eleutherodactylus latrans Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 34.
Lithodytes latrans Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 316, fig. 80.

type locality: Helotes, Bexar County, Texas.

range: Texas.

Syrrhophus (*GENUS*)

COPE, Amer. Nat., Vol. 12, 1878, p. 253
TYPE: *marnockii*

Syrrhophus campi STEJNEGER
Syrrhophus campi STEJNEGER
Proc. Biol. Soc. Wash., Vol. 28, June 29, 1915, p. 131.

TYPE LOCALITY: Brownsville, Texas.

RANGE: At present known from the type locality only.

Syrrhophus marnockii COPE
Syrrhophus marnockii COPE
Amer. Nat., Vol. 12, 1878, p. 253.
Syrrhophus marnockii COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 318, fig. 81.

TYPE LOCALITY: Near San Antonio, Texas.

RANGE: Bexar, Hays, Travis, and Brewster Counties, Texas.

RANIDAE (*FAMILY*)

Rana (*GENUS*)

LINNÉ, Syst. Nat., Ed. 10, Vol. 1, 1758, p. 210
TYPE: *temporaria*

Rana areolata areolata BAIRD and GIRARD
Rana areolata BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 173.
Rana areolata COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 409, fig. 103.
Rana areolata areolata GOIN and NETTING
Ann. Carn. Mus. 28, art. 8, 1940, pp. 143–163.

TYPE LOCALITY: Indianola, Texas.

RANGE: Matagorda County, Texas, north to McCurtain County, Oklahoma, and Lafayette County, Arkansas; probably also in extreme northwestern Louisiana.

Rana areolata circulosa RICE

Rana areolata circulosa RICE
in Jordan, Man. Vert. East. N. Amer., Ed. 2, 1878, p. 355.
Rana areolata circulosa COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 413, fig. 105.
Rana areolata circulosa GOIN and NETTING
Ann. Carn. Mus., Vol. 28, 1940, p. 146.

TYPE LOCALITY: "Northern" Illinois.

RANGE: From Rogers and Tulsa Counties, Oklahoma, north through eastern Kansas, eastward across central Missouri and Illinois to Benton and Monroe counties, Indiana (possibly to Greene County, Ohio), and southward in the Mississippi Valley through western Kentucky and Tennessee to Pontotoc County, Mississippi.

Rana aurora aurora (BAIRD and GIRARD)

Rana aurora BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 174.
Rana aurora aurora CAMP
Univ. Calif. Publ. Zool., Vol. 17, 1917, p. 123.
Rana agilis aurora COPE
Bull. U. S. Nat. Mus., No. 45, 1889, p. 439, fig. 113.

TYPE LOCALITY: Puget Sound.

RANGE: South coastal region of British Columbia south to northwestern California.

Rana aurora cascadae SLATER

Rana cascadae SLATER
Herpetologica, Vol. 1, No. 6, 1939, p. 1.

TYPE LOCALITY: Elysian Fields, Ranier National Park, Washington, 5700 ft. alt.

RANGE: Highlands of Washington; Pottsville, Idaho.

Rana aurora draytonii (BAIRD and GIRARD)

Rana draytonii BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 174.
Rana aurora draytonii CAMP
Univ. Calif. Publ. Zool., Vol. 17, No. 9, Feb. 3, 1917, p. 115.
Rana draytoni draytoni COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 441, fig. 114.

TYPE LOCALITY: San Francisco, and the Columbia River.

RANGE: Central and southern California, rare and local west of the Sierras. Introduced into Nevada near Millett.

Rana boylii boylii (BAIRD)

Rana boylii BAIRD
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 62.
Rara boylii boylii CAMP
Univ. Calif. Publ. Zool., Vol. 17, No. 9, Feb. 3, 1917, p. 117.
Rana boylii COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 444, fig. 115.

TYPE LOCALITY: Eldorado County, California.

RANGE: Central and northern California and western Oregon in foothill streams.

Rana boylii muscosa CAMP

Rana boylii muscosa CAMP
Univ. Calif. Publ. Zool., Vol. 17, No. 9, Feb. 3, 1917, p. 118.

TYPE LOCALITY: Arroyo Seco Cañon, at about 1300 feet altitude, near Pasadena, California.

RANGE: California: San Gabriel, San Bernardino, and San Jacinto Mountains, south to San Diego County.

Rana boylii sierrae CAMP

Rana boylii sierrae CAMP
Univ. Calif. Publ. Zool., Vol. 17, No. 9, 1917, p. 120.

TYPE LOCALITY: Matlack Lake, Sierra Nevada, Inyo County, California, 10,500 feet altitude.

RANGE: Southern half of Sierra Nevada, above 7000 foot altitude, California. Vicinity of Lake Tahoe and northern slopes of Lake Rose, Nevada.

Rana capito LECONTE

Rana capito LE CONTE
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1855, p. 425, pl. 5.
Rana capito HARPER
Proc. Biol. Soc. Wash., Vol. 48, 1935, p. 79.
Rana aesopus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 38.

TYPE LOCALITY: Georgia "in the ditches of the rice fields," i.e., Le Conte plantation, Riceborough, Liberty County, Georgia.

RANGE: From Beaufort County, North Carolina, southward throughout peninsular Florida.

Rana catesbeiana Shaw

BULLFROG

Rana catesbeiana Shaw
Gen. Zool., Vol. 3, Pt. 1, 1802, p. 106, pl. 33.
Rana catesbiana Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 424, fig. 108.

TYPE LOCALITY: South Carolina.

RANGE: North America east of Rocky Mountains except extreme southeast and Gulf States coastal plain. (Introduced into many localities all over North America and Cuba.) In the north in ponds and sluggish streams; in the south in small ponds and streams and cypress swamps.

Rana clamitans Latreille

GREEN FROG, SPRING-FROG

Rana clamitans Latreille
Hist. Nat. Rept., Vol. 2, 1802, p. 157.
Rana clamata Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 419, fig. 107.

TYPE LOCALITY: Charleston, South Carolina.

RANGE: Eastern North America, Canada to Florida and Louisiana, west to Michigan, Wisconsin, Minnesota, Illinois, Kansas, Arkansas, and Texas. Introduced into western Washington.

Rana fisheri Stejneger

Rana fisheri Stejneger
N. Amer. Fauna No. 7, 1893, p. 227.
Rana onca Slevin
Occ. Papers, Calif. Acad. Sci. 16, 1928, p. 126.
Rana fisheri Linsdale
Proc. American Acad. Arts & Sci., 73, No. 8, 1940, p. 210.

TYPE LOCALITY: Vegas Valley, Clark County, Nevada.

RANGE: Vicinity of Las Vegas, Vegas Valley, Clark County, Nevada.

Rana grylio Stejneger

Rana grylio Stejneger
Proc. U. S. Nat. Mus., Vol. 24, Oct. 4, 1901, p. 212.

TYPE LOCALITY: Bay St. Louis, Mississippi.

RANGE: Southern Louisiana to peninsular Florida, north to southeastern Georgia. In "glades" or lakes with fairly deep water, usually living among lily pads.

Rana heckscheri Wright

Rana heckscheri Wright
Proc. Biol. Soc. Wash., Vol. 37, Dec. 29, 1924, p. 143, pl. 11, 12, fig. 2.

TYPE LOCALITY: Alligator Swamp, Callahan, Florida.

RANGE: Coastal South Carolina and Georgia, northern and west central Florida and southern Mississippi. In rivers and streams or in lakes connected by short streams with a river system.

Rana palustris Le Conte
PICKEREL-FROG

Rana palustris Le Conte
Ann. Lyc. Nat. Hist., New York, Vol. 1, Pt. 2, 1825, p. 282.
Rana palustris Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 406, fig. 102.

TYPE LOCALITY: Not given.

RANGE: Hudson Bay south to Arkansas, Kansas, Oklahoma, and Louisiana and all of eastern North America from Gaspesia west to Wisconsin and Minnesota.

Rana pipiens pipiens Schreber
LEOPARD-FROG

Rana pipiens Schreber
Naturforscher, Vol. 18, 1782, p. 185, pl. 4.
Rana virescens Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 397.
Rana pipiens pipiens Mittleman and Gier
Proc. New England Zool. Club, 22, July 28, 1942, pp. 7–15.

TYPE LOCALITY: Raccoon, Gloucester County, New Jersey and New York.

RANGE: Southeastern New York, southern Connecticut, southeastern Pennsylvania, New Jersey, Delaware, and Maryland, southwestward to the Gulf coastal plain.

Rana pipiens berlandieri (BAIRD)

Rana berlandieri BAIRD
U. S. & Mex. Bound. Surv., Vol. 2, Pt. 2, Rept., pp. 27–28, pl. 36, figs. 7–10.
Rana pipiens berlandieri MITTLEMAN and GIER
Proc. N. England Zool. Club, 22, July 28, 1942, pp. 7–15.

TYPE LOCALITY: Southern Texas.

RANGE: Texas, Oklahoma and Kansas.

Rana pipiens brachycephala (COPE)

Rana virescens brachycephala COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 403, fig. 101.
Rana brachycephala KAUFFELD
Herpetologica, Vol. 1, No. 3, July 15, 1937, p. 85.
Rana pipiens brachycephala MITTLEMAN and GIER
Proc. New England Zool. Club, 22, July 28, 1942, pp. 7–15.

TYPE LOCALITY: Yellowstone River.

RANGE: Southern Canada and New England west to the Pacific States, but excluding the region composed of Texas, Oklahoma and Kansas.

Rana pipiens sphenocephala (COPE)
SOUTHERN LEOPARD-FROG

Rana halecina sphenocephala COPE
Proc. Amer. Philos. Soc., Vol. 23, Dec. 1886, p. 517.
Rana sphenocephala STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 39.
Rana virescens sphenocephala COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 399, fig. 99.
Rana pipiens sphenocephala MITTLEMAN and GIER
Proc. New England Zool. Club, 22, July 28, 1942, pp. 7–15.

TYPE LOCALITY: Near St. John's River, Florida.

RANGE: Southeastern States but extending westward in the coastal plain to northeastern Texas.

Rana pretiosa pretiosa (BAIRD and GIRARD)

Rana pretiosa BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1853, p. 378.

Rana temporaria pretiosa Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 432, fig. 110.

TYPE LOCALITY: Puget Sound, Washington.

RANGE: Arizona, Utah, and Montana west to the Pacific Coast, California south in the Cascade system to the Mt. Lassen area; also British Columbia.

Rana pretiosa luteiventris Thompson

Rana pretiosa luteiventris Thompson
Proc. Biol. Soc. Wash., Vol. 26, March 22, 1913, p. 53.

TYPE LOCALITY: Anne Creek, Elko County, Nevada.

RANGE: Eureka and Elko Counties, Nevada. Central and southern Idaho, Oregon.

Rana sevosa Goin and Netting

Rana sevosa Goin and Netting
Ann. Carn. Mus., Vol. 28, 1940, p. 137, pl. 12, figs. 1 & 2.

TYPE LOCALITY: Slidell, Saint Tammany Parish, Louisiana.

RANGE: Along the Gulf Coast from St. Tammany Parish, Louisiana, to Mobile County, Alabama.

Rana septentrionalis Baird
MINK-FROG

Rana septentrionalis Baird
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 61.
Rana septentrionalis Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 416, fig. 106, pl. 86.

TYPE LOCALITY: Northern Minnesota.

RANGE: Northern New England to the Gaspé Peninsula and northern New York, west through Michigan to Minnesota, Canada to Hudson Bay.

Rana sylvatica sylvatica (Le Conte)
WOOD-FROG

Rana sylvatica Le Conte
Ann. Lyc. Nat. Hist. New York, Vol. 1, Pt. 2, 1825, p. 282.
Rana sylvatica Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 447, fig. 115.

Rana sylvatica sylvatica Schmidt
Field Mus. Publ. Zool., Vol. 20, No. 29, Apr. 29, 1938, p. 378.

TYPE LOCALITY: Not stated.

RANGE: Quebec and Nova Scotia to South Carolina, westward to southern Ontario, and Ohio to Arkansas.

Rana sylvatica cantabrigensis Baird

Rana cantabrigensis Baird
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 62.
Rana cantabrigensis cantabrigensis Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 436, fig. 110.
Rana sylvatica cantabrigensis Schmidt
Field Mus. Publ. Zool., Vol. 20, No. 29, Apr. 29, 1938, p. 377.
Rana cantabrigensis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 40.

TYPE LOCALITY: Cambridge, Massachusetts (in errore).

RANGE: Alaska, through the lowlands eastward to Michigan, north to the mouth of the Yukon.

Rana sylvatica latiremis (Cope)

Rana cantabrigensis latiremis Cope
Proc. Amer. Philos. Soc., Vol. 23, 1886, p. 520.
Rana sylvatica latiremis Schmidt
Field Mus. Publ. Zool., Vol. 20, No. 29, Apr. 29, 1938, p. 378.

TYPE LOCALITY: Lake Alloknagic, Alaska.

RANGE: Alaska to Labrador.

Rana tarahumarae Boulenger

Rana tarahumarae Boulenger
Ann. Mag. Nat. Hist., Ser. 8, Vol. 20, 1917, p. 416.

TYPE LOCALITY: Sierra Tarahumare, northwestern Mexico.

RANGE: Chihuahua and Sonora, southern Arizona in mountains, 3000–4000 feet; also Socorro County, New Mexico.

Rana virgatipes Cope
SPHAGNUM-FROG

Rana virgatipes Cope
Amer. Nat., Vol. 25, 1891, p. 1017.

TYPE LOCALITY: Mare Run, near Great Egg Harbor, Atlantic County, New Jersey.

RANGE: Acid lakes and streams from the New Jersey pine barrens south to the Okefinokee Swamp, Georgia. Not known in Maryland.

BREVICIPITIDAE (*FAMILY*)

Gastrophryne[1] (*GENUS*)

FITZINGER, Syst. Rept., 1843, p. 33
TYPE: *rugosa* = carolinensis

Gastrophryne areolata (STRECKER)

Engystoma areolata (STRECKER)
Proc. Biol. Soc. Wash., Vol. 22, June 25, 1909, p. 118.
Gastrophryne areolata STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 40.

TYPE LOCALITY: Guadalupe River bottom, Victoria, Victoria County, Texas.

RANGE: Southeastern Texas.

Gastrophryne carolinensis (HOLBROOK)

Engystoma carolinense HOLBROOK
N. Amer. Herp., Ed. 1, Vol. 1, 1836, p. 83, pl. 11.
Gastrophryne carolinensis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 40.
Engystoma carolinense (part) COPE
Bull. U. S. Nat. Mus., No. 34, 1889, p. 385, fig. 97.

TYPE LOCALITY: Charleston, South Carolina.

RANGE: Maryland to the Florida Keys, Gulf States to Texas, northward through central valley to southern Indiana, Kentucky and northeastern Tennessee.

Gastrophryne olivacea (HALLOWELL)

Engystoma olivaceum HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 8, Oct. 1856, p. 252.

---

[1] This generic name is retained as convenient to designate the American forms which have completely lost the web between the toes. Contrary-minded see Parker, Monograph Microhylidae, London, 1934, p. 123, et seq.

Engystoma texense Girard
Proc. Ac. Nat. Sci. Phila., Vol. 11, June 28, 1859, pp. 169–170.
Gastrophryne olivacea Smith
Copeia, 1933, No. 4, Dec. 27, p. 217.

TYPE LOCALITY: "Kansas and Nebraska."

RANGE: Kansas south to Texas.

Hypopachus (*GENUS*)

Keferstein, Nachr. Ges. Wiss. Göttingen, July 24, 1867, p. 351
TPYE: *seebachii* = variolosus

Hypopachus cuneus Cope

Hypopachus cuneus Cope
Proc. U. S. Nat. Mus., Vol. 11, July 5, 1889, p. 395.
Hypopachus cuneus Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 388, fig. 98.

TYPE LOCALITY: San Diego, Duval County, Texas.

RANGE: Southern Texas.

REPTILIA (*CLASS*)

LAURENTI, Syn. Rept., 1768, p. 19

DIAPSIDA (*SUBCLASS*)

OSBORN, Science, N.S., Vol. 17, Feb. 13, 1903, p. 276

LORICATA (*ORDER*)

MERREM, Syst. Amph., 1820, p. 34

CROCODYLIDAE (*FAMILY*)

Crocodylus (*GENUS*)

LAURENTI, Syn. Rept., 1768, p. 53
TYPE: *niloticus* = Lacerta crocodilus LINNÉ in part

Crocodylus acutus CUVIER
CROCODILE
Crocodilus acutus CUVIER
Ann. Mus. Hist. Nat. Paris, Vol. 10, 1807, p. 55, pl. 1, fig. 3, pl. 2, fig. 5.
Crocodilus americanus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 173, fig. 2.

TYPE LOCALITY: San Domingo.

RANGE: Southeastern Florida, the Florida Keys, the Greater Antilles (except Porto Rico), both coasts of Central America from Mexico to Ecuador and Colombia.

Alligator (*GENUS*)

CUVIER, Ann. Mus. Hist. Nat. Paris, Vol. 10, 1807, p. 25
TYPE: *lucius* = Lacerta alligator BLUMENBACH, 1788,
in part = mississipiensis

Alligator mississipiensis (DAUDIN)
ALLIGATOR
Crocodilus mississipiensis DAUDIN
Hist. Nat. Reptl, Vol. 2, 1803, p. 412.

Alligator mississipensis [sic] Gray
Syn. Rept., 1831, p. 62.
Alligator mississippiensis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 168, fig. 1.

TYPE LOCALITY: "Les bords du Mississippi."

RANGE: Rivers and swamps of the lowlands of the Carolinas, Georgia and Florida, west to Louisiana, Mississippi and westward to the Rio Grande in Texas.

SQUAMATA (*ORDER*)

Oppel, Ordn. Rept., 1811, p. 14

SAURIA (*SUBORDER*)

Macartney, in Ross's Transl. Cuvier's Lect. Comp. Anat., 1802, Vol. 1, table 3

GEKKONIDAE (*FAMILY*)

Phyllodactylus (*GENUS*)

Gray, Spicileg. Zool., 1830, p. 3
TYPE: *pulcher*

Phyllodactylus tuberculosus Wiegmann

Phyllodactylus tuberculosus Wiegmann
Nova Acta Ac. Leopold.-Carol., Vol. 17, 1835, p. 241, pl. 18, figs. 2–2a
Phyllodactylus tuberculosus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 458, fig. 83.

TYPE LOCALITY: "Californien."

RANGE: Lower California Islands in the Gulf, and extreme southern California.

Phyllodactylus unctus Cope

Diplodactylus unctus Cope
Proc. Ac. Nat. Sci. Phila., 1863, p. 102.
Phyllodactylus (*Diplodactylus*) *unctus* Bocourt
Miss. Sci. Mex., Rept., Pt. 2, 1873, p. 43.
Phyllodactylus unctus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 460, fig. 84.

TYPE LOCALITY: Cape St. Lucas, Lower California.
RANGE: Cape region of Lower California and Islands in the Gulf off the southern portion of the Peninsula.

Coleonyx (*GENUS*)

GRAY, Ann. Mag. Nat. Hist., Vol. 16, 1845, p. 162
TYPE: *elegans*

Coleonyx brevis STEJNEGER
Coleonyx brevis STEJNEGER
N. Amer. Fauna, No. 7, 1893, p. 163.
Eublepharis variegatus (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), fig. 86.

TYPE LOCALITY: Helotes, Bexar County, Texas.
RANGE: New Mexico, Texas, Coahuila, Durango, and Nuevo Leon.

Coleonyx variegatus (BAIRD)
Stenodactylus variegatus BAIRD
Proc. Ac. Nat. Sci. Phila., 1858, p. 254.
Coleonyx variegatus COPE
Proc. Ac. Nat. Sci. Phila., 1866, p. 125.
Eublepharis variegatus (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 466.

TYPE LOCALITY: Rio Grande and Gila Valleys.
RANGE: Southwestern Utah, to California and Nevada, northern Lower California, Cerros Island, Santa Ynez Island, and San Marcos Island; also Sonora.

IGUANIDAE (*FAMILY*)

Anolis (*GENUS*)

DAUDIN, Hist. Nat. Rept., Vol. 4, 1803, p. 50
TYPE: *bullaris* = carolinensis

Anolis carolinensis VOIGT
"CHAMELEON," ANOLIS
Anolius carolinensis VOIGT
Cuvier's Thierreich, Vol. 2, 1832, p. 71.
Anolis carolinensis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 233, fig. 16.

TYPE LOCALITY: Carolina.

RANGE: North Carolina to Florida, westward through the Gulf region to the Rio Grande; also Tennessee. Introduced into Kansas, also the Missouri River at Fort Leavenworth and Leavenworth.

Anolis stejnegeri Barbour

Anolis stejnegeri Barbour
Copeia, 1931, No. 3, Oct. 30, p. 88.

TYPE LOCALITY: Key West, Florida.

RANGE: The Island of Key West.

Ctenosaura (*GENUS*)

Wiegmann, Isis, 1828, p. 371
TYPE: *cycluroides*

Ctenosaura hemilopha (Cope)

Cyclura (Ctenosaura) hemilopha Cope
Proc. Ac. Nat. Sci. Phila., 1863, p. 105.
Ctenosaura hemilopha Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 238, fig. 17.

TYPE LOCALITY: Cape St. Lucas, Lower California.

RANGE: Cape region of Lower California, north to San Esteban Island, and eastward to the region about Nogales, Arizona.

Dipsosaurus (*GENUS*)

Hallowell, Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 92
TYPE: *dorsalis*

Dipsosaurus carmenensis Van Denburgh

Dipsosaurus carmenensis Van Denburgh
Occ. Papers Calif. Ac. Sci., Vol. 10, Nov. 23, 1922, p. 81.

TYPE LOCALITY: Carmen Island, Gulf of California.

RANGE: Carmen and Coronado Islands, Lower California.

Dipsosaurus catalinensis Van Denburgh

Dipsosaurus catalinensis Van Denburgh
Occ. Papers Calif. Ac. Sci., Vol. 10, Nov. 23, 1922, p. 83.

TYPE LOCALITY: Santa Catalina Island, Gulf of California.

RANGE: Same.

Dipsosaurus dorsalis dorsalis (BAIRD and GIRARD)

Crotaphytus dorsalis BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 126.
Dipso-saurus dorsalis HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 92.
Dipsosaurus dorsalis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 243, fig. 18.

TYPE LOCALITY: Colorado Desert, California.

RANGE: Colorado and Mojave Deserts, east to the Colorado River, southern Nevada, and Utah, and extending into southwestern and south central Arizona.

Dipsosaurus dorsalis lucasensis VAN DENBURGH

Dipsosaurus dorsalis lucasensis VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 4, Vol. 10, Aug. 6, 1920, p. 33.

TYPE LOCALITY: San José del Cabo, Lower California.

RANGE: Cape region of Lower California.

Crotaphytus (*GENUS*)

HOLBROOK, N. Amer. Herp., Ed. 2, Vol. 2, 1842, p. 79
TYPE: *collaris*

Crotaphytus collaris collaris (SAY)

COLLARED LIZARD, MOUNTAIN BOOMER

Agama collaris SAY
Long's Exp. Rocky Mts., Vol. 2, 1823, p. 252.
Crotaphytus collaris HOLBROOK
N. Amer. Herp., Ed. 2, Vol. 2, 1842, p. 79, pl. 10.
Crotaphytus collaris (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 248.

TYPE LOCALITY: Verdigris River near its union with the Arkansas River, Oklahoma.

RANGE: Missouri, Kansas and Arkansas south to middle-western and northwestern Texas and west to eastern New Mexico.

Crotaphytus collaris baileyi (STEJNEGER)

Crotaphytus baileyi STEJNEGER
N. Amer. Fauna, No. 3, 1890, p. 103, pl. 12, fig. 1.
Crotaphytus collaris baileyi STONE
Proc. Ac. Nat. Sci. Phila., 1903, p. 30.
Crotaphytus collaris (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 250, fig. 19.

TYPE LOCALITY: Painted Desert, Arizona.

RANGE: Southwestern Texas, southern and western New Mexico, Arizona, Utah, Nevada, Idaho, eastern Oregon, southeastern California, northern Mexico, and Lower California.

Crotaphytus dickersonae SCHMIDT

Crotaphytus dickersonae SCHMIDT
Bull. Amer. Mus. Nat. Hist., Vol. 46, Dec. 7, 1922, p. 638, fig. 2.

TYPE LOCALITY: Tiburon Island, Gulf of California.

RANGE: Same.

Crotaphytus insularis VAN DENBURGH and SLEVIN

Crotaphytus insularis VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, July 30, 1921, p. 96.

TYPE LOCALITY: Angel de la Guarda Island, Lower California.

RANGE: Same.

Crotaphytus reticulatus BAIRD

Crotaphytus reticulatus BAIRD
Proc. Ac. Nat. Sci. Phila., 1858, p. 253.
Crotaphytus reticulatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 254, fig. 20.

TYPE LOCALITY: Laredo and Ringgold Barracks, Texas.

RANGE: Extreme southwestern Texas, and adjacent Louisiana. Tamaulipas and Nuevo Leon, Mexico.

Crotaphytus silus STEJNEGER

Crotaphytus silus STEJNEGER
N. Amer. Fauna, No. 3, 1890, p. 105.
Crotaphytus wislizenii (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 255.

TYPE LOCALITY: Fresno, California.

RANGE: San Joaquin Valley, California; Washington.

Crotaphytus wislizenii BAIRD AND GIRARD

LEOPARD-LIZARD

Crotaphytus wislizenii BAIRD and GIRARD
Stansbury's Expl. Surv. Vall. Great Salt Lake, 1852, p. 340, pl. 3.
Crotaphytus wislizenii (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 255, fig. 21.

TYPE LOCALITY: Near Santa Fé, New Mexico.

RANGE: Northern Idaho, Nevada, Colorado, and Utah into eastern Oregon and southward into Mexico; Cerros Island; Lower and southern California; east to western Texas.

Sauromalus (*GENUS*)

DUMÉRIL, Arch. Mus. Hist. Nat. Paris, Vol. 8, 1856, p. 535
TYPE: *ater*

Sauromalus ater DUMÉRIL

CHUCK-WALLA

Sauromalus ater DUMÉRIL
Arch. Mus. Hist. Nat. Paris, Vol. 8, 1856, p. 536, pl. 23, fig. 3.

TYPE LOCALITY: Unknown.

RANGE: Southern Lower California and Espiritu Santo Island.

Sauromalus hispidus STEJNEGER

Sauromalus hispidus STEJNEGER
Proc. U. S. Nat. Mus., Vol. 14, Oct. 27, 1891, p. 409.
Sauromalus hispidus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 264, fig. 22.

TYPE LOCALITY: Angel de la Guarda Island, Gulf of California.

RANGE: Type locality.

Sauromalus klauberi SHAW

Sauromalus klauberi SHAW
Trans. San Diego Soc. Nat. Hist., 9, 1941, No. 28, pp. 285–288.

TYPE LOCALITY: Santa Catalina Island, Gulf of California, Mexico.

RANGE: Same as type locality.

Sauromalus obesus (BAIRD)

Euphryne obesus BAIRD
Proc. Ac. Nat. Sci. Phila., 1858, p. 253.
Sauromalus obesus SCHMIDT
Bull. Amer. Mus. Nat. Hist., Vol. 46, Dec. 7, 1922, p. 641.
Sauromalus ater COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 266, fig. 23.

TYPE LOCALITY: Fort Yuma, Arizona.

RANGE: Southern Nevada, southwestern Utah, Arizona, the desert area of southeastern California, and northern Lower California.

Sauromalus slevini VAN DENBURGH

Sauromalus slevini VAN DENBURGH
Occ. Papers Calif. Ac. Sci., Vol. 10, Nov. 23, 1922, p. 97.

TYPE LOCALITY: Monserrate Island, Gulf of California.

RANGE: Monserrate, Carmen, and Coronado Islands, Lower California.

Sauromalus townsendi DICKERSON

Sauromalus townsendi DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 464.

TYPE LOCALITY: Tiburon Island, Gulf of California.

RANGE: Tiburon Island and possibly adjacent coast region of Sonora, Mexico.

Sauromalus varius DICKERSON

Sauromalus varius DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 464.

TYPE LOCALITY: San Esteban Island, Gulf of California.

RANGE: Same.

Callisaurus (*GENUS*)

BLAINVILLE, Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 286
TYPE: *draconoides*

Callisaurus crinitus COPE

Callisaurus crinitus COPE
Amer. Nat., Vol. 30, Dec. 5, 1896, p. 1049.

TYPE LOCALITY: Ballenas Bay, Lower California.

RANGE: Ballenas Bay and San Bartolomé Bay, Lower California.

Callisaurus draconoides draconoides BLAINVILLE

Callisaurus draconoides BLAINVILLE
Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 286, pl. 24, fig. 2.
Callisaurus draconoides draconoides COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 270, fig. 24.

TYPE LOCALITY: California.

RANGE: Southern Lower California.

Callisaurus draconoides carmenensis DICKERSON

Callisaurus carmenensis DICKERSON
Bull. Amer. Mus. Nat. Hist., 41, 1919, Art. 10, p. 465.
Callisaurus draconoides carmenensis LINSDALE
Univ. Calif. Publ. Zool., 38, No. 6, 1932, p. 358.

TYPE LOCALITY: Carmen Island, Gulf of California, Mexico.

RANGE: Lower California.

Callisaurus draconoides gabbii COPE

Callisaurus ventralis gabbii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 272.
Callisaurus draconoides gabbii LINSDALE
Proc. Amer. Acad. Arts and Sci., 73, No. 8, May 1940, pp. 220–221.

TYPE LOCALITY: Northern Lower California.

RANGE: Southern Nevada, western Arizona, southeastern California and northern Lower California.

Callisaurus draconoides myurus RICHARDSON

Callisaurus ventralis myurus RICHARDSON
Proc. U. S. Nat. Mus., Vol. 48, Jan. 19, 1915, p. 408.

Callisaurus draconoides myurus Linsdale
Proc. Amer. Acad. Arts and Sci., 73, No. 8, May 1940, pp. 221–222.

TYPE LOCALITY: Pyramid Lake Indian Agency, Nevada.

RANGE: Western Nevada.

Callisaurus splendidus Dickerson

Callisaurus splendidus Dickerson
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 467.

TYPE LOCALITY: Angel de la Guarda Island, Lower California.

RANGE: Same.

Callisaurus ventralis ventralis (Hallowell)

GRIDIRON-TAILED LIZARD

Homalosaurus ventralis Hallowell
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 179.
Callisaurus ventralis Baird
U. S. Mex. Bound. Surv., Vol. 1, Pt. 2, 1859, Rept., p. 8.
Callisaurus draconoides ventralis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 272, fig. 25.

TYPE LOCALITY: New Mexico west of Rio Grande.

RANGE: Arizona to California, north to Nevada, southward to Mexico at least to Guaymas.

Callisaurus ventralis inusitatus (Dickerson)

Callisaurus inusitatus Dickerson
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 465.

TYPE LOCALITY: Tiburon Island, Gulf of California.

RANGE: Tiburon Island and region about Guaymas, Mexico.

Uma (*GENUS*)

Baird, Proc. Ac. Nat. Sci. Phila., 1858, p. 253
TYPE: *notata*

Uma notata notata Baird

Uma notata Baird
Proc. Ac. Nat. Sci. Phila., 1858, p. 253.

Uma notata Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 277, fig. 27.
Uma notata Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 58.
Uma notata notata Heifetz
Copeia, 1941, 2, July 8, pp. 101–104.

TYPE LOCALITY: "Mojave Desert."

RANGE: Lower California; Yuma County, Arizona; Imperial and San Diego Counties, California.

Uma inornata Cope

Uma inornata Cope
Amer. Nat., 29, 1895, p. 939.
Callisaurus notatus Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1917, p. 47 (part).
Uma inornata Heifetz
Copeia, 1941, 2, July 8, p. 106.

TYPE LOCALITY: "Colorado Desert, San Diego, California."

RANGE: Riverside County, California.

Uma scoparia Cope

Uma scoparia Cope
Amer. Nat., 28, 1894, p. 435, figs. 3, 4.
Uma notata Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 58 (part).
Uma scoparia Heifetz
Copeia 1941, 2, July 8, p. 108.

TYPE LOCALITY: "Fort Buchanan, Arizona."

RANGE: Riverside, San Bernardino and Los Angeles, Counties, California.

Holbrookia (*GENUS*)

Girard, Proc. Amer. Assoc. Adv. Sci., New Haven, Vol. 4, 1851, p. 201
TYPE: *maculata*

Holbrookia elegans Bocourt

Holbrookia elegans Bocourt
Miss. Sci. Mex., Rept., 1874, p. 164, pl. 27 bis, figs. 8–8a.

TYPE LOCALITY: Mazatlan, Mexico.

RANGE: Western Mexico from Sinaloa northward to Tuscon, Arizona.

Holbrookia lacerata Cope

Holbrookia lacerata Cope
Bull. U. S. Nat. Mus., No. 17, 1880, p. 15.
Holbrookia maculata lacerata Stejneger
N. Amer. Fauna, No. 3, 1890, p. 109.
Holbrookia maculata lacerata Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 292, fig. 32.

TYPE LOCALITY: Texas: Erath County; west of the Upper Brazos, Comanche County; on the Guadalupe River in Kendall or Comal County.

RANGE: Texas, middle district east of the plains and west of the timbered region, from the northern boundary south to the Rio Grande.

Holbrookia maculata maculata (Girard)

Holbrookia maculata Girard
Proc. Amer. Assoc. Adv. Sci., New Haven, Vol. 4, 1851, p. 201.
Holbrookia maculata maculata Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 293, fig. 33.

TYPE LOCALITY: Opposite Grand Island, Platte River, Colorado now in Nebraska. (Fide Burt, in litt., Oct. 9, 1933.)

RANGE: Northern Texas west to Arizona and northward to Wyoming and Nebraska.

Holbrookia maculata approximans (Baird)

Holbrookia approximans Baird
Proc. Ac. Nat. Sci. Phila., 1858, p. 253.
Holbrookia maculata approximans Stejneger
N. Amer. Fauna, No. 3, 1890, p. 109.
Holbrookia maculata approximans Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 297.

TYPE LOCALITY: "Lower Rio Grande."

RANGE: Southern New Mexico and Arizona, south into northern Mexico.

Holbrookia propinqua propinqua (Baird and Girard)

Holbrookia propinqua Baird and Girard
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 126.
Holbrookia propinqua Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 289, fig. 31.

TYPE LOCALITY: Between Indianola and San Antonio, Texas.
RANGE: Texas.

Holbrookia propinqua stonei Harper

Holbrookia propinqua stonei Harper
Proc. Biol. Soc. Wash., Vol. 45, Apr. 2, 1932, p. 15.

TYPE LOCALITY: Padre Island, Texas.
RANGE: Padre Island and possibly Mustang Island, Texas.

Holbrookia pulchra Schmidt

Holbrookia pulchra Schmidt
Amer. Mus. Nov., No. 22, Dec. 1, 1921, p. 1.

TYPE LOCALITY: Carr Cañon, Huachuca Mountains, Arizona.
RANGE: Huachuca Mountains, east of Nogales, Arizona.

Holbrookia texana (Troschel)

Cophosaurus texanus Troschel
Arch. Naturg., Jahrg. 16, Vol. 1, 1850 (1852), p. 389, pl. 6.
Holbrookia texana Baird and Girard
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 124.
Holbrookia texana Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 286, fig. 30.

TYPE LOCALITY: The German colony of Neubraunfels, on the Guadalupe River in western Texas, Lat. 28° N.
RANGE: Arizona, Texas and eastern New Mexico.

Sceloporus (*GENUS*)

Wiegmann, Isis, 1828, p. 369
TYPE: *torquatus*

Sceloporus clarkii clarkii (Baird and Girard)

Sceloporus clarkii Baird and Girard
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 127.

Sceloporus clarkii clarkii BURT
Papers Mich. Ac. Sci., Vol. 22, 1936 (1937), p. 534.
Sceloporus clarkii (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 358, fig. 54.

TYPE LOCALITY: Sonora.

RANGE: New Mexico, Arizona, and northern Mexico.

Sceloporus couchii BAIRD

Sceloporus couchii BAIRD
Proc. Ac. Nat. Sci. Phila., 1858, p. 254.
Lysoptychus lateralis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 329, fig. 47.
Sceloporus couchii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 395, fig. 66.

TYPE LOCALITY: Santa Caterina, Nuevo Leon, Mexico.

RANGE: Northern Mexico to southern Texas.

Sceloporus cyanogenys (COPE)

Sceloporus torquatus cyanogenys COPE
Proc. Amer. Philos. Soc., Vo. 22, 1885, p. 402.
Sceloporus torquatus cyanogenys TAYLOR
Proc. Biol. Soc. Wash., Vol. 44, Oct. 17, 1931, p. 129.
Sceloporus cyanogenys H. M. SMITH
Univ. Kansas Sci. Bull. 24, 1936 (1938), No. 21, p. 599–606, fig. 13–14.

TYPE LOCALITY: Monterey, Nuevo Leon, Mexico.

RANGE: Southern Texas from Devil's River southeast to Starr County, Texas, south through northern Mexico.

Sceloporus disparilis STEJNEGER

Sceloporus disparilis STEJNEGER
Proc. Biol. Soc. Wash., Vol. 29, Dec. 16, 1916, p. 228.

TYPE LOCALITY: Lomita Ranch, six miles north of Hidalgo, Texas.

RANGE: Extreme southern corner of Texas and northeastern Mexico.

Sceloporus floridanus BAIRD

Sceloporus floridanus BAIRD
Proc. A. N. S. Phila., 1858, p. 253.

Sceloporus olivaceus Smith
Trans. Kans. Acad. Sci., Vol. 37, 1934, p. 277.
Sceloporus spinosus floridanus Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 64.

TYPE LOCALITY: Pensacola, Florida (in errore).

RANGE: Southeastern Texas and northeastern Mexico.

Sceloporus graciosus graciosus (Baird and Girard)

Sceloporus graciosus Baird and Girard
Stansbury's Expl. Surv. Vall. Great Salt Lake, 1852, p. 346, pl. 5, figs. 1–3
Sceloporus graciosus graciosus Camp
Univ. Calif. Publ. Zool., Vol. 17, Dec. 28, 1916, p. 67.
Sceloporus graciosus (part) Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 386.

TYPE LOCALITY: Valley of Great Salt Lake.

RANGE: Western Colorado to Utah, Nevada, California, Idaho, Oregon and eastern Washington.

Sceloporus graciosus gracilis (Baird and Girard)

Sceloporus gracilis Baird and Girard
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 175.
Sceloporus graciosus gracilis Van Denburgh
Occ. Papers Calif. Ac. Sci., Vol. 10, Nov. 23, 1922, p. 280.
Sceloporus graciosus (part) Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 386, fig. 63.

TYPE LOCALITY: Oregon.

RANGE: Now apparently confined to the sagebrush and desert country of eastern Washington.

Sceloporus graciosus vandenburgianus (Cope)

Sceloporus vandenburgianus Cope
Amer. Nat., Vol. 30, 1896, p. 834.
Sceloporus graciosus vandenburgianus Camp
Univ. Calif. Publ. Zool., Vol. 17, Dec. 28, 1916, p. 67.
Sceloporus vandenburgianus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 390, fig. 64.

TYPE LOCALITY: Summit of the Coast Range, San Diego County, California.

RANGE: Mountain ranges south of Ventura County, California, into northern Lower California.

Sceloporus jarrovii COPE

Sceloporus jarrovii COPE
In Wheeler's Rep. Surv. W. 100th Mer., Vol. 5, 1875, p. 569, pl. 23, figs. 2-2c.
Sceloporus jarrovii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 345, fig. 49.

TYPE LOCALITY: Southern Arizona.

RANGE: Central Arizona, east to western New Mexico, south to western Zacatecas and northern Tepic, Mexico.

Sceloporus licki VAN DENBURGH

Sceloporus licki VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 2, Vol. 5, 1895, p. 110, pl. 10.
Sceloporus lickii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 363.

TYPE LOCALITY: Sierra San Lazaro, Lower California.

RANGE: Southern Lower California.

Sceloporus lineatulus DICKERSON

Sceloporus lineatulus DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 467.

TYPE LOCALITY: Santa Catalina Island, Gulf of California.

RANGE: Same.

Sceloporus magister HALLOWELL

Sceloporus magister HALLOWELL
Proc. Ac. Nat. Sci. Phila., 1854, p. 93.
Sceloporus clarkii (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 358.

TYPE LOCALITY: Yuma, Arizona.

RANGE: Southeastern California, western Arizona, southern Nevada, southern and eastern Utah, and northwestern Lower California.

Sceloporus merriami merriami (Stejneger)

Sceloporus merriami Stejneger
Proc. Biol. Soc. Wash., Vol. 17, Feb. 5, 1904, p. 17.
Sceloporus merriami merriami Smith
Proc. Biol. Soc. Wash., Vol. 50, 1937, p. 86.

TYPE LOCALITY: East Painted Cave near mouth of Pecos River, Rio Grande Valley, Texas.

RANGE: Rio Grande Cañon, western Texas.

Sceloporus merriami annulatus Smith

Sceloporus merriami annulatus Smith
Proc. Biol. Soc. Wash., Vol. 50, June 22, 1937, p. 83.

TYPE LOCALITY: East slope of the Chisos Mountains, Brewster County, Texas.

RANGE: Chisos Mountains, Texas.

Sceloporus monserratensis Van Denburgh and Slevin

Sceloporus monserratensis Van Denburgh and Slevin
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, Dec. 17, 1921, p. 396.

TYPE LOCALITY: Monserrate Island, Lower California.

RANGE: Monserrate Island and adjacent mainland of Lower California.

Sceloporus occidentalis occidentalis (Baird and Girard)

Sceloporus occidentalis Baird and Girard
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 175.
Sceloporus occidentalis occidentalis Camp
Univ. Calif. Publ. Zool., Vol. 17, Dec. 28, 1916, p. 65.

TYPE LOCALITY: Benicia, California.

RANGE: Northern and north central California to Washington.

Sceloporus occidentalis becki (Van Denburgh)

Sceloporus becki Van Denburgh
Proc. Calif. Ac. Sci., Ser. 3, Zool., Vol. 4, June 15, 1905, p. 9, pl. 4.
Sceloporus occidentalis becki Grinnell and Camp
Univ. Calif. Publ. Zool., Vol. 17, July 11, 1917, p. 162.

TYPE LOCALITY: San Miguel Island, Santa Barbara County, California.

RANGE: Islands off coast of Santa Barbara County, California.

Sceloporus occidentalis biseriatus (Hallowell)

Sceloporus bi-seriatus Hallowell
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 93.
Sceloporus occidentalis bi-seriatus Camp
Univ. Calif. Publ. Zool., Vol. 17, Dec. 28, 1916, p. 65.
Sceloporus biseriatus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 381, fig. 61.

TYPE LOCALITY: El Paso Creek, Tejon Valley, California.

RANGE: Western Utah to California; also Washington, Idaho, Wyoming, Nevada, Oregon, and northern Lower California.

Sceloporus occidentalis taylori Camp

Sceloporus occidentalis taylori Camp
Univ. Calif. Publ. Zool., Vol. 17, Dec. 28, 1916, p. 65.

TYPE LOCALITY: Halfway between Merced Lake and Sunrise Trail (Echo Creek Basin), altitude 7500 feet, Yosemite National Park, California.

RANGE: Yosemite National Park, above 7000 feet altitude.

Sceloporus orcutti Stejneger

Sceloporus orcutti Stejneger
N. Amer. Fauna, No. 7, May 31, 1893, p. 181, pl. 1, figs. 4a-c.
Sceloporus orcuttii Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 354, fig. 52.

TYPE LOCALITY: Milquatay Valley, San Diego County, California.

RANGE: Northern Lower California, southern California.

Sceloporus poinsettii Baird and Girard

Sceloporus poinsettii Baird and Girard
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 126.
Sceloporus torquatus poinsettii Cope
Proc. Amer. Philos. Soc., Vol. 22, 1885, p. 402.
Sceloporus torquatus poinsettii Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 350, fig. 51.
Sceloporus poinsettii H. M. Smith
Univ. Kansas Sci. Bull. 24, No. 21, 1936 (1938), pp. 606-617, fig. 15.

TYPE LOCALITY: Rio San Pedro, Texas, and Sonora, Mexico.

RANGE: Southern New Mexico, east to central Texas, south through western Neuvo León and southern Coahuila to central Durango.

Sceloporus rufidorsum Yarrow[1]

Sceloporus rufidorsum (part) Yarrow
Proc. U. S. Nat. Mus., Vol. 5, 1882, p. 442.

TYPE LOCALITY: San Quentin Bay, [Lower] California.

RANGE: Western Lower California and Cerros Island.

Sceloporus scalaris slevini Smith

Sceloporus scalaris slevini Smith
Occ. Papers Mus. Zool. Univ. Mich., No. 361, Dec. 15, 1937, p. 3.

TYPE LOCALITY: Miller Peak, Huachuca Mountains, Cochise County, Arizona.

RANGE: "Southern Arizona, south to northern Durango, west a short distance into Sonora, and east to southern central Nuevo Leon."

Sceloporus spinosus Wiegmann

Sceloporus spinosus Wiegmann
Isis, 1828, p. 309.
Sceloporus spinosus Burt
Papers Mich. Ac. Sci., Vol. 22, 1936 (1937), p. 535.
Sceloporus spinosus (part) Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 364, fig. 55.

TYPE LOCALITY: Mexico.

RANGE: Texas, New Mexico, and northern Mexico.

Sceloporus undulatus consobrinus (Baird and Girard)

Sceloporus consobrinus Baird and Girard
In Marcy, Expl. Red River, 1854, p. 208, pl. 10, figs. 5–12.
Sceloporus undulatus consobrinus Burt
Papers Mich. Ac. Sci., Vol. 22, 1936 (1937), p. 537.
Sceloporus consobrinus consobrinus Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 60.

---

[1] Linsdale (Univ. of Calif. Publ. Zool., Vol. 38, 1932, p. 365) would reduce this form and *S. zosteromus* to subspecies of *magister*.

TYPE LOCALITY: Beckham County, Oklahoma, near confluence of North Fork of the Red River and Suydam Creek.

RANGE: West of the 97th Meridian in the Dakotas, Kansas, Oklahoma, and Texas.

Sceloporus undulatus elongatus STEJNEGER

Sceloporus elongatus STEJNEGER
N. Amer. Fauna, No. 3, 1890, p. 111.
Sceloporus undulatus (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 368.
Sceloporus elongatus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 65.
Sceloporus undulatus elongatus BURT
Amer. Midl. Nat. 14, No. 3, May 1933, pp. 241-243.

TYPE LOCALITY: Southern Arizona.

RANGE: Arizona, Colorado, Nevada and Utah.

Sceloporus undulatus fasciatus (GREEN)

Lacerta hyacinthina GREEN
Journ. Acad. Nat. Sci. Phila., 1 (1818), p. 349.
Lacerta fasciata GREEN
Journ. Acad. Nat. Sci. Phila., 1 (1818), p. 349.
Sceloporus thayerii BAIRD and GIRARD
Proc. Acad. Nat. Sci. Phila., 6 (1852), p. 127.
Sceloporus undulatus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 65.
Sceloporus undulatus undulatus BURT
Trans. Kans. Acad. Sci., 38 (1935), p. 280.
Sceloporus undulatus fasciatus H. M. SMITH
Occ. Papers Mus. Zool., Univ. Mich., 387, Oct. 31, 1938, pp. 8–9.

TYPE LOCALITY: Probably the vicinity of Princeton, New Jersey.

RANGE: Georgia, North Carolina, Virginia, Kentucky, Maryland, Tennessee, Indiana and Texas.

Sceloporus undulatus garmani (BOULENGER)

Sceloporus garmani Boulenger
Proc. Zool. Soc. London, 1882, p. 761, pl. 56.
Sceloporus consobrinus garmani STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 53.

TYPE LOCALITY: Near Pine Ridge, South Dakota.

RANGE: Northern prairies of South Dakota south to Central Oklahoma.

Sceloporus variabilis marmoratus (HALLOWELL)

Sceloporus marmoratus HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 178.
Sceloporus variabilis marmoratus SMITH
Proc. Biol. Soc. Wash., Vol. 47, 1934, p. 121.
Sceloporus variabilis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 398, fig. 67.

TYPE LOCALITY: San Antonio, Texas.

RANGE: Southern Texas to northern Mexico.

Sceloporus woodi STEJNEGER

SOUTHERN FLORIDA PINE-LIZARD

Sceloporus woodi STEJNEGER
Proc. Biol. Soc. Wash., Vol. 31, June 29, 1918, p. 90.

TYPE LOCALITY: Auburndale, Polk County, Florida.

RANGE: Spruce Pine ridges of central Florida, the east coast from Malabar south to Hallandale, and extreme southwest Florida.

Sceloporus zosteromus COPE

Sceloporus zosteromus COPE
Proc. Ac. Nat. Sci. Phila., 1863, p. 105.
Sceloporus zosteromus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 356, fig. 53.

TYPE LOCALITY: Cape St. Lucas, Lower California.

RANGE: Southern and central Lower California.

Sator (*GENUS*)

DICKERSON, Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 468
TYPE: *grandaevus*

Sator angustus DICKERSON

Sator angustus DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 469.

TYPE LOCALITY: Santa Cruz Island, Gulf of California.
RANGE: Same.

Sator grandaevus DICKERSON

Sator grandaevus DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 469.

TYPE LOCALITY: Cerralvo Island, Gulf of California.
RANGE: Same.

Uta (*GENUS*)

BAIRD and GIRARD, Stansbury's Expl. Surv. Vall.
Great Salt Lake, 1852, p. 345
TYPE: *stansburiana*

Uta concinna DICKERSON

Uta concinna DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 470.

TYPE LOCALITY: Cerros Island, Lower California.
RANGE: Cerros and Natividad Islands, Lower California.

Uta mannophorus DICKERSON

Uta mannophorus DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 470.

TYPE LOCALITY: Carmen Island, Gulf of California.
RANGE: Same.

Uta martinensis VAN DENBURGH

Uta martinensis VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 3, Zool., Vol. 4, 1905, p. 18, pl. 6.

TYPE LOCALITY: San Martin Island, Lower California.
RANGE: Same.

Uta nolascensis VAN DENBURGH and SLEVIN

Uta nolascensis VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, Dec. 17, 1921, p. 395.

TYPE LOCALITY: San Pedro Nolasco Island, Lower California.
RANGE: Same.

Uta palmeri STEJNEGER
Uta palmerii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 313, fig. 39.
TYPE LOCALITY: San Pedro Martir Island, Gulf of California.
RANGE: Same.

Uta squamata DICKERSON
Uta squamata DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, 1919, p. 471.
TYPE LOCALITY: Santa Catalina Island, Gulf of California.
RANGE: Same.

Uta stansburiana stansburiana (BAIRD and GIRARD)
Uta stansburiana BAIRD and GIRARD
Stansbury's Expl. Surv. Vall. Great Salt Lake, 1852, p. 345, pl. 5, figs. 4–6.
Uta stansburiana COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 306, fig. 38.
TYPE LOCALITY: Salt Lake Valley.
RANGE: Parts of Utah, Idaho, Nevada, Washington, eastern Oregon and California.

Uta stansburiana elegans (YARROW)
Uta elegans YARROW
Proc. U. S. Nat. Mus., Vol. 5, 1882, p. 442.
Uta stansburiana elegans RICHARDSON
Proc. U. S. Nat. Mus., Vol. 48, 1915, p. 413.
TYPE LOCALITY: La Paz, Lower California.
RANGE: Southern Lower California.

Uta stansburiana hesperis RICHARDSON
Uta stansburiana hesperis RICHARDSON
Proc. U. S. Nat. Mus., Vol. 48, 1915, p. 415.
TYPE LOCALITY: Arroyo Seco Canon, near Pasadena, Los Angeles County, California.
RANGE: Coast region of southern California.

Uta stansburiana stejnegeri SCHMIDT
Uta stansburiana stejnegeri SCHMIDT
Amer. Mus. Nov., No. 15, 1921, p. 1.

TYPE LOCALITY: Mouth of Dry Canon, Alamogordo, Otero County, New Mexico.

RANGE: Western Texas and northern Mexico, west to the Coast Range in California, northern Lower California, Angel de la Guarda Island.

Uta stellata VAN DENBURGH

Uta stellata VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 3, Zool., Vol. 4, 1905, p. 21, pl. 8.

TYPE LOCALITY: San Benito Island, Lower California.

RANGE: Same.

Urosaurus (*GENUS*)

HALLOWELL, Proc. Acad. Nat. Sci. Phila., 7, 1854, p. 92.
Lower California (= Southern California)
TYPE: *graciosus*

Urosaurus auriculata (COPE)

Uta auriculata COPE
Proc. Boston Soc. Nat. Hist., Vol. 14, 1871, p. 303.
Urosaurus auriculata MITTLEMAN
Bull. Mus. Comp. Zool. 41, 1942, No. 2, p. 125, pl. 16.

TYPE LOCALITY: Socorro Island, Revilla Gigedo Archipelago, Mexico.

RANGE: Same.

Urosaurus clarionensis (TOWNSEND)

Uta clarionensis TOWNSEND
Proc. U. S. Nat. Mus., Vol. 13, 1890, p. 143.
Urosaurus clarionensis MITTLEMAN
Bull. Mus. Comp. Zool., 41, 1942, No. 2, p. 125, pl. 8.

TYPE LOCALITY: Clarion Island, Revilla Gigedo Archipelago, Mexico.

RANGE: Same.

Urosaurus microscutatus (VAN DENBURGH)

Uta microscutata VAN DENBURGH
Proc. Calif. Acad. Sci., Ser. 2, Vol. 4, 1894, p. 298.

Uta parviscutata COPE
Ann. Rept. U. S. Nat. Mus., 1898 (1900), p. 324, fig. 45.
Urosaurus microscutatus MITTLEMAN
Bull. Mus. Comp. Zool., 41, 1942, No. 2, pp. 159–163.

TYPE LOCALITY: San Pedro Martir Mountains, Baja California.

RANGE: Borego Palm Canon, San Diego County, California, south through the San Pedro Martir district and lower Sonoran zone of Baja California to Medano Amarillo, also islands in the Gulf of California.

Urosaurus nigricaudus (COPE)

Uta nigricauda COPE
Proc. Acad. Nat. Sci., Phila., 1864, p. 176.
Urosaurus nigricaudus MITTLEMAN
Bull. Mus. Comp. Zool., 41, 1942, No. 2, pp. 157–159, pl. 10.

TYPE LOCALITY: Cape San Lucas, Baja California.

RANGE: South of latitude 24° 30. on Baja California peninsular; also the islands of Espiritu Santo, Ballena, San José and Magdalena.

Urosaurus ornatus ornatus (BAIRD and GIRARD)

Uta ornata BAIRD and GIRARD
Proc. Acad. Nat. Sci., Phila., 6, 1852, p. 126 (part)
Uta ornata COPE
Ann. Rept. U. S. Nat. Mus., 1898 (1900), p. 315, (part).
Uta ornata ornata SCHMIDT
Amer. Mus. Nov. 22, 1921, p. 6 (part)
Urosaurus ornatus ornatus MITTLEMAN
Bull. Mus. Comp. Zool., 41, 1942, No. 2, pp. 133–135, pl. 1.

TYPE LOCALITY: Rio San Pedro (=Devil's River), Val Verde County, Texas.

RANGE: Southern Texas and probably Coahuila and Nuevo Leon.

Urosaurus ornatus chiricahuae (MITTLEMAN)

Uta ornata chiricahuae MITTLEMAN
Proc. Biol. Soc. Wash., 54, 1941, p. 165.
Urosaurus ornatus chiricahuae MITTLEMAN
Bull. Mus. Comp. Zool., 41, 1942, No. 2, pp. 139–142, pl. 5.

TYPE LOCALITY: Pinery Canon, Chiricahua Mountains, 6000 ft. Cochise County, Arizona.

RANGE: Type locality and the Dos Cabezos Mountains, Cochise County, Arizona.

Urosaurus ornatus graciosus HALLOWELL

Uro-saurus graciosus HALLOWELL
Proc. Acad. Nat. Sci. Phila., 7, 1854, p. 92.
Uta graciosa BAIRD
U. S. Mex. Bound. Survey, 2, Pt. 2, 1859, p. 7.
Uta gratiosa COUES
Surv. W. 100th Mer. 5, 1875, p. 596.
Urosaurus ornatus graciosus MITTLEMAN
Bull. Mus. Comp. Zool. 4, 1942, pp. 144–145, pl. 7.

TYPE LOCALITY: Lower California (=Southern California.)

RANGE: Colorado River desert and valley in Nevada, parts of Arizona, California, Baja California and Mexico.

Urosaurus ornatus levis (STEJNEGER)

Uta levis STEJNEGER
N. Amer. Fauna, 3, 1890, p. 108.
Urosaurus ornatus levis MITTLEMAN
Bull. Mus. Comp. Zool., 41, 1942, No. 2, pp. 147–149, pl. 6.

TYPE LOCALITY: Tierra Amarilla, Rio Arriba County, New Mexico.

RANGE: New Mexico: Rio Arriba and extreme northern Sandoval Counties.

Urosaurus ornatus linearis (BAIRD)

Uta ornata var. *linearis* BAIRD
U. S. Mex. Bound. Surv. 2, 1857, p. 7.
Uta ornata linearis SCHMIDT
Amer. Mus. Nov. 22, 1921, p. 6.
Uta symmetrica YARROW
Surv. W. 100th Mer., 5, 1875, p. 569.
Urosaurus ornatus linearis MITTLEMAN
Bull. Mus. Comp. Zool., 41, 1942, No. 2, pp. 137–139, pl. 3.

TYPE LOCALITY: Los Nogales, Sonora, Mexico.

RANGE: Arizona and New Mexico, south of latitude 35°; Mexico: Sonora and Chihuahua.

Urosaurus ornatus schmidti (MITTLEMAN)

Uta ornata schmidti MITTLEMAN
Herpetologica 2, 1940, 2, p. 33, pl. 3, fig. 1.
Urosaurus ornatus schmidti MITTLEMAN
Bull. Mus. Comp. Zool. 41. 1942, No. 2, pp. 135–136, pl. 2.

TYPE LOCALITY: Fort Davis, Jeff Davis County, Texas.

RANGE: Brewster, Jeff Davis and Presidio Counties, Texas. Parts of Mexico.

Urosaurus ornatus symmetricus (BAIRD)

Uta symmetrica BAIRD
Proc. Acad. Nat. Sci., Phila., 1858, p. 253.
Uta ornata symmetrica SCHMIDT
Amer. Mus. Nov. 22, 1921, p. 6.
Urosaurus ornatus symmetricus MITTLEMAN
Bull. Mus. Comp. Zool., 41, 1942, No. 2, pp. 142–144. pl. 4.

TYPE LOCALITY: Fort Yuma, Imperial County, California,

RANGE: The Colorado River valley in California, Arizona, Lower California and the Gran Desierto of Sonora.

Urosaurus ornatus wrighti (SCHMIDT)

Uta wrighti SCHMIDT
Amer. Mus. Nov. 22, 1921, p. 3.
Uta levis VAN DENBURGH
Occ. Pap. Calif. Acad. Sci. 10 (1), 1922, p. 208.
Urosaurus ornatus wrighti MITTLEMAN
Bull. Mus. Comp. Zool., 41, 1942, No. 2, pp. 145–147, pl. 9.

TYPE LOCALITY: Grand Gulch, 4000–5000 ft., San Juan County, Utah.

RANGE: Parts of Colorado, New Mexico, Utah, and Arizona.

Petrosaurus (*GENUS*)

BOULENGER: Cat. Liz., Brit. Mus., 2, 1885, p. 205
TYPE: *thalassina* COPE

Petrosaurus repens (VAN DENBURGH)

Uta repens VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 2, Vol. 5, 1895, p. 102. pl. 7–8, figs. a–e.

Uta repens Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 303, fig. 36.
Petrosaurus repens Mittleman
Bull. Mus. Comp. Zool., 41, 1942, No. 2, p. 111.

TYPE LOCALITY: Comondú, Lower California.

RANGE: Lower California.

Petrosaurus thalassina (Cope)

Uta thalassina Cope
Proc. Acad. Nat. Sci. Phila., 1863, p. 104.
Petrosaurus thalassina Boulenger
Cat. Liz., Brit. Mus., 2, 1885, p. 205.
Petrosaurus thalassina Mittleman
Bull. Mus. Comp. Zool. 41, 1942, No. 2, pp. 110–111.

TYPE LOCALITY: Cape St. Lucas, Lower California.

RANGE: Southern portions of Baja California and a few of the adjacent islands in the Gulf of California.

Streptosaurus (*GENERA*)

Mittleman. Bull. Mus. Comp. Zool. 41, 1942, No. 2, pp. 111–117
TYPE: *mearnsi*

Streptosaurus mearnsi (Stejneger)

Uta mearnsi Stejneger
Proc. U. S. Nat. Mus., 17, 1894, p. 589.
Streptosaurus mearnsi Mittleman
Bull. Mus. Comp. Zool., 41, 1942, No. 2, pp. 111–112.

TYPE LOCALITY: Summit of the Coast Range, Mexican boundary of California.

RANGE: Extreme southern California and adjacent portion of Baja California, Angel de la Guardia and Mejia islands in the Gulf of California.

Streptosaurus slevini (Van Denburgh)

Uta slevini Van Denburgh
Occ. Papers Calif. Ac. Sci., Vol. 10, 1922, p. 194.
Streptosaurus slevini Mittleman
Bull. Mus. Comp. Zool. 41, No. 2, 1942, p. 112.

TYPE LOCALITY: Mejia Island, Gulf of California.

RANGE: Angel de la Guarda Island and Mejia Island, Lower California.

Phrynosoma (*GENUS*)

WIEGMANN, Isis, 1828, p. 367
TYPE: *orbiculare*

THE HORN-TOADS

Phrynosoma blainvillii blainvillii (GRAY)

Phrynosoma blainvillii GRAY
Zoöl. Beechey's Voyage, 1839, p. 96, pl. 29, fig. 1.
Phrynosoma blainvillei blainvillei BRYANT
Univ. Calif. Publ. Zool., Vol. 9, 1911, pp. 5, 29.
Phrynosoma blainvillei (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 423, fig. 74.

TYPE LOCALITY: California.

RANGE: Southern California, northern Lower California.

Prynosoma blainvillii frontale (VAN DENBURGH)

Phrynosoma frontalis VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 2, Vol. 4, 1894, p. 296.
Phrynosoma frontale STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 59.
Phrynosoma blainvillei (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 423.

TYPE LOCALITY: Bear Valley, San Benito County, California.

RANGE: California west of the Sierra Nevada, from the San Francisco Bay region and the northern Sacramento Valley to the Los Angeles basin; also northern Lower California west of the Sierra de Juárez and Sierra San Pedro Mártir, from Lat. 32° N. south to Lat. 29° N.; also Cedros Island.

Phrynosoma brevirostre (GIRARD)

Tapaya brevirostris GIRARD
U. S. Expl. Exp., Herp., 1858, p. 397.
Phrynosoma brevirostre COPE
Proc. Ac. Nat. Sci. Phila., 1866, p. 302.

TYPE LOCALITY: Plains of Nebraska.

RANGE: North Dakota, Wyoming, the basins of the Yellowstone and Platte Rivers.

Phrynosoma cerroense STEJNEGER

Phrynosoma cerroense STEJNEGER
N. Amer. Fauna, No. 7, May 31, 1893, p. 187.
Phrynosoma cerroense COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 428, fig. 75.

TYPE LOCALITY: Cerros Island, Lower California.

RANGE: The type locality.

Phrynosoma cornutum (HARLAN)

Agama cornuta HARLAN
Journ. Ac. Nat. Sci. Phila., Vol. 4, 1825, p. 299, pl. 20.
Phrynosoma cornutum GRAY
Griffith's Animal Kingdom, Syn. Rept., 1831, p. 9.
Phrynosoma brevicorne STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 60.
Phrynosoma cornutum COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 432, fig. 77.

TYPE LOCALITY: Great Plains east of the Rocky Mountains.

RANGE: Arkansas, Kansas to the northern states of Mexico, west to Colorado, New Mexico, and Arizona.[1]

Phrynosoma coronatum coronatum (BLAINVILLE)

Agama (Phrynosoma) coronata BLAINVILLE
Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 284, pl. 25, fig. 1.
Phrynosoma coronatum DUMÉRIL and BIBRON
Erp. Gén., Vol. 4, 1837, p. 318.
Phrynosoma coronatum coronatum KLAUBER
Copeia, 1936, No. 2, July 31, p. 110.
Phrynosoma coronatum COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 430.

TYPE LOCALITY: "California" by inference.

RANGE: Southern Lower California.

---

[1] Apparently introduced and established in Florida.

Phrynosoma coronatum jamesi (SCHMIDT)

Phrynosoma jamesi SCHMIDT
Bull. Amer. Mus. Nat. Hist., Vol. 46, Dec. 7, 1922, p. 668, pl. 55–56.
Phrynosoma coronatum jamesi KLAUBER
Copeia, 1936, No. 2, July 31, p. 110.
Phrynosoma jamesi STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3. 1933, p. 68.

TYPE LOCALITY: San Bartolomé Bay, Lower California.

RANGE: Central Lower California.

Phrynosoma ditmarsi STEJNEGER

Phrynosoma ditmarsi STEJNEGER
Proc. U. S. Nat. Mus., Vol. 29, Feb. 2, 1906, p. 565.

TYPE LOCALITY: State of Sonora, Mexico, not far from boundary of Arizona.

RANGE: Northern Mexico and probably southern Arizona.

Phrynosoma m'callii (HALLOWELL)

Anota m'callii HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 182.
Phrynosoma maccallii COPE
Proc. Ac. Nat. Sci. Phila., 1866, p. 310.
Anota maccallii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 448, fig. 82.

TYPE LOCALITY: Colorado Desert between Vallecita [sic] and Camp Yuma, 160 miles east of San Diego, California.

RANGE: Southeastern California, southwestern Arizona, northwestern Sonora, and northern Lower California.

Phrynosoma modestum GIRARD

Phrynosoma modestum GIRARD
Stansbury's Expl. Surv. Vall. Great Salt Lake, 1852, pp. 361, 365, pl. 6, figs. 4–8.
Anota modesta COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 437, fig. 78.

TYPE LOCALITY: The Rio Grande, west of San Antonio, Texas, and from between San Antonio and El Paso.

RANGE: Texas to Arizona and northern Mexico.

Phrynosoma orbiculare douglassii (BELL)

Agama douglassii BELL
Trans. Linn. Soc. London, Vol. 16, 1833, p. 105, pl. 10.
Phrynosoma douglassii douglassii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 411, fig. 69.
Phrynosoma douglassii douglassii STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 74.
Phrynosoma orbiculare douglassii KLAUBER
Bull. Zool. Soc. San Diego, 14, 1939, pp. 91–93.

TYPE LOCALITY: "In ora occidentali Americae Borealis ad ripas fluminis Columbiae."

RANGE: South central British Columbia, Oregon and Washington.

Phrynosoma orbiculare hernandesi (GIRARD)

Tapaya hernandesi GIRARD
U. S. Expl. Exp., Herp. 1858, p. 395.
Phrynosoma douglassii hernandesi COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 413, fig. 70.
Phrynosoma douglassii hernandesi STEJNEGER and BARBOUR.
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 74.
Phrynosoma orbiculare hernandesi KLAUBER
Bull. Zool. Soc. San Diego, 14, 1939, pp. 91–93.

TYPE LOCALITY: New Mexico.

RANGE: The pleateau region of Colorado, southern New Mexico, southeastern and central Arizona, southwestern Texas, and northern Sonora.

Phrynosoma orbiculare ornatissimum (GIRARD)

Tapaya ornatissima GIRARD
U. S. Expl. Exp., Herp., 1858, p. 396.
Phrynosoma douglassii ornatissimum COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 415, fig. 71.
Phrynosoma douglassii ornatissimum STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 74.
Phrynosoma orbiculare ornatissimum KLAUBER
Bull. Zool. Soc. San Diego, 14, 1939, pp. 91–93.

TYPE LOCALITY: Mountainous region of New Mexico.

RANGE: Deserts of northeastern Arizona, northern New Mexico, Colorado, Idaho, Nevada and Utah.

Phrynosoma orbiculare ornatum (Girard)

Phrynosoma ornatum Girard
U. S. Expl. Exp., Herp., 1858, Atlas, pl. 21, fig. 1–5.
Phrynosoma douglassii ornatum Stejneger
Copeia, 1919, No. 65, Jan. 22, p. 4.
Phrynosoma orbiculare ornatum Klauber
Bull. Zool. Soc. San Diego, 14, 1939, pp. 91–93.

TYPE LOCALITY: Salt Lake.

RANGE: The Salt Lake Basin.

Phrynosoma platyrhinos platyrhinos Girard

Phrynosoma platyrhinos Girard
Stansbury's Expl. Surv. Vall. Great Salt Lake, 1852, pp. 361, 363, pl. 7, figs. 1–5.
Anota platyrhina Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 443, fig. 81.
Phrynosoma platyrhinos Stejnerger and Barbour
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 75.

TYPE LOCALITY: Great Salt Lake Valley, Utah.

RANGE: Washington southward to California, Utah, Idaho and Nevada, southwestern Arizona and northeastern Lower California.

Phrynosoma schmidti Barbour[1]

Phrynosoma schmidti Barbour
Proc. N. Engl. Zoöl. Club, Vol. 7, Sept. 7, 1921, p. 113.

TYPE LOCALITY: Cerros Island, Lower California.

RANGE: Same.

Phrynosoma solare Gray

Phrynosoma solaris Gray
Cat. Liz. Brit. Mus., 1845, p. 229.
Phrynosoma solare Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 420, fig. 73.

TYPE LOCALITY: "California."

RANGE: Northern Lower California and extreme southern Arizona and Sonora.

---

[1] Klauber (Copeia, 1936, No. 2, p. 110) suspects this form to be invalid, but the evidence is inconclusive until more specimens are collected.

ANGUIDAE (*FAMILY*)

Ophisaurus (*GENUS*)

DAUDIN, Bull. Soc. Philom. Paris, Vol. 3, No. 72, March, 1803, p. 188
TYPE: *ventralis*

Ophisaurus ventralis (LINNÉ)
GLASS-SNAKE, JOINT-SNAKE
Anguis ventralis LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 391.
Ophisaurus ventralis DAUDIN
Hist. Nat. Rept., Vol. 7, 1803, p. 352, pl. 88.
Ophisaurus ventralis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 494, fig. 88.

TYPE LOCALITY: Carolina.

RANGE: Southern United States, in the east distributed northward to Cumberland and Buckingham Counties, Virginia, and Tennessee, in the central valley to Wisconsin, the dune region of northern Indiana and Illinois, westward to New Mexico, and southward to the State of Vera Cruz, Mexico.

Gerrhonotus (*GENUS*)

WIEGMANN, Isis, 1828, p. 379
TYPE: *tessellatus* = liocephalus

Gerrhonotus cedrosensis FITCH
Gerrhonotus cedrosensis FITCH
Copeia, 1934, No. 1, April 24, p. 6.

TYPE LOCALITY: Cedros Island, Lower California, Mexico.

RANGE: Same.

Gerrhonotus coeruleus coeruleus (WIEGMANN)
Gerrhonotus coeruleus WIEGMANN
Isis, 1828, p. 380.
Gerrhonotus burnettii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 526, fig. 94.

TYPE LOCALITY: "Brasilia" (in errore; probably San Francisco, California).

RANGE: Coast region of northern California.

Gerrhonotus coeruleus palmeri (Stejneger)

Gerrhonotus scincicauda palmeri Stejneger
N. Amer. Fauna, No. 7, May 31, 1893, p. 196.
Gerrhonotus coeruleus palmeri Fitch
Trans. Ac. Sci. St. Louis, Vol. 29, No. 1, 1935, p. 35.
Gerrhonotus multicarinatus palmerii Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 525.
Gerrhonotus palmeri Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 71.

TYPE LOCALITY: South Fork King's River, California.

RANGE: Sierra Nevada slopes, in central California.

Gerrhonotus coeruleus principis (Baird and Girard)

Elgaria principis Baird and Girard
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 175.
Gerrhonotus coeruleus principis Fitch
Trans. Ac. Sci. St. Louis, Vol. 29, No. 1, 1935, p. 23.
Gerrhonotus principis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 529, fig. 95.
Gerrhonotus principis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 71.

TYPE LOCALITY: Oregon and Puget Sound.

RANGE: British Columbia, including Vancouver Island, Washington, Oregon, northern Idaho, western Montana, and northwestern California.

Gerrhonotus coeruleus shastensis Fitch

Gerrhonotus coeruleus shastensis Fitch
Copeia, 1934, No. 1, April 24, p. 6.

TYPE LOCALITY: Burney, Shasta County, California, 3000 feet.

RANGE: Mountains of northern California and southwestern Oregon.

Gerrhonotus imbricatus levicollis (Stejneger)

Barissia levicollis Stejneger
Proc. U. S. Nat. Mus., Vol. 13, Sept. 9, 1890, p. 184.
Barissia levicollis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 535, fig. 96.
Barissia levicollis Stejneger and Barbour
Check List N. Amer. Amph. and Rept., Ed. 4, 1939, p. 79.

Gerrhonotus imbricatus levicollis Dunn
Proc. Acad. Nat. Sci. Phila., 88, 1936, p. 475.

TYPE LOCALITY: "Mexican Boundary."

RANGE: State of Durango, Mexico, north to the border.

Gerrhonotus infernalis Baird

Gerrhonotus infernalis Baird
Proc. Ac. Nat. Sci. Phila., 1858, p. 255.
Gerrhonotus liocephalus infernalis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 517, fig. 91.

TYPE LOCALITY: Devil's River, Texas.

RANGE: Central, southeastern Texas and northern Mexico.

Gerrhonotus kingii Gray

Gerrhonotus kingii Gray
Ann. Mag. Nat. Hist., Vol. 1, 1838, p. 390.
Gerrhonotus kingii Van Denburgh
Rept. of Western N. Amer., Vol. 1, 1922, p. 461.
Gerrhonotus nobilis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 65.

TYPE LOCALITY: Unknown.

RANGE: New Mexico, Arizona and northern Mexico.

Gerrhonotus multicarinatus multicarinatus (Blainville)

Cordylus (Gerrhonotus) multi-carinatus Blainville
Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 289, pl. 25, fig. 2.
Gerrhonotus multicarinatus Duméril and Bibron
Erp. Gén., Vol. 5, 1839, p. 404.
Gerrhonotus multi-carinatus multi-carinatus Fitch
Copeia, 1934, No. 4, Dec. 31, p. 173.
Gerrhonotus multicarinatus (part) Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 520.

TYPE LOCALITY: "California." Fitch suggests Monterey.

RANGE: California, Sacramento Valley, southward to Ventura County (along the coast).

Gerrhonotus multicarinatus nanus Fitch

Gerrhonotus multi-carinatus nanus Fitch
Amer. Midl. Natl., Vol. 20, No. 2, Sept. 1938, p. 397.

TYPE LOCALITY: South Island, Los Coronados Islands, Lower California, Mexico.

RANGE: Los Coronados Islands (North, Middle, East and South), Lower California.

Gerrhonotus multicarinatus scincicauda (SKILTON)

Tropidolepis scincicauda SKILTON
Amer. Journ. Sci. Arts, Ser. 2, Vol. 7, 1849, p. 202, pl. at p. 312, figs. 1–3.
Gerrhonotus scincicauda scincicauda GRINNELL and CAMP
Univ. Calif. Publ. Zool., Vol. 17, No. 10, 1917, p. 166.
Gerrhonotus multi-carinatus scincicauda FITCH
Copeia, 1934, No. 4, Dec. 31, p. 173.
Gerrhonotus multicarinatus (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 520, fig. 93.
Gerrhonotus scincicauda scincicauda STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 71.

TYPE LOCALITY: "Dallas of the Columbia."

RANGE: Washington, through western Oregon into northern California.

Gerrhonotus multicarinatus webbii (BAIRD)

Gerrhonotus webbii BAIRD
Proc. Ac. Nat. Sci. Phila., 1858, p. 255.
Gerrhonotus scincicauda webbii GRINNELL and CAMP
Univ. Calif. Publ. Zool., Vol. 17, No. 10, 1917, p. 168.
Gerrhonotus multi-carinatus webbii FITCH
Copeia, 1934, No. 4, Dec. 31, p. 173.
Gerrhonotus scincicauda webbii STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 71.

TYPE LOCALITY: "From San Diego to El Paso."[1]

RANGE: Southern California and Lower California from the mountains to the coast.

Gerrhonotus paucicarinatus FITCH

Gerrhonotus paucicarinatus FITCH
Copeia, 1934, No. 4, Dec. 31, p. 172.
Gerrhonotus multi-carinatus STEJNEGER and BARBOUR (part)
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 70.

---

[1] Baird's MS. entry in U.S.N.M. register. Type U.S.N.M. No. 3078, a very young individual.

TYPE LOCALITY: Todos Santos, Lower California.
RANGE: Cape region of Lower California.

ANNIELLIDAE (*FAMILY*)

Anniella (*GENUS*)

GRAY, Ann. Mag. Nat. Hist., Ser. 2, Vol. 10, 1852, p. 440
TYPE: *pulchra*

Anniella geronimensis SHAW

Anniella geronimensis SHAW
Trans. San Diego Soc. Nat. Hist., 9, No. 24, July 31, 1940, pp. 225-228.

TYPE LOCALITY: San Geronimo Island, Lower California, Mexico.

RANGE: Same as type locality.

Anniella pulchra pulchra GRAY

Anniella pulchra GRAY
Ann. Mag. Nat. Hist., Ser. 2, Vol. 10, 1852, p. 440.
Anniella pulchra COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 674, fig. 138.
Anniella pulchra pulchra KLAUBER
Copeia, 1940, No. 1, pp. 15-16.

TYPE LOCALITY: California.

RANGE: Central and southern California and northern Lower California west of the desert.

Anniella pulchra nigra FISCHER

Anniella nigra FISCHER
Abh. Naturw. Ver. Hamburg, Vol. 9, Pt. 1, 1886, p. 9.
Anniella pulchra var. *A. nigra* COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 675.
Anniella nigra STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 79.
Anniella pulchra nigra KLAUBER
Copeia, 1940, No. 1, pp. 15-16.

TYPE LOCALITY: San Diego, California, probably in errore.

RANGE: Country near Pacific Grove, California.

HELODERMATIDAE (*FAMILY*)

Heloderma (*GENUS*)

WIEGMANN, Isis, 1829, p. 624
TYPE: *horridum*

Heloderma suspectum COPE
GILA MONSTER
Heloderma suspectum COPE
Proc. Ac. Nat. Sci. Phila., 1869, p. 5.
Heloderma suspectum COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 476, fig. 87.

TYPE LOCALITY: Sierra de la Union, Arizona ("Sonora").

RANGE: Extreme southern Utah and Nevada, Arizona, and Sonora.

XANTUSIIDAE (*FAMILY*)

Xantusia (*GENUS*)

BAIRD, Proc. Ac. Nat. Sci. Phila., 1858, p. 255
TYPE: *vigilis*

Xantusia arizonae KLAUBER
Xantusia arizonae KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 7, No. 1, Oct. 6, 1931, p. 1, pl. 1.

TYPE LOCALITY: Yarnell, Yavapai County, Arizona.

RANGE: The Weaver, McCloud and Superstition Mountains, north to Mohave County, Arizona.

Xantusia gilberti VAN DENBURGH
Xantusia gilberti VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 2, Vol. 5, 1895, p. 121, pl. 11.
Amoebopsis gilbertii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 555, fig. 101.

TYPE LOCALITY: San Francisquito, Sierra Laguna, Lower California.

RANGE: Southern Lower California.

Xantusia henshawi STEJNEGER
Xantusia henshawi STEJNEGER
Proc. U. S. Nat. Mus., Vol. 16, July 21, 1893, p. 467.

Zablepsis henshawii Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 553, fig. 100.

TYPE LOCALITY: Witch Creek, San Diego County, California.

RANGE: Rocky areas on both slopes of the mountains from northern Riverside County, California, to the San Pedro Martir Mountains, Lower California.

Xantusia riversiana Cope

Xantusia riversiana Cope
Proc. Ac. Nat. Sci. Phila., 1883, p. 29.
Xantusia riversiana Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 550, fig. 99.

TYPE LOCALITY: California, according to Cope, but later stated by Professor Rivers to have been San Nicolas Island, off the California coast.

RANGE: San Nicolas, Santa Barbara, and San Clemente Islands, coast of California.

Xantusia vigilis Baird

Xantusia vigilis Baird
Proc. Ac. Nat. Sci. Phila., 1858, p. 255.
Xantusia vigilis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 545, fig. 97.

TYPE LOCALITY: Fort Tejon, California.

RANGE: The deserts and desert mountains of the Californias and southern Nevada from Kern County and the Inyo Mountains, Inyo County, California, to San Felipe Bay and San Matias Pass, Lower California. Also Washington County, Utah.

TEIIDAE (*FAMILY*)

Cnemidophorus (*GENUS*)

Wagler, Syst. Amph., 1830, p. 154
TYPE: *murinus*

THE SWIFTS OR WHIP-TAILS

Cnemidophorus bacatus Van Denburgh and Slevin

Cnemidophorus bacatus Van Denburgh and Slevin
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, July 30, 1921, p. 97.

TYPE LOCALITY: San Pedro Nolasco Island, Lower California.
RANGE: Same.

Cnemidophorus bartolomas DICKERSON
Cnemidophorus bartolomas DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 476.
TYPE LOCALITY: San Bartolomé Bay, Lower California.
RANGE: Same.

Cneimophorus catalinensis VAN DENBURGH and SLEVIN
Cnemidophorus catalinensis VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, Dec. 17, 1921, pl. 396.
TYPE LOCALITY: Santa Catalina Island, Lower California.
RANGE: Same.

Cnemidophorus ceralbensis (VAN DENBURGH and SLEVIN)
Verticaria ceralbensis VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, Dec. 17, 1921, p. 396
TYPE LOCALITY: Ceralbo Island, Lower California.
RANGE: Same.

Cnemidophorus estebanensis DICKERSON
Cnemidophorus estebanensis DICKERSON
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 474.
TYPE LOCALITY: San Esteban Island, Gulf of California.
RANGE: Same.

Cnemidophorus grahamii BAIRD and GIRARD
Cnemidophorus grahamii BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 128.
Cnemidophorus grahamii grahamii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 598, fig. 117.
TYPE LOCALITY: Between San Antonio and El Paso, Texas.
RANGE: Texas.

Cnemidophorus gularis BAIRD and GIRARD
Cnemidophorus gularis BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 128.

Cnemidophorus gularis gularis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 602, fig. 118.

TYPE LOCALITY: Indianola and San Pedro River, Texas.

RANGE: Arkansas and Oklahoma through Texas west to Arizona; also the northern states of Mexico.

Cnemidophorus hyperythrus hyperythrus (Cope)

Cnemidophorus hyperythrus Cope
Proc. Ac. Nat. Sci. Phila., 1863, p. 103.
Verticaria hyperythra (part) Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 563.

TYPE LOCALITY: Cape San Lucas, Lower California.

RANGE: Southern California, Lower California, Cerros, Espiritu Santo, Magdalena, San Francisco, San Marcos, and Santa Margarita Islands.

Cnemidophorus hyperythrus caeruleus (Dickerson)

Verticaria caerulea Dickerson
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 472.
Cnemidophorus hyperythra caeruleus Burt
Bull. U. S. Nat. Mus., No. 154, 1931, p. 240.

TYPE LOCALITY: Carmen Island, Lower California.

RANGE: Same.

Cnemidophorus hyperythrus danheimae Burt

Cnemidophorus hyperythrus danheimae Burt
Proc. Biol. Soc. Wash., Vol. 42, 1929, p. 154, fig. 33.
Verticaria sericea Van Denburgh
Proc. Calif. Ac. Sci., Ser. 2, Vol. 5, 1895, p. 132, pl. 12.
Verticaria sericea Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 564, fig. 103.

TYPE LOCALITY: San José Island, Lower California.

RANGE: Same.

Cnemidophorus hyperythrus pictus (Van Denburgh and Slevin)

Verticaria picta Van Denburgh and Slevin
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, July 30, 1921, p. 98.
Cnemidophorus hyperythrus pictus Burt
Bull. U. S. Nat. Mus., No. 154, 1931, p. 242.

TYPE LOCALITY: Monserrate Island, Lower California.
RANGE: Same.

Cnemidophorus labialis STEJNEGER

Cnemidophorus labialis STEJNEGER
Proc. U. S. Nat. Mus., Vol. 14, June, 1890, p. 643.
Cnemidophorus labialis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 610, fig. 122.

TYPE LOCALITY: Cerros Island, Lower California.
RANGE: Cerros Island, Lower California.

Cnemidophorus maximus COPE

Cnemidophorus maximus COPE
Proc. Ac. Nat. Sci. Phila., 1863, p. 104.
Cnemidophorus maximus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 570, fig. 104.

TYPE LOCALITY: Cape St. Lucas, Lower California.
RANGE: Southern Lower California.

Cnemidophorus melanostethus COPE

Cnemidophorus melanostethus COPE
Proc. Ac. Nat. Sci. Phila., 1863, p. 104.
Cnemidophorus tessellatus melanostethus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 581. fig. 109.

TYPE LOCALITY: "Region of the Colorado of California," Colorado Desert, Arizona.
RANGE: Deserts of southern Arizona.

Cnemidophorus perplexus BAIRD and GIRARD

Cnemidophorus perplexus BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 128.
Cnemidophorus tessellatus perplexus (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 573, fig. 106.

TYPE LOCALITY: Valley of the Rio San Pedro, tributary of the Rio Grande del Norte, Texas.
RANGE: Texas, New Mexico and parts of Utah.

Cnemidophorus sexlineatus (LINNÉ)

Lacerta sexlineata LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 364.

Cnemidophorus sexlineatus Duméril and Bibron
Erp. Gén., Vol. 5, 1839, p. 1.
Cnemidophorus sexlineatus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 593, fig. 116.

TYPE LOCALITY: In Carolina.

RANGE: Maryland to Florida, west to northern Mexico and Arizona and up the Mississippi Valley as far north as Lake Michigan.

Cnemidophorus tessellatus tessellatus (Say)[1]

Ameira tesselata Say
Long's Exp. Rocky Mts., Vol. 2, 1823, p. 50.
Cnemidophorus tessellatus tessellatus (part) Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 575, fig. 107.

TYPE LOCALITY: Arkansas River, near Castle Rock Creek, Colorado.

RANGE: Texas to California and eastern Oregon, Idaho, Utah, Colorado, Nevada, Isla Partida, near Espiritu Santo Island, Lower California, Cerros Island, Tiburon Island, and adjacent region of Sonora (Guaymas).

Cnemidophorus tessellatus canus (Van Denburgh and Slevin)

Cnemidophorus canus Van Denburgh and Slevin
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, July 30, 1921, p. 97.
Cnemidophorus tessellatus canus Burt
Bull. U. S. Nat. Mus., No. 154, 1931, p. 208.

TYPE LOCALITY: Sal Si Puedes Island, Lower California.

RANGE: Same, and North and South San Lorenzo Island.

Cnemidophorus tessellatus celeripes (Dickerson)

Cnemidophorus celeripes Dickerson
Bull. Amer. Mus. Nat. Hist., Vol. 41, Oct. 2, 1919, p. 472.
Cnemidophorus tessellatus celeripes Burt
Bull. U. S. Nat. Mus., No. 154, 1931, p. 202.

TYPE LOCALITY: San José Island, Lower California.

RANGE: Same.

---

[1] *C. tesselatus* by Say is *in errore* and should be *C. tessellatus*.

Cnemidophorus tessellatus martyris (Stejneger)

Cnemidophorus martyris Stejneger
Proc. U. S. Nat. Mus., Vol. 14, Aug. 31, 1891, p. 407.
Cnemidophorus tessellatus martyris Burt
Bull. U. S. Nat. Mus., No. 154, 1931, p. 205.

TYPE LOCALITY: San Pedro Martir Island, Gulf of Califonia.
RANGE: Same.

Cnemidophorus tessellatus rubidus Cope

Cnemidophorus tessellatus rubidus Cope
Trans. Amer. Philos. Soc., Ser. 2, Vol. 17, 1892, p. 36, pl. 12, fig. 1.
Cnemidophorus vandenburghi Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 74.
Cnemidophorus tessellatus rubidus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 584, fig. 110.

TYPE LOCALITY: Sta. Margarita Island, Lower California.
RANGE: Carmen, Sta. Margarita and Magdalena Islands, Lower California.

Cnemidophorus tessellatus stejnegeri (Van Denburgh)

Cnemidophorus stejnegeri Van Denburgh
Proc. Calif. Ac. Sci., Ser. 2, Vol. 4, 1894, p. 300.
Cnemidophorus tessellatus stejnegeri Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 68.
Cnemidophorus grahamii stejnegerii Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 599.

TYPE LOCALITY: Near Ensenada, Lower California.
RANGE: Southern California and northern Lower California.

SCINCIDAE (*FAMILY*)

Leiolopisma (*GENUS*)

Duméril and Bibron, Erp. Gén., Vol. 5, 1839, p. 742
TYPE: *telfairii*

Leiolopisma unicolor (Harlan)

Scincus unicolor Harlan
Journ. Ac. Nat. Sci. Phila., Vol. 5, Pt. 1, 1825, p. 156.
Leiolopisma unicolor Stejneger
Copeia, 1934, No. 4, Dec. 31, p. 182.

Leiolopisma laterale STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 79.

TYPE LOCALITY: Southern states.

RANGE: New Jersey to Florida, west to Illinois, Kansas, Oklahoma, and Texas.

Eumeces (*GENUS*)

WIEGMANN, Herp. Mexicana, 1834, p. 36
TYPE: *pavimentatus*

Eumeces anthracinus (BAIRD)

Plestiodon anthracinus BAIRD
Journ. Ac. Nat. Sci. Phila., Ser. 2, Vol. 1, 1849, fig. 294.
Eumeces anthracinus COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 45.
Eumeces anthracinus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 661, fig. 135.
Eumeces pluvialis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 82.

TYPE LOCALITY: North Mountain near Carlisle, Pennsylvania.

RANGE: New York to North Carolina and the extreme northeastern corner of Georgia, to Missouri, Arkansas, Kansas, and Texas.

Eumeces brevilineatus COPE

Eumeces brevilineatus COPE
Bull. U. S. Nat. Mus., No. 17, 1880, p. 18.
Eumeces brevilineatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 664, fig. 137.

TYPE LOCALITY: Helotes, Bexar County, Texas.

RANGE: Texas.

Eumeces callicephalus BOCOURT

Eumeces callicephalus BOCOURT
Miss. Sci. Mex., Rept., 1879, p. 431, pl. 22 D, fig. 2, pl. 22 E, fig. 2.
Eumeces callicephalus TAYLOR
Sci. Bull. Univ. Kansas, Vol. 19, No. 7, Nov. 1929, p. 67.

TYPE LOCALITY: Guanajuato, Mexico.

RANGE: Table land of north central Mexico north to the Huachuca Mountains, Arizona.

Eumeces egregius (Baird)

Plestiodon egregius Baird
Proc. Ac. Nat. Sci. Phila., 1858, p. 256.
Eumeces egregius Cope
Bull. U. S. Nat. Mus., No. 1, 1875, p. 45.
Eumeces egregius egregius Taylor
Trans. Kansas Ac. Sci., Vol. 38, Apr. 25, 1936, p. 345.
Eumeces egregius (part) Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 655, fig. 132.

TYPE LOCALITY: Indian Key, Florida.

RANGE: Lake County, Florida and Florida Keys north along the east coast to southern and east central Georgia, and Alabama.

Eumeces fasciatus (Linné)

BLUE-TAILED SKINK, SCORPION

Lacerta fasciata Linné
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 209.
Eumeces fasciatus Cope
Bull. U. S. Nat. Mus., No. 1, 1875, p. 45.
Eumeces quinquelineatus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 632, fig. 125.

TYPE LOCALITY: Carolina.

RANGE: Southern New England to Georgia, up the Mississippi Valley to Canada.

Eumeces gaigeae (Taylor)

Eumeces gaigei Taylor
Sci. Bull. Univ. Kansas, Vol. 22, No. 11, Apr. 15, 1935, p. 219.

TYPE LOCALITY: Taos, New Mexico.

RANGE: New Mexico and western Texas.

Eumeces gilberti gilberti (Van Denburgh)

Eumeces gilberti Van Denburgh
Proc. Calif. Ac. Sci., Ser. 2, Vol. 6, 1896, p. 350.
Eumeces gilberti gilberti Van Denburgh
Sci. Bull. Univ. Kansas, Vol. 23, Aug. 15, 1936, p. 438, figs. 71, 72.

TYPE LOCALITY: Yosemite Valley, Mariposa County, California.

RANGE: Mountains of north central California in Mariposa, Madera, Tulare, Stanislaus, and Inyo Counties; Yavapai County, Arizona.

Eumeces gilberti rubricaudatus (TAYLOR)

Eumeces gilberti rubricaudatus TAYLOR
Sci. Bull. Univ. Kansas, Vol. 23, Aug. 15, 1936, p. 446, fig. 72.

TYPE LOCALITY: Tehachapi Mountain, California.

RANGE: Fresno County, California, south to northern Lower California.

Eumeces humilis BOULENGER

Eumeces humilis BOULENGER
Cat. Liz. Brit. Mus., Vol. 3, 1887, p. 377.
Eumeces humilis MOSAUER
Occ. Pap. Mus. Zool., Univ. Mich., No. 246, June 9, 1932, p. 10, pl. 1, fig. 3.

TYPE LOCALITY: Presidio (near Mazatlan), Mexico.

RANGE: Known from west coast of Mexico; has recently been found in the Guadalupe Mountains, Texas.

Eumeces inexpectatus TAYLOR

Eumeces inexpectatus TAYLOR
Sci. Bull. Univ. Kansas, Vol. 20, No. 13, May 1932, p. 251.

TYPE LOCALITY: Citrus County, Florida.

RANGE: From Virginia, south through most of Florida and westward to Mississippi in the coastal plain.

Eumeces lagunensis VAN DENBURGH

Eumeces lagunensis VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 2, Vol. 5, 1895, p. 79, pl. 13.
Eumeces lagunensis TAYLOR
Sci. Bull. Univ. Kansas, Vol. 23, Aug. 15, 1936, p. 431, fig. 70.

TYPE LOCALITY: San Francisquito, Sierra de la Laguna, Lower California.

RANGE: Southern Lower California.

Eumeces laticeps (SCHNEIDER)

Scincus laticeps SCHNEIDER
Hist. Amphib., Vol. 2, 1801, p. 189.
Eumeces laticeps PETERS
Monatsber. Akad. Wiss., Berlin, 1864, p. 49.
Eumeces laticeps TAYLOR
Sci. Bull. Univ. Kansas, Vol. 20, No. 14, May 1932, p. 263.

TYPE LOCALITY: Not stated.

RANGE: Southeastern states west to Oklahoma and Indiana. Absent from southern Florida. Very frequently if not usually arboreal.

Eumeces longirostris (COPE)

Plestiodon longirostris COPE
Proc. Ac. Nat. Sci. Phila., 1861, p. 313.
Eumeces longirostris COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 45.
Eumeces longirostris COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 631, fig. 124.

TYPE LOCALITY: Bermuda.

RANGE: Bermuda.

Eumeces multivirgatus (HALLOWELL)

Plestiodon multivirgatum HALLOWELL
Proc. Ac. Nat. Sci. Phila., 1857, p. 215.
Eumeces multivirgatus COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 45.
Eumeces epipleurotus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 650, fig. 129.
Eumeces leptogrammus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 651, fig. 130.
Eumeces multivirgatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 653, fig. 131.

TYPE LOCALITY: Posa Creek,[1] 460 miles west of Fort Riley, Kansas.

RANGE: Nebraska to northern Texas; Colorado, New Mexico and Arizona.

Eumeces obsoletus (BAIRD and GIRARD)

Plestiodon obsoletum BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 129.
Eumeces obsoletus COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 45.
Eumeces obsoletus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 646, fig. 128.

---

[1] Cow Creek according to Taylor, Sci. Bull. Univ. Kansas, Vol. 23, p. 343.

TYPE LOCALITY: Valley of the Rio San Pedro, tributary of the Rio Grande del Norte, Texas.

RANGE: Utah and Kansas south to northern Mexico.

Eumeces onocrepis (COPE)

Plistodon onocrepis COPE
Appendix to Rep. Peabody Ac. Sci. Salem. 1869–70 (Jan. 15, 1871), p. 82.
Eumeces onocrepis COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 45.
Eumeces egregius onocrepis TAYLOR
Trans. Kansas Ac. Sci., Vol. 38, Apr. 25, 1936, p. 345.
Eumeces egregius (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 655, fig. 132.

TYPE LOCALITY: Dummet's Plantation, 20 miles south of New Smyrna, Florida. (Now Allenhurst.)

RANGE: Central and western peninsular Florida.

Eumeces septentrionalis septentrionalis (BAIRD)

Plestiodon septentrionalis BAIRD
Proc. Ac. Nat. Sci. Phila., 1858, p. 256.
Eumeces septentrionalis COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 44.
Eumeces septentrionalis septentrionalis TAYLOR
Sci. Bull. Univ. Kansas, Vol. 23, Aug. 15, 1936, p. 394.
Eumeces septentrionalis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 656, fig. 133.
Eumeces septentrionalis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 82.

TYPE LOCALITY: Minnesota and Nebraska.

RANGE: Manitoba, Minnesota, Iowa, Nebraska, and Kansas.

Eumeces septentrionalis obtusirostris BOCOURT

Eumeces obtusirostris BOCOURT
Miss Sci. Mexique, Liv. 6, 1879, p. 423, pl. 22 D, figs. 1 A, 1 B.
Eumeces septentrionalis obtusirostris TAYLOR
Trans. Kansas Ac. Sci., Vol. 38, Apr. 25, 1936, p. 345.
Eumeces pachyurus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 82.

TYPE LOCALITY: Texas.

RANGE: Eastern Texas northward to Kansas.

Eumeces skiltonianus skiltonianus (BAIRD and GIRARD)

Plestiodon skiltonianum BAIRD and GIRARD
Stansbury's Expl. Surv. Vall. Great Salt Lake, 1852, p. 349, pl. 4, figs. 4–6.
Eumeces skiltonianus COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 45.
Eumeces skiltonianus skiltonianus TAYLOR
Sci. Bull. Univ. Kansas, Vol. 23, Aug. 15, 1936, p. 415.
Eumeces skiltonianus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 640, fig. 126.
Eumeces skiltonianus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 83.

TYPE LOCALITY: Oregon.

RANGE: British Columbia, Idaho, and western Montana, southwest through most of California, except the extreme southwestern desert area; Lower California eastward through Nevada to Utah.

Eumeces skiltonianus brevipes (COPE)

Eumeces skiltonianus var. *brevipes* COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 643.
Eumeces skiltonianus brevipes TAYLOR
Sci. Bull. Univ. Kansas, Vol. 23, Aug. 15, 1936, p. 428.

TYPE LOCALITY: Fresno, California.

RANGE: Mountains of Eldorado County, California.

Eumeces tetragrammus (BAIRD)

Plestiodon tetragrammus BAIRD
Proc. Ac. Nat. Sci. Phila., 1858, p. 256.
Eumeces tetragrammus COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 45.
Eumeces tetragrammus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 660.

TYPE LOCALITY: Lower Rio Grande.

RANGE: Southern Texas and northeastern Mexico.

Neoseps (*GENUS*)

Stejneger, Proc. U. S. Nat. Mus., Vol. 39, Sept. 23, 1910, p. 33
TYPE: *reynoldsi*

Neoseps reynoldsi Stejneger

Neoseps reynoldsi Stejneger
Proc. U. S. Nat. Mus., Vol. 39, Sept. 23, 1910, p. 34.

TYPE LOCALITY: Near Spring Lake, Fruitland Park, Lake County, Florida.

RANGE: Alochua, Lake and Polk Counties in Central Florida.

AMPHISBAENIDAE (*FAMILY*)

Bipes (*GENUS*)

Latreille, Hist. Nat. Rept., Vol. 2, 1802, p. 90
TYPE: *canaliculatus*

Bipes biporus (Cope)

Euchirotes biporus Cope
Amer. Nat., Vol. 28, 1904, p. 436, figs. 5a–e.
Bipes biporus Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 72.
Euchirotes biporus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 680, fig. 140.

TYPE LOCALITY: La Paz, Lower California.

RANGE: Southern Lower California.

Rhineura (*GENUS*)

Cope, Proc. Ac. Nat. Sci. Phila., 1861, p. 75
TYPE: *floridana*

Rhineura floridana (Baird)

Lepidosternon floridanum Baird
Proc. Ac. Nat. Sci. Phila., 1858, p. 255.
Rhineura floridana Cope
Proc. Ac. Nat. Sci. Phila., 1861, p. 75.
Rhineura floridana Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 686, fig. 141.

TYPE LOCALITY: Micanopy, Florida.

RANGE: Northern and central Florida.

SERPENTES (*SUBORDER*)

Linné, Syst. Nat., Ed. 10, Vol. 1, 1758, p. 214

LEPTOTYPHLOPIDAE (*FAMILY*)

Leptotyphlops (*GENUS*)

Fitzinger, Syst. Rept., 1843, p. 24
TYPE: *nigricans*

Leptotyphlops dulcis dulcis (Baird and Girard)

Rena dulcis Baird amd Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 142.
Leptotyphlops dulcis Stejneger
Proc. U. S. Nat. Mus., Vol. 14, Oct. 31, 1891, p. 501.
Glauconia dulcis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 717, fig. 143.
Leptotyphlops dulcis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 93.
Leptotyphlops dulcis dulcis Klauber
Trans. San Diego Soc. Nat. Hist., 9, No. 18, April 30, 1940, pp. 108-110.

TYPE LOCALITY: Between San Pedro and Comanche Springs, Texas.

RANGE: Central Oklahoma and the Panhandle south through central Texas to northern Tamaulipas and central Nuevo Leon.

Leptotyphlops dulcis dissectus (Cope)

Glauconia dissecta Cope
Am. Nat. Vol. 30, 1896, p. 753.
Leptotyphlops myopica (part) Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 85.
Leptotyphlops dulcis dissectus Klauber
Trans. San Diego Soc. Nat. Hist., 9, No. 18, 1940, pp. 112-117.

TYPE LOCALITY: Lake Valley, New Mexico.

RANGE: From southern Coahuila, Mexico, north and northwest through trans-Pecos Texas and southern New Mexico to southeastern Arizona; also southern Kansas, and central and northeastern Oklahoma.

Leptotyphlops humilis humilis (Baird and Birard)

Rena humilis Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 143.
Leptotyphlops humilis humilis Klauber
Trans. San Diego Nat. Hist. Soc., Vol. 6, No. 23, July 8, 1931, p. 343.
Siagonodon humilis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 79.
Glauconia humilis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 719, fig. 144.

TYPE LOCALITY: Valliecitas [sic], California.

RANGE: Southern California (except the southeastern deserts), northern and central Lower California, through Mojave Desert and southern Nevada to central and southeastern Arizona. Also Cedros Island.

Leptotyphlops humilis cahuilae Klauber

Leptotyphlops humilis cahuilae Klauber
Trans. San Diego Nat. Hist. Soc., Vol. 6, No. 23, July 8, 1931, p. 339.

TYPE LOCALITY: Yaqui Well, San Diego County, California.

RANGE: Colorado and Yuma Deserts of California and Arizona. The Vizcaíno Desert of Lower California.

Leptotyphlops humilis segregus Klauber

Leptotyphlops humilis segregus Klauber
Trans. San Diego Soc. Nat. Hist., Vol. 9, No. 14a, 1939, pp. 67–69.

TYPE LOCALITY: Chalk Draw, Brewster County, Texas.

RANGE: Brewster Co., Texas, south into Cuahuila.

Leptotyphlops humilis slevini Klauber

Leptotyphlops humilis slevini Klauber
Trans. San Diego Nat. Hist. Soc., Vol. 6, No. 23, July 8, 1931, p. 338.

TYPE LOCALITY: La Paz, Lower California.

RANGE: Extreme southern Lower California, Mexico.

Leptotyphlops humilis utahensis Tanner

Leptotyphlops humilis utahensis Tanner
Proc. Utah Acad. Sci. Arts and Letters, Vol. 15, 1938, p. 149.

Leptotyphlops humilis utahensis Klauber
Trans. San Diego Soc. Nat. Hist., Vol. 9, No. 18, 1940, pp. 137–140.

TYPE LOCALITY: Saint George, Washington County, Utah.

RANGE: Washington County, extreme southwestern Utah.

BOIDAE (*FAMILY*)

Lichanura (*GENUS*)

Cope, Proc. Ac. Nat. Sci. Phila., 1861, p. 304
TYPE: *trivirgata*

Lichanura roseofusca roseofusca (Cope)

Lichanura roseofusca Cope
Proc. Ac. Nat. Sci. Phila., 1868, p. 2.
Lichanura roseofusca roseofusca Klauber
Trans. San Diego Soc. Nat. Hist., Vol. 6, No. 20, Apr. 30, 1931, p. 316.
Lichanura roseofusca Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 724, fig. 146.

TYPE LOCALITY: Northern Lower California.

RANGE: Southwestern California and northern Lower California.

Lichanura roseofusca gracia Klauber

Lichanura roseofusca gracia Klauber
Trans. San Diego Soc. Nat. Hist., Vol. 6, No. 20, Apr. 30, 1931, p. 307.

TYPE LOCALITY: Randsburg, Kern County, California.

RANGE: Desert regions of southeastern California, northern Lower California, southwestern Arizona and western Sonora.

Lichanura trivirgata Cope

Lichanura trivirgata Cope
Proc. Ac. Nat. Sci. Phila., 1861, p. 304.
Lichanura trivirgata Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 723, fig. 145.

TYPE LOCALITY: Cape St. Lucas, Lower California.

RANGE: Southern Lower California.

Charina (*GENUS*)

Gray, Cat. Snakes Brit. Mus., 1849, p. 113
TYPE: *bottae*

Charina bottae (Blainville)
RUBBER-SNAKE, BALL-SNAKE

Tortrix bottae Blainville
Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 289, pl. 26, figs 1–1B.
Charina bottae Gray
Cat. Snakes Brit. Mus., 1849, p. 113.
Charina bottae Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 728, fig. 148.

TYPE LOCALITY: California.

RANGE: Humid districts of British Columbia, and California, south to San Bernardino Mountains, Nevada, Idaho, Oregon, and Washington, east to Montana, Wyoming, and Utah.

COLUBRIDAE (*FAMILY*)

Carphophis (*GENUS*)

Gervais, D'Orbigny's Dict. Univ. Hist. Nat., Vol. 3, 1843, p. 191
TYPE: *amoena*

WORM-SNAKES

Carphophis amoena amoena (Say)

Coluber amoenus Say
Journ. Ac. Nat. Sci. Phila., Vol. 4, Pt. 2, 1825, p. 237.
Carphophis amoena amoena Blanchard
Papers Mich. Ac. Sci. Arts Letters, Vol. 4, 1924, p. 527.
Carphophiops amoenus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 735, fig. 151.

TYPE LOCALITY: Pennsylvania.

RANGE: Connecticut to New York, south to central Florida, and west into the Appalachian Mountains.

Carphophis amoena helenae (Kennicott)

Celuta helenae Kennicott
Proc. Ac. Nat. Sci. Phila., 1859, p. 100.

Carphophis amoena helenae Blanchard
Papers Mich. Ac. Sci. Arts Letters, Vol. 4, 1924, p. 527.

TYPE LOCALITY: Monticello, Mississippi.

RANGE: Central Illinois south to Mississippi, east to northwestern Alabama, the Tennessee Valley to eastern Tennessee, West Virginia and extreme southern Ohio.

Carphophis amoena vermis (Kennicott)

Celuta vermis Kennicott
Proc. Ac. Nat. Sci. Phila., 1859, p. 99.
Carphophis amoena vermis Blanchard
Papers Mich. Ac. Sci. Arts Letters, Vol. 4, 1924, p. 527.
Carphophiops vermis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 737, fig. 152.

TYPE LOCALITY: Missouri.

RANGE: Iowa and central Missouri through southeastern Nebraska and eastern Oklahoma, Arkansas, Louisiana, Kansas, and Texas.

Abastor (*GENUS*)

Gray, Cat. Snakes Brit. Mus., 1849, p. 78
TYPE: *erythrogrammus*

Abastor erythrogrammus Latreille
RAINBOW-SNAKE

Coluber erytrogrammus [1]Latreille
Hist. Nat. Rept., Vol. 4, 1802, p. 141.
Abastor erythrogrammus Gray
Cat. Snakes Brit. Mus., 1849, p. 78.
Abastor erythrogrammus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 738, fig. 153.
Abastor erytrogrammus Harper
American Midl. Nat. 23 (3), 1940, pp. 713–714.

TYPE LOCALITY: "L'Amérique septentrionale."

RANGE: Charles County, Maryland, southward to Central Florida and Alabama.

---

[1] Original spelling is *lapsus calami.*

Farancia (*GENUS*)

Gray, Zool. Misc., 1832, p. 78
TYPE: *drummondi* = abacura

Farancia abacura abacura (Holbrook)
HORN-SNAKE, MUD-SNAKE
Coluber abacurus Holbrook
N. Amer. Herp., Ed. 1, Vol. 1, 1836, p. 119, pl. 23.
Farancia abacura Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 123.
Farancia abacura abacura Smith
Copeia, 1938, No. 3, Sept. 24, p. 112.
Farancia abacura Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 741, fig. 154.

TYPE LOCALITY: South Carolina.

RANGE: Peninsular Florida northward in the coastal regions to Amelia County, Virginia, westward to about the 86th Meridian including extreme eastern Alabama.

Farancia abacura reinwardtii (Schlegel)
Farancia reinwardtii Schlegel
Essai Phys. Serp., Vol. 1, 1837, p. 173.
Farancia abacura reinwardtii Smith
Copeia, 1938, No. 3, Sept. 24, p. 116.

TYPE LOCALITY: Louisiana.

RANGE: Extreme western Florida northward in the lowlands to southern Indiana and southeastern Missouri; westward along the coast to about the 97th Meridian.

Diadophis (*GENUS*)

Baird and Girard, Cat. N. Amer. Rept., Pt. 1, 1853, p. 112
TYPE: *punctatus*

Diadophis amabilis amabilis (Baird and Girard)
Diadophis amabilis Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 113.
Diadophis amabilis amabilis Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 142, July 9, 1923, p. 3.
Diadophis amabilis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 746, figs. 157, 160.

TYPE LOCALITY: San José, California.

RANGE: California, restricted to the regions about San Francisco and the San Joachin and Sacramento Valleys.

Diadophis amabilis anthonyi (VAN DENBURGH and SLEVIN)

Diadophis anthonyi VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 13, No. 1, July 25, 1923, p. 1.
Diadophis amabilis anthonyi BLANCHARD
Bull. Chic. Acad. Sci., Vol. 7, No. 1, 1942, p. 47.

TYPE LOCALITY: South Todos Santos Island, Lower California.

RANGE: Same.

Diadophis amabilis modestus (BOCOURT)

Diadophis punctatus var. *modestus* BOCOURT
Miss. Sci. Mexique, Vol. 3, Pt. 10, 1886, p. 623.
Diadophis amabilis modestus BLANCHARD
Occ. Papers Mus. Zool. Univ. Mich., No. 142, July 9, 1923, p. 8.

TYPE LOCALITY: California.

RANGE: San Bernardino Mountains, Los Angeles County, and Santa Catalina Island, California.

Diadophis amabilis occidentalis BLANCHARD

Diadophis amabilis occidentalis BLANCHARD
Occ. Papers Mus. Zool. Univ. Mich., No. 142, July 9, 1923, p. 6.

TYPE LOCALITY: Bridgeville, Humboldt County, California.

RANGE: From Sonoma County, California, northward to Washington, east to 5 mi. southwest of Horseshoe Bend, Boise County, Idaho.

Diadophis amabilis pulchellus (BAIRD and GIRARD)

Diadophis pulchellus BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 115.
Diadophis amabilis pulchellus BLANCHARD
Occ. Papers Mus. Zool. Univ. Mich., No. 142, July 9, 1923, p. 8.

TYPE LOCALITY: Eldorado County, California.

RANGE: Western slopes of the Sierra Nevada, south perhaps to Tejon Pass in California and north perhaps to southern Oregon.

Diadophis amabilis similis Blanchard

Diadophis amabilis similis Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 142, July 9, 1923, p. 4.

TYPE LOCALITY: San Diego, California.

RANGE: From southwestern San Bernardino County south into the San Pedro Martir range in Lower California.

Diadophis amabilis vandenburghi Blanchard

Diadophis amabilis vandenburghi Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 142, July 9, 1923, p. 5.

TYPE LOCALITY: Carmel, Monterey County, California.

RANGE: Ventura to Santa Cruz County, California.

Diadophis punctatus punctatus (Linné)

Coluber punctatus Linné
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 376.
Diadophis punctatus Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 112.
Diadophis punctatus punctatus Barbour
Proc. N. Engl. Zoöl. Club, Vol. 7, 1919, p. 7.
Diadophis punctatus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 751, fig. 162.

TYPE LOCALITY: Carolina and eastern Gulf States.

RANGE: Southeastern states northward into Maryland from sea-level to about 2500 feet, possibly higher in the mountains of South Carolina and Georgia.

Diadophis punctatus arnyi (Kennicott)

Diadophis arnyi Kennicott
Proc. Ac. Nat. Sci. Phila., 1858, p. 99.
Diadophis regalis arnyi Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 745, fig. 156.

TYPE LOCALITY: Hyatt, Anderson County, Kansas.

RANGE: Northern Illinois, Indiana, Kansas, Iowa, South Dakota, extreme southeastern Minnesota, Missouri, northwestern Arkansas, Oklahoma, and Texas.

Diadophis punctatus docilis (Baird and Girard)

Diadophis docilis Baird and Girard
Cat. N. Amer. Rept., 1853, p. 114.
Diadophis punctatus docilis Jan
Arch. Zool. Anat. Fisiol. 1863, p. 262.
Diadophis punctatus docilis Blanchard
Bull. Chic. Acad. Sci. Vol. 7, No. 1, 1942, p. 66.

TYPE LOCALITY: Between Rio San Pedro or Devil's River and Comanche Spring, Texas.

RANGE: Western Texas.

Diadophis punctatus edwardsii (Merrem)

Coluber edwardsii Merrem
Tent. Syst. Amphib., 1820, p. 136.
Diadophis punctatus edwardsii Barbour
Proc. N. Eng. Zoöl. Club, Vol. 7, 1919, p. 9.

TYPE LOCALITY: Pennsylvania.

RANGE: The mountains of the Carolinas through the Appalachians northward to the Northern Peninsula of Michigan, Wisconsin, Minnesota, southern Canada, and the Maritime Provinces.

Diadophis punctatus stictogenys Cope

Diadophis punctatus var. *stictogenys* Cope
Proc. Ac. Nat. Sci. Phila., 1860, p. 250.

TYPE LOCALITY: Unknown.

RANGE: Southern Illinois, through the lower Mississippi Valley to the Gulf.

Diadophis regalis regalis (Baird and Girard)

Diadophis regalis Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 115.
Diadophis regalis regalis Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 142, July 9, 1923, p. 1.
Diadophis regalis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 744, fig. 155.

TYPE LOCALITY: Sonora, Mexico.

RANGE: Southern Idaho, Utah, southeastern Arizona, to central Texas, and to the State of Vera Cruz, Mexico.

Diadophis regalis laetus (Jan)

Diadophis punctatus laetus Jan.
Arch. Zool. Anat. e Fisiol., 1863, p. 262, 265.
Diadophis regalis laetus Blanchard
Bull. Chic. Acad. Sci., 7, 1942, p. 55.
Diadophis regalis arizonae Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 142, July 9, 1923, p. 2.

TYPE LOCALITY: Probably Tucson, Arizona.

RANGE: Central Arizona to northern Sonora.

Rhadinaea (*GENUS*)

Cope, Proc. Ac. Nat. Sci. Phila., 1863, p. 101
TYPE: *vermiculaticeps*

Rhadinaea flavilata (Cope)

Dromicus flavilatus Cope
Proc. Ac. Nat. Sci. Phila., 1871, p. 222.
Leimadophis flavilatus Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 86, Ed. 2, 1923, p. 96.
Rhadinaea flavilata Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 759, fig. 164.

TYPE LOCALITY: Fort Macon, North Carolina.

RANGE: Eastern North Carolina to Florida, and along the Gulf coast to Western Texas.

Heterodon (*GENUS*)

Latreille, Hist. Nat. Rept., Vol. 4, 1802, p. 32
TYPE: *platirhinos* = contortrix

HOG-NOSE SNAKES

Heterodon contortrix contortrix (Linné)

PUFFING ADDER, SPREADING ADDER

Boa contortrix Linné
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 373.
Heterodon platyrhinus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 761, fig. 165.

Heterodon contortrix Stejneger and Barbour
Check List No. Amer. Amph. Rept., Ed. 1, 1917, p. 76.
Heterodon contortrix contortrix Carr
Univ. Flor. Biol. Ser. 3, No. 1, 1940, p. 79.

TYPE LOCALITY: Carolina.

RANGE: New Hampshire to peninsula Florida; except eastern Dade County, westward to Texas and Oklahoma and northward through the states of the Mississippi basin in to Minnesota.

Heterodon contortrix browni (Stejneger)

Heterodon browni Stejneger
Proc. Biol. Soc. Wash., Vol. 16, 1903, p. 123.
Heterodon contortrix browni Carr
Univ. Flor. Biol. Series 3, No. 1, 1940, p. 79.

TYPE LOCALITY: Lemon City, Florida. (Now part of Miami.)

RANGE: Eastern Dade County.

Heterodon nasicus nasicus (Baird and Girard)

Heterodon nasicus Baird and Girard
Stansbury's Expl. Surv. Vall. Great Salt Lake, 1852, p. 352.
Heterodon nasicus nasicus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 774, fig. 168.

TYPE LOCALITY: Texas.

RANGE: Illinois, southwestern Iowa, Missouri, and Kansas, west to Montana and south to northern Mexico. Common along the Mexican border of eastern Texas.

Heterodon nasicus kennerlyi (Kennicott)

Heterodon kennerlyi Kennicott
Proc. Ac. Nat. Sci. Phila., 1860, p. 336.
Heterodon nasicus kennerlyi Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 773.

TYPE LOCALITY: Rio Grande, Sonora.

RANGE: Western Texas, southern New Mexico, southern Arizona, and northwestern Mexico.

Heterodon simus (Linné)

Coluber simus Linné
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 375.

Heterodon simus HOLBROOK
N. Amer. Herp., Ed. 2, Vol. 4, 1842, p. 57, pl. 15.
Heterodon simus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 770, fig. 167.

TYPE LOCALITY: Carolina.

RANGE: North Carolina southward to central Florida, and northwestward to Indiana.*

Opheodrys (*GENUS*)

FITZINGER, Syst. Rept., 1843, p. 26
TYPE: *aestivus*

Opheodrys aestivus (LINNÉ)

ROUGH GREEN-SNAKE

Coluber aestivus LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 387.
Opheodrys aestivus COPE
Proc. Ac. Nat. Sci. Phila., 1860, p. 560.
Cyclophis aestivus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 784, fig. 170.

TYPE LOCALITY: Carolina.

RANGE: Connecticut to Florida, westward to eastern New Mexico, in the Mississippi drainage basin found in the southern portion and northward to Kansas, Illinois, and Ohio.

Opheodrys vernalis vernalis (HARLAN)

SMOOTH GREEN-SNAKE

Coluber vernalis HARLAN
Journ. Ac. Nat. Sci. Phila., Vol. 5, 1827, p. 361.
Liopeltis vernalis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 782, fig. 169.
Liopeltis vernalis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 92.
Opheodrys vernalis SCHMIDT and NECKER
Herpetologica, Vol. 1, No. 2, Dec. 30, 1935, p. 64.
Opheodrys vernalis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 102.
Opheodrys vernalis vernalis GROBMAN
Misc. Publ. Univ. Mich. Mus. Zool., 50, 1941, p. 38.

---

[1] Mittleman (in litt.) feels sure it does not occur in Indiana.

TYPE LOCALITY: Pennsylvania and New Jersey are mentioned as habitat.

RANGE: Glaciated and mountainous areas east of the prairie-forest border and north of Madison County, North Carolina.

Opheodrys vernalis blanchardi GROBMAN

Opheodrys vernalis blanchardi GROBMAN
Misc. Publ. Univ. Mich. Mus. Zool., 50, 1941, p. 38.

TYPE LOCALITY: Spanish Peaks, Colorado.

RANGE: Glaciated and mountainous areas west of the prairie-forest boundary and east of the New Mexico-Mexico border.

Coluber (*GENUS*) [1]

LINNÉ, Syst. Nat., Ed. 10, Vol. 1, 1758, p. 216
TYPE: *constrictor*

Coluber anthonyi (STEJNEGER)

Bascanion anthonyi STEJNEGER
Proc. U. S. Nat. Mus., Vol. 23, June 5, 1901, p. 715.
Coluber anthonyi STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 78.

TYPE LOCALITY: Clarion Island, Revilla Gigedo group, off west coast of Mexico.

RANGE: Clarion Island, Revilla Gigedo group, off west coast of Mexico.

Coluber aurigulus (COPE)

Drymobius aurigulus COPE
Proc. Ac. Nat. Sci. Phila., 1861, p. 301.
Zamenis aurigulus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 810, fig. 179.
Coluber aurigulus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 78.

TYPE LOCALITY: Cape St. Lucas, Lower California.

RANGE: Southern Lower California.

---

[1] Ortenburger (Occ. Papers Mus. Zool. Univ. Mich., No. 139, 1923) would divide this genus, but the old world species of this Holarctic group were not studied. A complete monographic treatment of the whole genus is awaited.

Coluber barbouri Van Denburgh and Slevin

Coluber barbouri Van Denburgh and Slevin
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, July 30, 1921, p. 98.

TYPE LOCALITY: Isla Partida, Espiritu Santo Island, Lower California.

RANGE: Same.

Coluber constrictor constrictor (Linné)

BLACK-SNAKE

Coluber constrictor (part) Linné
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 216.
Zamenis constrictor (part) Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 791, fig. 171.

TYPE LOCALITY: "Habitat in America septentrionale."

RANGE: The whole of the eastern United States, westward to the Mississippi and Ohio Rivers.

Coluber constrictor anthicus (Cope)

Bascanion anthicum Cope
Proc. Ac. Nat. Sci., Phila., 14, 1862, p. 338.
Coluber constrictor constrictor Ortenburger
Mem. Mus. Zool., Univ. Mich., 1, 1928, p. 176.
Coluber constrictor flaviventris Ortenburger
Mem. Mus. Zool., Univ. Mich., 1, 1928, p. 193.
Coluber constrictor flaviventris Blanchard
Copeia, 1930, No. 3, Sept. 30, p. 85, fig. 3.
Coluber constrictor anthicus Dunn
Notulae Naturae, No. 5, June 8, 1939, p. 1.

TYPE LOCALITY: Unknown, stated as possibly "Siam."

RANGE: Northeastern Louisiana from Beauregard and Allen counties north and probably in adjacent Texas and Arkansas.

Coluber constrictor flaviventris (Say)

WESTERN OR BLUE RACER

Coluber flaviventris Say
Long's Exp. Rocky Mts., Vol. 1, 1823, p. 185.
Coluber constrictor flaviventris Garman
Mem. Mus. Comp. Zoöl., Vol. 8, No. 3, 1883, p. 147.

TYPE LOCALITY: Stone quarry on west side of Missouri River three miles above the mouth of Boyer's River.

RANGE: Central and southwestern states.

Coluber constrictor mormon (BAIRD and GIRARD)

Coluber mormon BAIRD and GIRARD
Stansbury's Expl. Surv. Vall. Great Salt Lake, Append. C, Rept., 1852, p. 351.
Coluber constrictor mormon VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Vol. 11, 1921, p. 28.

TYPE LOCALITY: Valley of the Great Salt Lake, Utah.

RANGE: From the Pacific Ocean north into British Columbia, east to Montana, south to extreme southern California, Idaho, Nevada and Utah.

Coluber constrictor priapus DUNN and WOOD

Coluber constrictor priapus DUN and WOOD
Notulae Naturae Phila., No. 5, 1939, p. 4.

TYPE LOCALITY: West Palm Beach, Florida.

RANGE: Florida.

Coluber constrictor stejnegerianus (COPE)

Zamenis stejnegerianus COPE
Amer. Nat., 29, 1895, 00. 676–680.
Coluber constrictor flaviventris ORTENBURGER
Mem. Univ. Mich. Mus., Zool., 1, XIII+247.
Coluber constrictor stejnegerianus S. and D. MULIAK
Copeia, 1942, No. 1, March 24, pp. 13–15.

TYPE LOCALITY: Brownsville, Texas.

RANGE: Vicinity of Brownsville, Texas.

Coluber flagellum flagellum (SHAW)

COACH WHIP

Coluber flagellum SHAW
Gen. Zool., Vol. 3, 1802, p. 475.
Zamenis flagellum flagellum COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 799, fig. 174.

TYPE LOCALITY: Carolina and Virginia.

RANGE: North Carolina to Florida, westward to eastern Texas and central Kansas.

Coluber flagellum frenatum (STEJNEGER)

Bascanion flagellum frenatum STEJNEGER
N. Amer. Fauna, No. 7, 1893, p. 208.

Coluber flagellum frenatum ORTENBURGER
Mem. Univ. Mich. Mus., Vol. 1, 1928, p. 112.

TYPE LOCALITY: Mountain Springs, Colorado Desert, San Diego County, California.

RANGE: Central and southern California, Lower California. Nevada, Utah, Arizona, and Sonora to Sinaloa.

Coluber flagellum lineatulus H. M. SMITH

Masticophis flagellum lineatulus H. M. SMITH
Journ. Wash. Acad. Sci. 31, no. 9, 1941, pp. 394–397.

TYPE LOCALITY: 11 miles south of San Buenventura, Chihuahua.

RANGE: Guanajuato, Chihuahua, Durango, Coahuila and New Mexico.

Coluber flagellum piceus (COPE)

Bascanium piceum COPE
Proc. U. S. Nat. Mus., Vol. 14, 1892, p. 625.
Zamenis flagellum piceus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 804, fig. 175.
Coluber flagellum piceus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 79
Masticophis flagellum piceus H. M. SMITH
Journ. Wash. Ac. Sci., 31, no. 9, 1941, pp. 397–398.

TYPE LOCALITY: Camp Grant, Arizona.

RANGE: Southeastern Arizona, extreme southern California, and Lower California.

Coluber flagellum testaceus SAY

Coluber testaceus SAY
In Long's Expedition to the Rocky Mountains, Vol. 2, 1823, p. 48.
Psammophis flavi-gularis HALLOWELL
Proc. Ac. Nat. Sci. Phila., 1852, p. 178.
Masticophis flagellum flavigularis ORTENBURGER
Mem. Univ. Mich. Mus., Vol. 1, 1928, p. 92.
Coluber flagellum testaceus KLAUBER
Copeia, 1942, No. 2, July 10, p. 93.

TYPE LOCALITY: Near the Rocky Mountains (at this date the Long Expedition was at the head waters of Arkansas River. Fide Klauber).

RANGE: Western Kansas, southeastern Colorado south to central Mexico.

Coluber lateralis (HALLOWELL)

Leptophis lateralis HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1853, p. 237.
Zamenis lateralis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 807, fig. 177.
Coluber lateralis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 80.

TYPE LOCALITY: California.

RANGE: California and Lower California.

Coluber semilineatus (COPE)

Bascanium semilineatum COPE
Proc. U. S. Nat. Mus., Vol. 14, 1891, p. 626.
Zamenis semilineatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 805, fig. 176.
Coluber semilineatus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 80.

TYPE LOCALITY: Camp Grant and Colorado River, Arizona.

RANGE: Southeastern Arizona, extreme southwestern New Mexico, and the adjacent territory of Mexico.

Coluber taeniatus taeniatus (HALLOWELL)

Leptophis taeniata HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 181.
Coluber taeniatus GARMAN
Mem. Mus. Comp. Zoöl., Vol. 8, No. 3, 1883, p. 46.
Zamenis taeniatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 815, fig. 182.

TYPE LOCALITY: New Mexico west of Rio Grande.

RANGE: Washington, Oregon, Idaho and Utah, southward to all the border states just entering Texas and California.

Coluber taeniatus girardi STEJNEGER and BARBOUR

Zamenis ornatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 813, fig. 181.
Coluber taeniatus girardi STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 80.

TYPE LOCALITY: "Between Indianola and El Paso," Texas

RANGE: Central and western Texas southward to Zacatecas, Mexico.

Coluber taeniatus ruthveni (ORTENBURGER)

Masticophis ruthveni ORTENBURGER
Occ. Papers Mus. Zool. Univ. Mich., No. 139, July 9, 1923, p. 3, pl. 1–3.
Coluber ruthveni STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 96.
Masticophis taeniatus ruthveni GLOYD and CONANT
Occ. Papers Mus. Zool. Univ. Mich., No. 287, June 25, 1934, p. 4.

TYPE LOCALITY: Brownsville, Texas.

RANGE: Southeastern Texas and Tamaulipas, Mexico.

Coluber taeniatus schotti (BAIRD and GIRARD)

Masticophis schotti BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 160.
Zamenis schotti COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 811, fig. 18a.
Coluber schotti STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 80.
Masticophis taeniatus schotti GLOYD and CONANT
Occ. Papers Mus. Zool. Univ. Mich., No. 287, June 25, 1934, p. 4.

TYPE LOCALITY: Eagle Pass, Texas.

RANGE: Southern Texas and northeastern Mexico.

Drymobius (*GENUS*)

FITZINGER, Syst. Rept., 1843, p. 26
TYPE: *margaritiferus*

Drymobius margaritiferus (SCHLEGEL)

Herpetodryas margaritiferus SCHLEGEL
Essai Physion. Serp., Vol. 2, 1837, p. 184.
Drymobius margaritiferus COPE
Proc. Ac. Nat. Sci. Phila., 1860, p. 561.

TYPE LOCALITY: New Orleans (in errore).

RANGE: Southwestern Texas to Venezuela and Colombia.

Drymarchon (GENUS)

FITZINGER, Syst. Rept., 1843, p. 26
TYPE: *corais*

Drymarchon corais couperi (HOLBROOK)
GOPHER-SNAKE, INDIGO-SNAKE

Coluber couperi HOLBROOK
N. Amer. Herp., Ed. 2, Vol. 3, 1842, p. 75, pl. 16.
Drymarchon corais couperi STRECKER
Baylor Bulletin, Vol. 18, No. 4, Aug. 1915, p. 32.
Compsosoma corais couperii (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 858, figs. 199, 200.

TYPE LOCALITY: Dry pine hills south of Alatamaha [sic], Georgia.

RANGE: South Carolina to Florida, westward to southern Louisiana.

Drymarchon corais erebennus (COPE)

Spilotes erebennus COPE
Proc. Acad. Nat. Sci. Phila., 1860, 342, p. 564.
Drymarchon corais erebennus H. M. Smith
Jour. Wash. Acad. Sci., 31, No. 11, pp. 478–479.

TYPE LOCALITY: Eagle Pass, Texas.

RANGE: Central southern Texas south to extreme northern Veracruz and central Hidalgo.

Salvadora (GENUS)

BAIRD and GIRARD, Cat. N. Amer. Rept., Pt. 1, 1853, p. 104
TYPE: *grahamiae*

Salvadora grahamiae grahamiae (BAIRD and GIRARD)
PATCH-NOSE SNAKE

Salvadora grahamiae BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 104.
Salvadora grahamiae grahamiae BOGERT
Bull. S. Calif. Ac. Sci., Vol. 34, Pt. 1, May 15, 1935, p. 88.
Salvadora grahamiae (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 818.
Salvadora grahamiae STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 97.

TYPE LOCALITY: Sonora, Mexico.

RANGE: "Sonora, Mexico". The Sonora of before the Gadsden Purchase, hence now southern Arizona.

Salvadora hexalepis hexalepis (COPE)

Phimothyra hexalepis COPE
Proc. Ac. Nat. Sci. Phila., 1866, p. 304.
Salvadora hexalepis STEJNEGER
Proc. U. S. Nat. Mus., Vol. 25, Sept. 8, 1902, p. 154.
Salvadora grahamiae hexalepis BOGERT
Bull. S. Calif. Ac. Sci., Vol. 34, No. 1, May 15, 1935, p. 88.
Salvadora hexalepis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 97.
Salvadora hexalepis hexalepis SCHMIDT
Zool. Series, Field Mus. Nat. Hist., 24, No. 12, 1940, pp. 143–150.

TYPE LOCALITY: Fort Whipple, Arizona.

RANGE: Southern and western Arizona, southwestern Utah, southern and western Nevada to southeastern California. Lower California and Tiburon Island and western Mexico.

Salvadora hexalepis deserticola SCHMIDT

Salvadora hexalepis deserticola SCHMIDT
Zool. Series, Field Mus., Nat. Hist., 1940, 24, No. 12, pp. 146–148.

TYPE LOCALITY: Government Spring, near Chisos Mountains, Brewster County, Texas.

RANGE: Vicinity of Chisos Mountains.

Salvadora hexalepis virgultea BOGERT

Salvadora grahamiae virgultea BOGERT
Bull. S. Calif. Ac. Sci., Vol. 34, Jan.-Apr. 1935, Pt. 1, p. 89.
Salvadora hexalepis virgultea SCHMIDT
Zool. Series, Field Mus. Nat. Hist., 1940, 24, No. 12, p. 148.

TYPE LOCALITY: Deerhorn Flat, San Diego County, California.

RANGE: Foothills of southwestern California and northwestern Lower California.

Salvadora lineata SCHMIDT

Salvadora lineata SCHMIDT
Zool. Series, Field Mus. Nat. Hist., 1940, 24, No. 12, pp. 148–150.

TYPE LOCALITY: Kingsville, Kleberg County, Texas.

RANGE: Southwestern and Central Texas.

Phyllorhynchus (*GENUS*)

STEJNEGER, Proc. U. S. Nat. Mus., Vol. 13, Sept. 9, 1899, p. 151.
TYPE: *browni*

Phyllorhynchus browni browni STEJNEGER

Phyllorhynchus browni STEJNEGER
Proc. U. S. Nat. Mus., Vol. 13, 1890, p. 152.
Phyllorhynchus browni COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 821, fig. 184.
Phyllorhynchus browni browni KLAUBER
Trans. San Diego Soc. Nat. Hist., 1940, Vol. 9, No. 20, p. 204, pl. 8, fig. 3.

TYPE LOCALITY: Tucson, Arizona.

RANGE: Southern Arizona.

Phyllorhynchus browni lucidus KLAUBER

Phyllorhynchus browni lucidus KLAUBER
Trans. San Diego Soc. Nat. Hist., 1940, Vol. 9, No. 20, p. 202, pl. 8, fig. 2.

TYPE LOCALITY: Encanto Valley, 7 mi. w. of Cave Creek, Maricopa County, Arizona.

RANGE: Same as type locality.

Phyllorhynchus decurtatus decurtatus (COPE)

Phimothyra decurtata COPE
Proc. Ac. Nat. Sci. Phila., 1868, p. 310.
Phyllorhynchus decurtatus STEJNEGER
Proc. U. S. Nat. Mus., Vol. 13, 1890, p. 154.
Phyllorhynchus decurtatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 823, fig. 186.
Phyllorhynchus decurtatus decurtatus KLAUBER
Bull. Zool. Soc. San Diego, 1940, No. 12, 1935, p. 9.

TYPE LOCALITY: "In the upper part of Lower California."

RANGE: Lower California, southwestern Arizona, and Sonora.

Phyllorhynchus decurtatus nubilus KLAUBER

Phyllorhynchus decurtatus (part) SCHMIDT
Bull. Am. Mus. Nat. Hist., Vol. 46, Art. 11, 1922, p. 685.
Phyllorhynchus decurtatus browni LINSDALE
Copeia, No. 4, 1933, p. 222.
Phyllorhynchus decurtatus decurtatus, (part) KLAUBER
Bull. Zool. Soc. San Diego, No. 12, p. 9.
Phyllorhynchus decurtatus nubilus KLAUBER
Trans. San Diego Soc. Nat. Hist., 1940, Vol. 9, No. 20, pp. 197–201, pl. 8, fig. 1.

TYPE LOCALITY: Xavier (Weisner's Ranch), Pima County, Arizona.

RANGE: Pima County and Pinal County, near Tucson, Arizona.

Phyllorhynchus decurtatus perkinsi KLAUBER

Phyllorhynchus decurtatus perkinsi KLAUBER
Bull. Zool. Soc. San Diego, No. 12, 1935, p. 11.

TYPE LOCALITY: Dry Lake, San Diego County, California.

RANGE: Deserts of southern California, extreme southern Nevada and western Arizona.

Elaphe (*GENUS*)

FITZINGER in WAGLER, Descr. Icon. Amph., Pt. 3, 1833,
text to plate 27

TYPE: *parreysii* = quatuorlineata

Elaphe bairdi (YARROW)

Coluber bairdi YARROW
Bull. U. S. Nat. Mus., No. 17, 1880, p. 41.
Elaphe bairdi STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 82.
Coluber bairdii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 854, fig. 198.

TYPE LOCALITY: Fort Davis, 50 miles northwest of Presidio, Texas.

RANGE: Davis Mountains in Jeff Davis and Brewster Counties, Kerr County, Texas; also Coahuila, Mexico.

Elaphe chlorosoma (GÜNTHER)

Coluber chlorosoma GÜNTHER
Biol. Centr.-Amer., Rept., 1894, p. 115, pl. 41.
Elaphe chlorosoma STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 82.

TYPE LOCALITY: Atoyak and Amula in Guerrero and San Ramon in Jalisco, Mexico.

RANGE: Guerrero and Jalisco, Mexico, northward to the Santa Rita Mountains in Arizona.

Elaphe guttata (LINNÉ)
CORN-SNAKE

Coluber guttatus LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 385.
Elaphis guttatus DUMÉRIL and BIBRON
Erp. Gén., Vol. 7, 1854, p. 273.
Coluber guttatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 833, figs. 189,190.

TYPE LOCALITY: Carolina.

RANGE: New Jersey to Florida, to Louisiana. No valid record for Missouri.

Elaphe laeta laeta (BAIRD and GIRARD)

Scotophis laetus BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 77.
Coluber laetus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 850, fig. 196.
Coluber emoryi COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 852, fig. 197.
Elaphe laeta STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 82.
Elaphe laeta laeta WOODBURY, A. M. and M. W.
Proc. Biol. Soc. Wash., 55, 1942, pp. 133–142.

TYPE LOCALITY: Red River, Arkansas.

RANGE: Kansas and Nebraska southward to Central Mexico.

Elaphe laeta intermontanus WOODBURY, A. M. and M. W.

Elaphe laeta intermontanus WOODBURY, A. M. and M. W.
Proc. Biol. Soc. Wash., 55, 1942, pp. 133–142.

TYPE LOCALITY: Parriott Ranch, near Moab, Grand County, Utah.

RANGE: Colorado River Basin in Utah and Montana. Possibly New Mexico.

Elaphe obsoleta obsoleta (SAY)

PILOT BLACK-SNAKE

Coluber obsoletus SAY
Long's Exp. Rocky Mts., Vol., 1, 1823, p. 140.
Elaphis obsoletus GARMAN
Mem. Mus. Comp. Zool., Vol. 8, no. 3, 1883, p. 54.
Coluber obsoletus obsoletus (part) COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 844, fig. 194.

TYPE LOCALITY: Isle au Vache [sic] to Council Bluffs on the Missouri River.

RANGE: Southern New England westward to Wisconsin, southern Ontario, southward to Texas, Louisiana, and Florida.

Elaphe obsoleta confinis (BAIRD and GIRARD)

Scotophis confinis BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 76.
Elaphe obsoleta confinis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 83.
Coluber confinis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 829, fig. 187.

TYPE LOCALITY: Anderson, South Carolina.

RANGE: South Atlantic and Gulf States and states of southern Mississippi Valley.

Elaphe quadrivittata quadrivittata (HOLBROOK)

CHICKEN-SNAKE

Coluber quadrivittatus HOLBROOK
N. Amer. Herp., Ed. 1, Vol. 1, 1836, p. 113, pl. 21.
Coluber quadrivittatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 838, fig. 192.

TYPE LOCALITY: "North Carolina to Florida and westward as far as the Mississippi."

RANGE: Eastern North Carolina to Florida and west to the Mississippi River.

Elaphe quadrivittata deckerti BRADY

Elaphe quadrivittata deckerti BRADY
Proc. Biol. Soc. Wash., Vol. 45, 1932, p. 5.

TYPE LOCALITY: Lower Matecumbe [sic] Key, Florida.

RANGE: Southern Florida and the Keys.

Elaphe quadrivittata parallela BARBOUR and ENGELS

Elaphe quadrivittata parallela BARBOUR and ENGELS
Proc. New Engl. Zool. Club, 22, 1942, pp. 103–104, pl. 17.

TYPE LOCALITY: Sam Windsor's Lump, 3 miles from Beaufort Inlet on the Shackelford Banks, Carteret County, North Carolina.

RANGE: Same.

Elaphe rosacea (COPE)

Coluber rosaceus COPE
Proc. U. S. Nat. Mus., Vol. 11, 1888, p. 388, pl. 36, fig. 3.
Elaphe rosacea BARBOUR
Copeia, 1920, No. 84, July 31, p. 68.

TYPE LOCALITY: Key West, Florida.

RANGE: The lower Florida Keys.

Elaphe rosaliae (MOCQUARD)

Coluber rosaliae MOCQUARD
Nouv. Arch. Mus. Hist. Nat. Paris, Ser. 4, Vol. 1, 1899, p. 321, pl. 12, fig. 1–1b.
Elaphe rosaliae STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 84.

TYPE LOCALITY: Santa Rosalia, Lower California.

RANGE: Central and southern Lower California.

Elaphe sclerotica H. M. SMITH

Coluber subocularis BROWN
Proc. Ac. Nat. Sci. Phila., 1901, p. 492, pl. 29.

Elaphe subocularis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 84.
Elaphe sclerotica H. M. SMITH
Copeia 1941, No. 3, pp. 135–136.

TYPE LOCALITY: Davis Mountains, Jeff Davis County, 50 miles south of Pecos, Texas.

RANGE: Extreme southwestern Texas southward to near Saltillo, Mexico.

Elaphe vulpina vulpina (BAIRD and GIRARD)

FOX-SNAKE

Scotophis vulpinus BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 75.
Coluber vulpinus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 831, fig. 188.
Elaphe vulpinus RUTHVEN
Eleventh Rep. Mich. Ac. Sci., 1909, p. 116.
Elaphe vulpina vulpina CONANT
Herpetologica Vol. 2, No. 1, Sept. 4, 1940, p. 10, fig. 1, pl. 1.

TYPE LOCALITY: Racine, Wisconsin.

RANGE: Northwestern Indiana and the northern peninsula of Michigan, southwestward to eastern Missouri, eastern Nebraska and southwestern South Dakota.

Elaphe vulpina gloydi CONANT

Elaphe vulpina gloydi CONANT
Herpetologica Vol. 2, No. 1, Sept. 4, 1940, p. 2, figs. 2–3, pl. 1.

TYPE LOCALITY: Little Creek Point, Lucas Co., Ohio.

RANGE: Shores of Lakes Huron and Erie, from Georgian and Saginaw Bays southward to north central Ohio and eastward along the north shore of Lake Erie to Log Point and perhaps Buffalo.

Elaphe williamsi BARBOUR and CARR

Elaphe williamsi BARBOUR and CARR
Occ. Papers, Boston Soc. Nat. Hist., 8, 1940, pp. 340–342.

TYPE LOCALITY: Near Lebanon, Levy County, Florida.

RANGE: Gulf Hammock section of Levy County, Florida.

Arizona (GENUS)

KENNICOTT in BAIRD, U. S. Mex. Bound. Surv., Vol. 2, 1859, Rept., p. 18
TYPE: *elegans*

Arizona elegans elegans (KENNICOTT)

Arizona elegans KENNICOTT
in Baird, U. S. Mex. Bound. Surv., Vol. 2, 1859, Rept., p. 18, pl. 13.
Arizona elegans elegans BLANCHARD
Occ. Papers Mus. Zool. Univ. Mich., No. 150, April 28, 1924, p. 1.
Rhinechis elegans COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 863, fig. 201.

TYPE LOCALITY: Rio Grande, Texas, and between Arkansas and Cimarron, Oklahoma.

RANGE: Southwestern Kansas, southward through central Texas, westward to southeastern Arizona.

Arizona elegans occidentalis BLANCHARD

Arizona elegans occidentalis BLANCHARD
Occ. Papers Mus. Zool. Univ. Mich., No. 150, April 26, 1924, p. 1.

TYPE LOCALITY: La Jolla, California.

RANGE: Southeastern Arizona, extreme southwestern Utah, through southern Nevada to southern California and Lower California.

Pituophis (GENUS)

HOLBROOK, N. Amer. Herp., Ed. 2, Vol. 4, 1842, p. 7
TYPE: *melanoleucus*

Pituophis catenifer catenifer (BLAINVILLE)
WESTERN BULL-SNAKE

Coluber catenifer BLAINVILLE
Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 290, pl. 26, figs. 2–2b.
Pituophis catenifer BAIRD and GIRARD
Cat. N. Amer. Amph. Rept., Ed. 2, 1853, p. 95.
Pityophis catenifer COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 876, fig. 208.
Pituophis catenifer heermanni STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 95.
Pituophis catenifer catenifer STULL
Bull. U. S. Nat. Mus., 175, 1940, pp. 140–165, figs. 64–72.

TYPE LOCALITY: California.

RANGE: San Diego County, California to Washington. One record for Vernon, British Columbia.

Pituophis catenifer annectens (Baird and Girard)

Pituophis annectens Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 72.
Pituophis catenifer annectens Van Denburgh
Proc. Calif. Ac. Sci., Ser. 4, Vol. 9, Aug. 21, 1919, p. 216.
Pituophis catenifer annectens Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 185–203, figs. 79–84.

TYPE LOCALITY: San Diego, California.

RANGE: Coast of southern California, and Lower California. Coronado and Catalina Islands.

Pituophis catenifer deserticola Stejneger

Pituophis catenifer deserticola Stejneger
N. Amer. Fauna, No. 8, May 31, 1893, p. 206.
Pituophis catenifer stejnegeri Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 95.
Pituophis catenifer deserticola Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 166–184, figs. 73–78.

TYPE LOCALITY: Great Basin and southwestern deserts.

RANGE: From the eastern desert regions of California throughout the States of Utah, Nevada and Arizona to western Colorado, and north to Idaho and the western parts of Oregon and Washington.

Pituophis deppei deppei (Duméril and Bibron)

Elaphis deppei Duméril and Bibron
Erp. Gén. Vol. 7, 1854, p. 268.
Epiglottophis pleurostictus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 861.
Pituophis deppei deppei Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 25–42, figs. 11–23.

TYPE LOCALITY: Mexico.

RANGE: From Tehuantepec, in the southern part of Oaxaca, Mexico, north to Real de Pinos, California, on the west, and to San Marcos, Hays County, Texas, on the east.

Pituophis melanoleucus melanoleucus (Daudin)

PINE-SNAKE

Coluber melanoleucus Daudin
Hist. Nat. Rept., Vol. 6, 1803, p. 409.
Pituophis melanoleucus Holbrook
N. Amer. Herp., Ed. 2, Vol. 4, 1842, p. 7, pl. 1.
Pityophis melanoleucus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 867, fig. 203.
Pituophis melanoleucus melanoleucus Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 52–65, figs. 27–32.

TYPE LOCALITY: South Carolina and Florida.

RANGE: From Charleston, S. C., north to Rockland County, New York, and west to Murphy, Tennessee.

Pituophis melanoleucus lodingi Blanchard

Pituophis lodingi Blanchard
Papers Mich. Ac. Sci. Arts Letters, Vol. 4, 1924, p. 531.
Pituophis melanoleucus lodingi Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 79–81.

TYPE LOCALITY: Grand Bay, Mobile County, Alabama.

RANGE: Mobile County, Alabama and Harrison County, Mississippi.

Pituophis melanoleucus mugitus Barbour

Pituophis melanoleucus mugitus Barbour
Proc. N. Engl. Zool. Club, Vol. 7, Oct. 22, 1921, p. 117.
Pituophis melanoleucus mugitus Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 66–74, figs. 33–40.

TYPE LOCALITY: Ten miles north of West Palm Beach, Florida.

RANGE: Ten miles north of West Palm Beach, north to Jacksonville and to Pensacola.

Pituophis melanoleucus ruthveni Stull

Pituophis melanoleucus ruthveni Stull
Occ. Papers Mus. Zool. Univ. Mich., No. 205, June 19, 1929, p. 1.
Pituophis melanoleucus ruthveni Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 74–77, fig. 41.

TYPE LOCALITY: Longleaf, Rapides County, Louisiana.

RANGE: Type locality.

Pituophis sayi sayi (Schlegel)
BULL-SNAKE

Coluber sayi Schlegel
Essai Physion, Serp., Pt. 2, 1837, p. 157.
Pityophis sayi sayi Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 870, fig. 204.
Pituophis sayi sayi Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 91–122, figs. 50–57.

TYPE LOCALITY: Missouri.

RANGE: From the northern part of Mexico north to Door County, Wisconsin, in the east, and to Medicine Hat, Alberta, Canada, in the west, and from the Rocky Mountains to western Indiana.

Pituophis sayi affinis Hallowell

Pituophis affinis Hallowell
Proc. Ac. Nat. Sci. Phila., 1852, p. 181.
Pityophis sayi bellona Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 872 (part)
Pituophis sayi affinis Stull
Occ. Papers Mus. Zool. Univ. Mich., No. 250, Oct. 12, 1932, p. 4.
Pituophis catenifer rutilus Van Denburgh
Proc. Calif. Ac. Sci., Ser. 4, Vol. 10, Aug. 6, 1920, p. 24, pl. 2, fig. 2.
Pituophis sayi affinis Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 123–139, figs. 58–63.

TYPE LOCALITY: New Mexico.

RANGE: From Batapilas, Chihuahua, Mexico, north to Pagosa, Colorado. Throughout Arizona, east in New Mexico to Otero and Guadalupe Counties, west in California to Silsbee, Imperial County, and south in Lower California to the Colorado desert.

Pituophis vertebralis (Blainville)

Coluber vertebralis Blainville
Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 293, pl. 27, figs. 2–2b.
Pityophis vertebralis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 879, fig. 209.
Pituophis vertebralis Duméril and Bibron
Erp. Gén., Vol. 7, 1854, p. 238.
Pituophis vertebralis Stull
Bull. U. S. Nat. Mus., 175, 1940, pp. 82–91, figs. 42–49.

TYPE LOCALITY: California, a term which formerly included Lower California.

RANGE: Throughout Lower California and as far north in California as Jim Grey, San Bernardino County. Cerros, Margarite and Magdalena Islands.

Lampropeltis (*GENUS*)

FITZINGER, Syst. Rept., 1843, p. 25
TYPE: *getulus* Schlegel, nec LINNÉ = holbrooki

Lampropeltis alterna (BROWN)

Ophibolus alternus BROWN
Proc. Ac. Nat. Sci. Phila., 1901 (Feb. 6, 1902), p. 612.
Lampropeltis alterna STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 87.

TYPE LOCALITY: Davis Mountains, Jeff Davis County, Texas.

RANGE: The westward extension of Texas.

Lampropeltis calligaster (HARLAN)

Coluber calligaster HARLAN
Journ. Ac. Nat. Sci. Phila., Vol. 5, 1827, p. 359.
Lampropeltis calligaster COPE
Proc. Ac. Nat. Sci. Phila., 1860, p. 255.
Ophibolus calligaster COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 905, fig. 223.

TYPE LOCALITY: Missouri.

RANGE: Hardin County, Kentucky, Indiana, Illinois, Wisconsin and Iowa; Mississippi, Kansas, Arkansas, Oklahoma and Texas.

Lampropeltis catalinensis VAN DENBURGH and SLEVIN

Lampropeltis catalinensis VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, Dec. 17, 1921, p. 397.

TYPE LOCALITY: Santa Catalina Island, Gulf of California.

RANGE: Same.

Lampropeltis getulus getulus (LINNÉ)

KING-SNAKE, CHAIN-SNAKE

Coluber getulus LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 382.

Lampropeltis getula Cope
Proc. Ac. Nat. Sci. Phila., 1860, p. 255.
Ophibolus getulus getulus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 914, figs. 227, 228.

TYPE LOCALITY: Carolina.

RANGE: Southern New Jersey to northern Florida and southeastern Alabama.

Lampropeltis getulus boylii (Baird and Girard)

Ophibolus boylii Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 82.
Lampropeltis getulus boylii Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 87, 1920, p. 3.
Ophibolus getulus boylii Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 919, fig. 230.

TYPE LOCALITY: Eldorado County, California.

RANGE: Southern Oregon to Lower California, also southern Nevada, southwestern Utah and northwestern Arizona.

Lampropeltis getulus brooksi Barbour

Lampropeltis getulus brooksi Barbour
Proc. N. Engl. Zoöl. Club, Vol. 7, June 5, 1919, p. 1, pl. 1.

TYPE LOCALITY: Royal Palm Hammock, 14 miles southwest of Homestead, Dade County, southeastern Florida.

RANGE: The tropical southeastern corner of Dade County, Florida.

Lampropeltis getulus californiae (Blainville)

Coluber (Ophis) californiae Blainville
Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 292, pl. 27, figs. 1, 1a, 1b.
Lampropeltis boylii var. *conjuncta* Cope
Proc. Ac. Nat. Sci. Phila., 1861, p. 301.
Lampropeltis nitida Van Denburgh
Proc. Calif. Ac. Sci., Ser. 2, Vol. 5, 1895, p. 143, pl. 14.
Lampropeltis getulus conjuncta Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 87, 1920, p. 4.
Lampropeltis californiae californiae Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 105.
Lampropeltis getulus californiae Klauber
Herpetologica, 1936, Vol. 1, No. 1, p. 26.

TYPE LOCALITY: California.

RANGE: Southern Oregon to southern Lower California; also southern Nevada, southwestern Utah and western Arizona.

Lampropeltis getulus floridana BLANCHARD

Lampropeltis getulus floridana BLANCHARD
Occ. Papers Mus. Zool. Univ. Mich., No. 70, May 5, 1919, p. 1, pl. 1, fig. 1.

TYPE LOCALITY: Orange Hammock, De Soto County, Florida.

RANGE: Florida from Orange County in the north to central Dade County in the southeast.

Lampropeltis getulus holbrooki (STEJNEGER)

Lampropeltis holbrooki STEJNEGER
Proc. U. S. Nat. Mus., Vol. 25, Sept. 8, 1902, p. 152.
Lampropeltis getulus holbrooki HURTER and STRECKER
Trans. Ac. Sci. St. Louis, Vol. 18, 1909, p. 26.
Ophibolus getulus sayi COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 911, fig. 226.

TYPE LOCALITY: Valley of the Mississippi.

RANGE: Western Alabama to Texas, northward through the states of the Mississippi basin mostly west of the river, to southern Iowa, southern Nebraska, and Wyoming.

Lampropeltis getulus niger (YARROW)

Ophibolus getulus niger YARROW
Proc. U. S. Nat. Mus., Vol. 5, 1882, p. 438.
Lampropeltis getulus niger BLANCHARD
Occ. Papers Mus. Zool. Univ. Mich., No. 87, 1920, p. 2.

TYPE LOCALITY: Wheatland, Indiana.

RANGE: Northern Alabama, Tennessee, West Virginia, Kentucky, Ohio, and southern Indiana.

Lampropeltis getulus splendida (BAIRD AND GIRARD)

Ophibolus splendidus BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 83.
Lampropeltis splendida COPE
Proc. Ac. Nat. Sci. Phila., 1860, p. 255.

Lampropeltis getulus splendida Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 87, 1920, p. 2.
Ophibolus getulus splendidus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 918, fig. 229.

TYPE LOCALITY: Sonora, Mexico.

RANGE: Northern Mexico and the boundary region.

Lampropeltis getulus sticticeps Barbour and Engels

Lampropeltis getulus sticticeps Barbour and Engels
Proc. New Engl. Zool. Club, 20, 1942, pp. 101–103, pl. 16.

TYPE LOCALITY: Knoll midway between Okracoke Inlet and Hatteras Inlet, Okracoke Island, North Carolina.

RANGE: Same.

Lampropeltis getulus yumensis Blanchard

Lampropeltis getulus yumensis Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 70, 1919, p. 6, pl. 1, fig. 2.
Lampropeltis getulus yumanensis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 100.

TYPE LOCALITY: 27 miles west of Indian Oasis, Pima County, Arizona.

RANGE: Southwestern Arizona, California, as far north as Blythe, Riverside County, and as far west as Seeley, Imperial County, and adjacent areas of Sonora and Lower California.

Lampropeltis multicincta[1] (Yarrow)

Ophibolus getulus multicinctus Yarrow
Proc. U. S. Nat. Mus., Vol. 5, 1882, p. 440.
Lampropeltis multicincta Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 87, 1920, p. 5.
Lampropeltis herrerae Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 100.

TYPE LOCALITY: Fresno, California.

RANGE: Washington, through Oregon to California and Lower California.

---

[1] See quotation from Stejneger, Copeia, 1936, No. 2, p. 95.

Lamperopeltis pyromelana (Cope)

Ophibolus pyromelanus Cope
Proc. Ac. Nat. Sci. Phila., 1866, p. 305.
Lampropeltis pyrrhomelaena Stejneger
Proc. U. S. Nat. Mus., Vol. 25, 1902, p. 152.
Ophibolus pyrrhomelas Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 907, fig. 224.

TYPE LOCALITY: Fort Whipple, Arizona.

RANGE: Utah, Arizona, Nevada and western New Mexico.

Lampropeltis rhombomaculata (Holbrook)

MOLE-SNAKE

Coluber rhombomaculatus Holbrook
N. Amer. Herp., Ed. 1, Vol. 4, 1840, p. 103, pl. 20.
Lampropeltis rhombomaculata Cope
Proc. Ac. Nat. Sci. Phila., 1860, p. 255.
Ophibolus rhombomaculatus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 903, fig. 222.

TYPE LOCALITY: Georgia and Alabama.

RANGE: Maryland to Central Florida and part of Alabama.

Lampropeltis triangulum triangulum (Lacépéde)

MILK-SNAKE

Coluber triangulum Lacépede
Hist. Nat. Quadr. Ovip. Serp., Vol. 2, 1788, tabl. méth., p. 86.
Lampropeltis triangula Cope
Proc. Ac. Nat. Sci. Phila., 1860, p. 256.
Osceola doliata triangula Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 885, figs. 210–215.

TYPE LOCALITY: America.

RANGE: Eastern North America from Maine through Ontario to Minnesota, south to Iowa and Virginia and in the mountains farther south.

Lampropeltis triangulum amaura (Cope)

Lampropeltis amaura Cope
Proc. Ac. Nat. Sci. Phila., 1860, p. 258.
Lampropeltis triangulum amaura Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 90.

Osceola doliata coccinea Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 896, fig. 220 (not of Schlegel).

TYPE LOCALITY: "Unknown" (original entry of type U. S. Nat. Mus. No. 5282 reads "Mississippi").

RANGE: Lower Mississippi Valley, southeastern Oklahoma, and eastern Texas.

Lampropeltis triangulum annulata (Kennicott)

Lampropeltis annulata Kennicott
Proc. Ac. Nat. Sci. Phila., 1860, p. 329.
Lampropeltis triangulum annulata Blanchard
Occ. Papers Mus. Zool. Univ. Mich., No. 87, 1920, p. 5.
Osceola doliata annulata Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 895, fig. 219.

TYPE LOCALITY: Matamoros, Mexico.

RANGE: Southeastern Texas and northeastern Mexico.

Lampropeltis triangulum elapsoides (Holbrook)

Coluber elapsoides Holbrook
N. Amer. Herp., Ed. 1, Vol. 2, 1838, p. 123, pl. 28.
Lampropeltis elapsoides Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 88.
Osceola elapsoidea Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 900, fig. 221.
Lampropeltis triangulum elapsoides Conant
Proc. New Engl. Zool. Club, Vol. 22, 1943, p. 3, pl. 2-4.

TYPE LOCALITY: South Carolina and Georgia.

RANGE: Kentucky, Tennessee, and North Carolina southward throughout the southeastern coastal plain.

Lampropeltis triangulum gentilis (Baird and Girard)

Ophibolis gentilis Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 90.
Lampropeltis triangulum gentilis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 90.
Lampropeltis pyromelaena celaenops Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 89.
Osceola doliata gentilis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 894, fig. 218.

TYPE LOCALITY: North Fork, Red River, near Sweetwater Creek, Wheeler County, Texas.

RANGE: Texas and northwestern Mexico; Arizona, Utah to South Dakota.

Lampropeltis triangulum syspila (COPE)

Ophibolus doliatus syspilus COPE
Proc. U. S. Nat. Mus., Vol. 11, 1888, p. 384.
Lampropeltis triangulum syspila RUTHVEN
Occ. Papers Mus. Zool. Univ. Mich., No. 66, 1919, p. 3.
Osceola doliata syspila COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 891, fig. 216.

TYPE LOCALITY: Richland County, Illinois.

RANGE: Oklahoma, Arkansas, and Tennessee northward to Kansas, Iowa, Illinois, Indiana, and southern Minnesota.

Lampropeltis triangulum temporalis (COPE)

Ophibolus doliatus temporalis COPE
American Naturalist 1893, pp. 1068–1069, pl. 25, fig. 4.
Lampropeltis triangulum temporalis MCCAULEY
Copeia, Sept. 30, 1941, No. 3, pp. 147–150, fig. 1.

TYPE LOCALITY: Delaware.

RANGE: New Jersey, Delaware, Maryland and District of Columbia.

Stilosoma (*GENUS*)

BROWN, Proc. Ac. Sci. Phila., 1890, p. 199
TYPE: *extenuatum*

Stilosoma extenuatum BROWN

Stilosoma extenuatum BROWN
Proc. Ac. Nat. Sci. Phila., 1890, p. 199.
Stylophis extenuatus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 90.
Stilosoma extenuatum COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 924, fig. 232.

TYPE LOCALITY: Lake Kerr, Marion County, Florida.

RANGE: Middle portion of peninsular Florida.

Cemophora (*GENUS*)

COPE, Proc. Ac. Nat. Sci. Phila., 1860, p. 244
TYPE: *coccinea*

Cemophora coccinea (BLUMENBACH)

Coluber coccineus BLUMENBACH
Voigt's Mag. Neu. Phys. Naturg., Vol. 5, Pt. 1, 1788, p. 11, pl. 1.
Cemophora coccinea COPE
Proc. Ac. Nat. Sci. Phila., 1860, p. 244.
Cemophora coccinea COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 928, fig. 235.

TYPE LOCALITY: Florida.

RANGE: Southern New Jersey to Alabama, Louisiana, Oklahoma, and Florida.

Rhinocheilus (*GENUS*)

BAIRD and GIRARD, Cat. N. Amer. Rept., Pt. 1, 1853, p. 120
TYPE: *lecontei*

Rhinocheilus lecontei lecontei BAIRD and GIRARD

Rhinocheilus lecontei BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 120.
Rhinochilus lecontei COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 931, fig. 236.
Rhinocheilus lecontei lecontei KLAUBER
Trans. San Diego Soc. Nat. Hist., 1941, Vol. 9, No. 29, p. 296.

TYPE LOCALITY: Borego Valley, 2 miles north of The Narrows, San Diego County, California.

RANGE: California from Mendocino and Lassen counties south; northern Lower California, southwestern Idaho, Nevada, southwestern Utah, southern and western Arizona.

Rhinocheilus lecontei clarus KLAUBER

Rhinocheilus lecontei clarus KLAUBER
Trans. San Diego Soc. Nat. Hist., 1941, Vol. 9, No. 29, p. 308.

TYPE LOCALITY: Borego Valley, 2 miles north of The Narrows, San Diego County, California.

RANGE: Borego and Coachella valleys in southern California, with scattered occurrences elsewhere in the Colorado, Mojave, and Yuma deserts of southern California, extreme southern Nevada, and western Arizona.

Rhinocheilus lecontei tesselatus Garman

Rhinocheilus lecontei var. *tessellatus* Garman
Mem. Mus. Comp. Zool. 8, 3, 1883. p. 74.
Rhinocheilus tessellatus Garman
Bull. Essex Inst., 1887, 19, p. 10.
Rhinocheilus lecontei tessellatus Barbour and Loveridge
Bull. Mus. Comp. Zool., 1929, 69, 10, p. 333.
Rhinocheilus lecontei Stejneger and Barbour
Check List N. Amer. Amph. Rept., ed. 4, 1939, p. 121.
Rhinocheilus lecontei tessellatus Klauber
Trans. San Diego Soc. Nat. Hist., 1941. Vol. 9. No. 29, pp. 302.

TYPE LOCALITY: Monclova, Coahuila, Mexico.

RANGE: Central and southern New Mexico, southwestern Kansas, western Oklahoma, Texas west of the 97th parallel, Coahuila and northern Nuevo Leon.

Contia (*GENUS*)

Baird and Girard, Cat. N. Amer. Rept., Pt. 1, 1853, p. 110
TYPE: *mitis* = tenuis

Contia tenuis (Baird and Girard)

Calamaria tenuis Baird and Girard
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 176.
Contia tenuis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 91.
Contia mitis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 925, fig. 233.
Lodia tenuis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 927, fig. 234.

TYPE LOCALITY: Puget Sound, Washington.

RANGE: South central California to Puget Sound.

Sonora (GENUS)

BAIRD and GIRARD, Cat. N. Amer. Rept., Pt. 1, 1853, p. 117
TYPE: *semiannulata*

Sonora episcopa (KENNICOTT)

Lamprosoma episcopum KENNICOTT
U. S. Mex. Bound. Surv., 1859, p. 22, pl. 8, fig. 2.
Contia episcopa torquata COPE
Bull. U. S. Nat. Mus., Vol. 17, 1880, p. 21.
Sonora episcopa STICKEL
Copeia, 1938, No. 4, Dec. 3, p. 184.

TYPE LOCALITY: Eagle Pass, Maverick County, Texas.

RANGE: Central Texas north to southeastern Kansas and Missouri and west to eastern Colorado and New Mexico.

Sonora miniata miniata STICKEL

Sonora miniata miniata STICKEL
Copeia, 1938, No. 4, Dec. 3, p. 187.

TYPE LOCALITY: Mesa, Arizona.

RANGE: South central Arizona and Ada County, Idaho.

Sonora miniata linearis STICKEL

Sonora miniata linearis STICKEL
Copeia, 1938, No. 4, Dec. 3, p. 189.

TYPE LOCALITY: Seeley, Imperial County, California.

RANGE: Southeastern California and western Nevada and the Cocopah Mountains, Lower California.

Sonora mosaueri STICKEL

Sonora mosaueri STICKEL
Copeia, 1938, No. 4, Dec. 3, p. 189.

TYPE LOCALITY: Comondú, Lower California.

RANGE: The type locality.

Sonora occipitalis (HALLOWELL)

Rhinostoma occipitale HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 95.

Sonora occipitalis Van Denburgh and Slevin
Proc. Calif. Ac. Sci., Ser. 4, Vol. 3, 1913, p. 411.
Chionactis occipitalis Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 941, fig. 240.

TYPE LOCALITY: Mojave Desert.

RANGE: Southern California, southern Nevada, and southern Arizona.

Sonora semiannulata semiannulata (Baird and Girard)

Sonora seminannulata Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 117.
Sonora semiannulata semiannulata Stickel
Copeia, 1938, No. 4, Dec. 3, p. 185.
Chionactis episcopus isozonus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 939, fig. 239.

TYPE LOCALITY: Sonora, Mexico.

RANGE: Arizona, Utah, Nevada; Inyo County, California; Snake River region, Idaho; Mexico only in the type locality.

Sonora semiannulata blanchardi Stickel

Sonora semiannulata blanchardi Stickel
Copeia, 1938, No. 4, Dec. 3, p. 185.

TYPE LOCALITY: Chisos Mountains, Brewster County, Texas.

RANGE: Southwestern Texas and adjacent Mexico.

Sonora semiannulata gloydi Stickel

Sonora semiannulata gloydi Stickel
Copeia, 1938, No. 4, Dec. 3, p. 186.

TYPE LOCALITY: Lower Sonoran level of the Grand Canyon, Arizona.

RANGE: The type locality.

Sonora taylori (Boulenger)

Contia taylori Boulenger
Cat. Snakes Brit. Mus., Vol. 2, 1894, pl. 12, fig. 3.
Sonora taylori Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 92.
Chionactis taylori Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 936.

TYPE LOCALITY: Duval County, Texas, and Nuevo Leon, Mexico.

RANGE: Southern Texas and northeastern Mexico.

Ficimia (*GENUS*)

GRAY, Cat. Snakes Brit. Mus., 1849, p. 80
TYPE: *olivacea*

Ficimia cana (COPE)

Gyalopion canum COPE
Proc. Ac. Nat. Sci. Phila., 1860, p. 243.
Ficimia cana GARMAN
Mem. Mus. Comp. Zoöl., Vol. 8, Pt. 3, 1883, p. 83.
Gyalopium canum COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 947, fig. 241.

TYPE LOCALITY: Fort Buchanan, Arizona.

RANGE: Western Texas to Arizona.

Ficimia streckeri TAYLOR

Ficimia streckeri TAYLOR
Copeia, 1931, No. 1, March 31, p. 5.

TYPE LOCALITY: Three miles east of Rio Grande City, Texas.

RANGE: Same as type locality.

Chilomeniscus (*GENUS*)

COPE, Proc. Ac. Nat. Sci. Phila., 1860, p. 339
TYPE: *stramineus*

Chilomeniscus cinctus COPE

Chilomeniscus cinctus COPE
Proc. Ac. Nat. Sci. Phila., 1861, p. 303.

TYPE LOCALITY: Guaymas, Mexico.

RANGE: Colorado Desert to adjacent Sonora, central and southwestern Arizona, and central Lower California.

Chilomeniscus punctatissimus VAN DENBURGH and SLEVIN

Chilomeniscus punctatissimus VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, July 30, 1921, p. 98.

TYPE LOCALITY: Isla Partida, Espiritu Santo Island, Lower California.
RANGE: Same.

Chilomeniscus stramineus stramineus Cope

Chilomeniscus stramineus Cope
Proc. Ac. Nat. Sci. Phila., 1860, p. 339.
Chilomeniscus stramineus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 949, fig. 242.
Chilomeniscus stramineus stramineus Hoard
Jour. Entom. and Zool. Pomona Coll., Claremont, California, Vol. 31, No. 4, Dec. 1939, pp. 45–46.

TYPE LOCALITY: Cape St. Lucas, Lower California.
RANGE: Southern Lower California.

Chilomeniscus stramineus esterensis Hoard

Chilomeniscus stramineus esterensis Hoard
Jour. Entom. and Zool. Pomona Coll. Claremont, California, Vol. 31, No. 4, Dec. 1939, pp. 45–46.

TYPE LOCALITY: Estero Salina, Lower California.
RANGE: Type locality.

Natrix (*GENUS*)

Laurenti, Syn. Rept., 1768, p. 73
TYPE: *vulgaris* = natrix

Natrix clarkii (Baird and Girard)

Regina clarkii Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 48.
Natrix clarkii Cope
Proc. U. S. Nat. Mus., Vol. 14, 1892, p. 669.
Natrix clarkii Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 987, fig. 261.

TYPE LOCALITY: Indianola, Texas.
RANGE: Coastal regions of northwest Florida and Texas.

Natrix compressicauda (Kennicott)
SALT-WATER MOCCASIN

Nerodia compressicauda Kennicott
Proc. Ac. Nat. Sci. Phila., 1860, p. 335.

Natrix compressicauda Cope
Proc. U. S. Nat. Mus., Vol. 11, 1889, p. 392.
Natrix compressicauda Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 978, fig. 255.

TYPE LOCALITY: Tampa Bay, Florida

RANGE: Southwestern Florida, especially the mangrove swamps of the extreme southern coast and the Keys; also north coast of Cuba, in mangrove swamps.

Natrix cyclopion cyclopion (Duméril and Bibron)

Tropidonotus cyclopion Duméril and Bibron
Erp. Gén., Vol. 7, 1854, p. 576.
Natrix cyclopium Cope
Proc. U. S. Nat. Mus., Vol. 14, 1892, p. 673.
Natrix cyclopion cyclopion Goff
Occ. Papers Mus. Zool. Univ. Mich., No. 327, March 31, 1936, p. 1.
Natrix cyclopium Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 961, figs. 247, 248.

TYPE LOCALITY: New Orleans.

RANGE: Southern Alabama to Louisiana and northward up the Mississippi Valley to southern Indiana.

Natrix cyclopion floridana Goff

Natrix cyclopion floridana Goff
Occ. Papers Mus. Zool. Univ. Mich., No. 327, March 31, 1936, p. 1.

TYPE LOCALITY: Leesburg, Florida.

RANGE: Florida to coastal South Carolina.

Natrix erythrogaster erythrogaster (Forster)

Coluber erythrogaster Forster
in Bossu, Travels Through That Part of North America Formerly Called Lousiana, Vol. 1, 1771, p. 364, n.
Natrix erythrogaster erythrogaster Burt
Amer. Midl. Nat., Vol. 16, 1935, p. 333 (part).

TYPE LOCALITY: Based on Catesby, Natural History of Carolina, Volume II, plate 46; hence probably from South Carolina.

RANGE: Eastern Texas, eastern Oklahoma and southeastern Kansas eastward throughout the southern states (excluding peninsular Florida) and north to Pennsylvania, Ohio, and extreme southern portions of Michigan and Wisconsin.

Natrix erythrogaster transversa (HALLOWELL)

Tropidonotus transversus HALLOWELL
Proc. Ac. Nat. Sci. Phila., 1852, p. 177.
Natrix erythrogaster transversa TAYLOR
Sci. Bull. Univ. Kansas, Vol. 19, 1929, p. 58.
Natrix transversa STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 118.

TYPE LOCALITY: "Creek boundary, found near the banks of the Arkansas and its tributaries."

RANGE: Western Missouri and eastern Kansas through western Oklahoma to southeastern Mexico, east to Fort Worth and Houston, Texas, and south to Nuevo Leon, Mexico.

Natrix grahamii (BAIRD and GIRARD)

Regina grahamii BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 47.
Natrix grahamii COPE
Proc. U. S. Nat. Mus., Vol. 14, 1892, p. 668.
Natrix grahamii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 991, fig. 264.

TYPE LOCALITY: Rio Salado, Texas.

RANGE: Illinois westward to eastern Kansas and southward to Louisiana and eastern Texas.

Natrix harteri TRAPIDO

Natrix harteri TRAPIDO
Amer. Mid. Nat., 1941, 25, No. 3, p. 673.

TYPE LOCALITY: Brazos River, north of Palo Pinto, Palo Pinto County, Texas.

RANGE: Along the Brazos River where the bed is covered with rocks and on the rocky portions of the banks.

Natrix kirtlandii (KENNICOTT)

Regina kirtlandii KENNICOTT
Proc. Ac. Nat. Sci. Phila., 1856, p. 95.
Natrix kirtlandii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 995, fig. 266.

TYPE LOCALITY: Northern Illinois.

RANGE: Wisconsin and southern Michigan south through northern and central Illinois and Indiana to Louisville, Kentucky, and east throughout Ohio to western Pennsylvania.

Natrix rhombifera rhombifera (HALLOWELL)

Tropidonotus rhombifer HALLOWELL
Proc. Ac. Nat. Sci. Phila. Vol. 6, 1852, p. 177
Natrix rhombifera COPE
Proc. U. S. Nat. Mus., Vol. 11, 1889, p. 398.
Natrix rhombifera rhombifera CLAY
Ann. Carn. Mus., Vol. 27, 1938, pp. 251–253.
Natrix rhombifera COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 963, fig. 249.

TYPE LOCALITY: Arkansas River and its tributaries near the northern boundary of the Creek Nation.

RANGE: Southern Illinois and Indiana south through Alabama to Texas and to Vera Cruz, Mexico.

Natrix rigida (SAY)

Coluber rigidus SAY
Journ. Ac. Nat. Sci. Phila., Vol. 4, Pt. 2, 1825, p. 239.
Natrix rigida COPE
Proc. U. S. Nat. Mus., Vol. 14, 1892, p. 668.
Natrix rigida COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 989, fig. 262.

TYPE LOCALITY: The southern states.

RANGE: New Kent County, Virginia, and South Carolina to western Louisiana, excluding peninsular Florida.

Natrix septemvittata (SAY)

MOON-SNAKE, QUEEN-SNAKE

Coluber septemvittatus SAY
Journ. Ac. Nat. Sci. Phila., Vol. 4, Pt. 2, 1825, p. 240.
Natrix septemvittata COPE
Trans. Amer. Philos. Soc., Vol. 18, 1895, p. 216.
Natrix leberis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 993, fig. 265.

TYPE LOCALITY: Pennsylvania.

RANGE: Central, eastern and Gulf States from Pennsylvania, New Jersey, Ohio, and Wisconsin southward to Alabama and northern Florida.

Natrix sipedon sipedon (LINNÉ)
WATER-SNAKE
Coluber sipedon LINNÉ
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 219.
Natrix spideon KIRSCH
Bull. U. S. Fish Comm., Vol. 14, 1895, p. 333.
Natrix fasciata sipedon COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 969, fig. 251.

TYPE LOCALITY: North America.

RANGE: Southern Maine through southern Quebec, southern Ontario, and Wisconsin to eastern Colorado, south to Oklahoma, Tennessee, and northwestern South Carolina.

Natrix sipedon confluens (BLANCHARD)
Natrix fasciata confluens BLANCHARD
Occ. Papers Mus. Zool. Univ. Mich., No. 140, July 19, 1923, p. 1.

TYPE LOCALITY: Butler County, Missouri.

RANGE: Eastern Louisiana north through Fulton County, Kentucky, southern and eastern Arkansas, Oklahoma and Kansas, west into central Texas.

Natrix sipedon engelsi BARBOUR
Natrix sipedon engelsi BARBOUR
Proc. New Engl. Zool. Club Vol. 22, 1943, p. 1, pl. 1.

TYPE LOCALITY: Mullet Pond, Shackleford Banks, Cartaret County, North Carolina.

RANGE: Shackleford Banks, Cartaret County, North Carolina.

Natrix sipedon fasciata [1] (LINNÉ)
Coluber fasciatus LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 378.
Natrix sipedon fasciata STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 96.
Natrix fasciata fasciata COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 966, fig. 250.

TYPE LOCALITY: Carolina.

---

[1] Isolated populations of more or less uniformly rufescent individuals are found in the ranges of both the subspecies *fasciata* and *sipedon*. By some these are considered to warrant specific recognition. Their status is as yet far from settled, and such settlement cannot be attempted in a check list.

RANGE: Virginia to northern Florida, westward to Louisiana and northward up the Mississippi through all the central states to Nebraska and Indiana.

Natrix sipedon insularum CONANT and CLAY

Natrix sipedon insularum CONANT and CLAY
Occ. Papers Mus. Zool. Univ. Mich., No. 346, Feb. 11, 1937, p. 1.

TYPE LOCALITY: Pelee Island, Lake Erie.

RANGE: Certain islands in Lake Erie.

Natrix sipedon pictiventris (COPE)

Natrix fasciata pictiventris COPE
Amer. Nat., Vol. 29, 1895, p. 677.
Natrix fasciata pictiventris COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 969.
Natrix sipedon pictiventris STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 96.

TYPE LOCALITY: Palatka, Florida

RANGE: Peninsular Florida.

Natrix sipedon pleuralis (COPE)

Natrix fasciata pleuralis COPE
Proc. U. S. Nat. Mus., Vol. 14, 1892, p. 672.
Natrix sipedon pleuralis CLAY
Copeia, 1938, No. 4, Dec. 3, p. 178.

TYPE LOCALITY: Probably Summerville, South Carolina.

RANGE: South Carolina westward around the southern extremity of the Appalachian Mountains, Mississippi, Arkansas, and southern Missouri, and northward to southern Illinois and southern Indiana.

Natrix sipedon taeniata COPE

Natrix compressicauda taeniata COPE
Amer. Nat. 29, 1895, p. 676.
Natrix sipedon taeniata CARR and GOIN
Proc. N. E. Zool. Club, 21, Oct. 1942, pp. 47–54, pls. 6.

TYPE LOCALITY: "Volusia" now National Gardens, Volusia County, Florida.

RANGE: East coast of Florida.

Natrix taxispilota (Holbrook)
WATER-PILOT
Tropidonotus taxispilotus Holbrook
N. Amer. Herp., Ed. 2, Vol. 4, 1842, p. 35, pl. 8.
Natrix taxispilota Cope
Proc. U. S. Nat. Mus., Vol. 11, 1889, p. 392.
Natrix taxispilota Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 959, fig. 246.

TYPE LOCALITY: State Carolina seaboard and the Atlamaha River, Georgia.

RANGE: Eastern Virginia, the Carolinas to Florida, west to Louisiana.

Natrix valida (Kennicott)
Regina valida Kennicott
Proc. Ac. Nat. Sci. Phila., 1860, p. 334.
Natrix valida Cope
Proc. U. S. Nat. Mus., Vol. 14, 1892, p. 670.
Natrix valida Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 984, figs. 258, 259.

TYPE LOCALITY: Durango, Mexico.

RANGE: Western Mexico, Lower California.

Seminatrix (*GENUS*)

Cope, Amer. Nat., Vol. 29, 1895, p. 678
TYPE: *pygaea*

Seminatrix pygaea (Cope)
Contia pygaea Cope
Proc. Ac. Nat. Sci. Phila., 1871, p. 223.
Seminatrix pygaea Cope
Amer. Nat., Vol. 29, 1895, p. 678.
Seminatrix pygaea Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 998, fig. 267.

TYPE LOCALITY: "Volusia," Florida.[1]

RANGE: Cartaret County, North Carolina, southward through the Florida peninsula.

---

[1] Cf. under N. s. fasciata.

Storeria (*GENUS*)

BAIRD and GIRARD, Cat. N. Amer. Rept., Pt. 1, 1853, p. 135
TYPE: *dekayi*

Storeria dekayi (HOLBROOK)

DEKAY'S SNAKE

Tropidonotus dekayi HOLBROOK
N. Amer. Herp., Ed. 2, Vol. 4, 1842, p. 53, pl. 14.
Storeria dekayi BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 135.
Storeria dekayi COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1000, fig. 268.

TYPE LOCALITY: Massachusetts and New York.

RANGE: Eastern North America, Ontario to Vera Cruz, west to Kansas, south to northern Florida.

Storeria occipitomaculata (STORER)

RED-BELLIED SNAKE

Coluber occipito-maculatus STORER
Rep. Fish. Rept. Birds Mass., 1839, p. 230.
Storeria occipito-maculatus BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 137.
Storeria occipitomaculata COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1003, fig. 269.

TYPE LOCALITY: Amherst, Massachusetts.

RANGE: From Ontario and Lake Superior southward to central Florida and Vera Cruz, westward to Kansas, Iowa, and North Dakota.

Storeria victa HAY

Storeria victa HAY
Science, Ser. 1, Vol. 19, April 8, 1892, p. 199.

TYPE LOCALITY: Oklawaha River, some distance north of Kissimee, Florida.

RANGE: Florida and southern Georgia.

Haldea (*GENUS*)

BAIRD and GIRARD, Cat. N. Amer. Rept., Pt. 1, 1853, p. 122
TYPE: *striatula*

Haldea striatula (LINNÉ)

Coluber striatulus LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 375.
Potamophis striatulus GARMAN
Bull. Essex Inst., Vol. 24, 1892, p. 105.
Haldea striatula COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1009, fig. 272.
Potamophis striatula STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 120.

TYPE LOCALITY: Carolina.

RANGE: Virginia to northern Florida, westward to central Texas, Oklahoma, Missouri and southeastern Kansas.

Haldea valeriae valeriae (BAIRD and GIRARD)

Virginia valeriae BAIRD and GIRARD
Cat N. Amer. Rept., Pt. 1, 1853, p. 127.
Virginia valeriae COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1006, fig. 270.
Virginia valeriae valeriae STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 119.

TYPE LOCALITY: Kent County, Maryland.

RANGE: New Jersey to northern Carolina, west to Ohio and Tennessee.

Haldea valeriae elegans (KENNICOTT)

Virginia elegans KENNICOTT
Proc. Ac. Nat. Sci. Phila., 1859, p. 99.
Virginia elegans COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1007, fig. 271.
Virginia valeriae elegans STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 119.

TYPE LOCALITY: Heavily timbered regions of southern Illinois.

RANGE: Indiana, Illinois and Iowa southward to Texas, eastward to southwestern Alabama. Not in Ohio nor Pennsylvania.

Liodytes (*GENUS*)

COPE, Proc. Amer. Philos. Soc., Vol. 22, 1885, p. 194
TYPE: *alleni*

Liodytes alleni (GARMAN)

Helicops alleni GARMAN
Proc. Boston Soc. Nat. Hist., Vol. 17, 1874, p. 92.
Liodytes alleni COPE
Proc. U. S. Nat. Mus., Vol. 11, 1888, p. 393.
Liodytes allenii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1013, fig. 274.

TYPE LOCALITY: Hawkinsville, Florida.

RANGE: Florida and the Okefinokee Swamp, Georgia.

Thamnophis (*GENUS*)

FITZINGER, Syst. Rept., 1843, p. 26
TYPE: *sauritus*

GARTER-SNAKES

Thamnophis angustirostris (KENNICOTT)

Eutaenia angustirostris KENNICOTT
Proc. Ac. Nat. Sci. Phila., 1860, p. 332.
Thamnophis angustirostris RUTHVEN
Bull. U. S. Nat. Mus., No. 61, 1908, p. 120.
Eutaenia angustirostris COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1047, fig. 290.

TYPE LOCALITY: Parras, Coahuila, Mexico.

RANGE: Texas, southeastern Arizona and southwestern New Mexico, south to Coahuila and Durango.

Thamnophis butleri (COPE)

Eutaenia butleri COPE
Proc. U. S. Nat. Mus., Vol. 11, 1889, p. 399.
Thamnophis butleri STEJNEGER
Proc. U. S. Nat. Mus., Vol. 17, 1895, p. 593.
Eutaenia butlerii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1031, fig. 281.

TYPE LOCALITY: Richmond, Indiana.

RANGE: Extreme western New York, and southwestern Ontario; western Pennsylvania, through Ohio and Indiana, southern Michigan and Wisconsin.

Thamnophis digueti (MOCQUARD)

Tropidonotus digueti MOCQUARD
Nouv. Arch. Mus. d'Hist. Nat. Paris sér. 4, No. 1, 1899, pp. 327–329, pl. 12, fig. 2.
Thamnophis digueti FITCH
Univ. Calif. Publ. Zool. 44, No. 1, 1940, pp. 81–83.

TYPE LOCALITY: San Ignacio, South District, Lower California, Mexico.

RANGE: Permanent streams of Sierra de la Giganta, Lower California, Mexico; at present known from only three widely separated localities of that general region: San Ignacio, Mulegé, and Comondú.

Thamnophis eques eques (REUSS)

Coluber eques REUSS
Mus. Senckenberg. Abh., Vol. 1, 1834, p. 152, pl. 8, fig. 2.
Eutaenia eques COPE
Ann. Rep. U.S. Nat. Mus., 1898 (1900), p. 1049, figs. 291–293.
Thamnophis eques RUTHVEN
Bull. U. S. Nat. Mus., No. 61, 1908, p. 158.
Thamnophis eques eques SMITH, H. M.
Zoologica 27, No. 17, 1942, p. 98.

TYPE LOCALITY: Mexico.

RANGE: Utah, Arizona, New Mexico and Texas, southward to Guatemala.

Thamnophis marcianus (BAIRD and GIRARD)

Eutainia marciana BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 36.
Eutaenia elegans marciana COPE
Ann. Rep. U. S. Nat. Must., 1898 (1900), p. 1044, fig. 289.
Thamnophis marcianus RUTHVEN
Bull. U. S. Nat. Mus., No. 61, 1908, p. 58.

TYPE LOCALITY: "Red River, Arkansas", [Oklahoma].

RANGE: Kansas, Oklahoma and Texas west to southeastern California and northeastern Mexico.

Thamnophis megalops (KENNICOTT)

Eutaenia megalops KENNICOTT
Proc. Ac. Nat. Sci. Phila., 1860, p. 330.
Eutaenia megalops COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), –. 1025, fig. 278.
Thamnophis megalops RUTHVEN
Bull. U. S. Nat. Mus., No. 61, 1908, p. 44.

TYPE LOCALITY: Tucson and Sta. Magdalena, Arizona.

RANGE: The whole Mexican plateau region north to Texas, southwestern New Mexico and Arizona, and the Cocopah Mountains, Lower California.

Thamnophis ordinoides ordinoides (BAIRD and GIRARD)

Tropidonotus ordinoides BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 176.
Thamnophis ordinoides RUTHVEN
Bull. U. S. Nat. Mus., No. 61, 1908, p. 147.
Eutaenia elegans ordinoides COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1046.

TYPE LOCALITY: Puget Sound.

RANGE: Coastal region of California, Oregon, Washington, and British Columbia.

Thamnophis ordinoides atratus (KENNICOTT)

Eutainia atrata KENNICOTT
U. S. Pacific R. R. Surv., Vol. 12, Pt. 2, 1860, p. 296.
Thamnophis ordinoides atratus VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 8, 1918, p. 224, pl. 9.

TYPE LOCALITY: California.

RANGE: Coastal region of California from Del Norte to Santa Barbara Counties.

Thamnophis ordinoides biscutatus (COPE)

Eutaenia biscutata COPE
Proc. Ac. Nat. Sci. Phila., 1883, p. 21.

Thamnophis ordinoides biscutatus VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 8, 1918, p. 245, pl. 11.

TYPE LOCALITY: Klamath Lake, Oregon.

RANGE: Southern British Columbia, Vancouver Island, to Siskiyou and Modoc Counties, California.

Thamnophis ordinoides couchii (KENNICOTT)

Eutainia couchii KENNICOTT
U. S. Pacif. R. R. Surv., Vol. 10, Pt. 4, 1859, p. 10.
Thamnophis ordinoides couchii VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, 1921, p. 29.

TYPE LOCALITY: Pitt River, California.

RANGE: Sacramento and San Joaquin Valley in California eastward over the Sierra Nevada into Douglas and Washoe Counties, Nevada.

Thamnophis ordinoides elegans (BAIRD and GIRARD)

Eutainia elegans BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 34.
Thamnophis ordinoides elegans RUTHVEN
Bull. U. S. Nat. Mus., No. 61, 1908, p. 138.
Eutaenia elegans elegans COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1036, fig. 284.

TYPE LOCALITY: Eldorado County, California.

RANGE: Southern Oregon, Sierra Nevada slopes of Nevada and California south to the San Bernardino Mountains.

Thamnophis ordinoides gigas FITCH

Thamnophis ordinoides gigas FITCH
Univ. Calif. Publ. Zool., 44, No. 1, 1940, pp. 69–73.

TYPE LOCALITY: Gadwell, Merced Co., California.

RANGE: Floor of the Great Valley of California from Sacramento and Antioch south to Buena Vista Lake, confined to vicinity of permanent fresh water.

Thamnophis ordinoides hammondii (KENNICOTT)

Eutaenia hammondii KENNICOTT
Proc. Ac. Nat. Sci. Phila., 1860, p. 322.

Thamnophis ordinoides hammondii Van Denburgh and Slevin
Proc. Calif. Ac. Sci., Ser. 4, Vol. 8, 1918, p. 256.
Eutaenia elegans couchii (part) Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1042, fig. 288.

TYPE LOCALITY: San Diego and Fort Tejon, California.

RANGE: Southwestern California and adjacent Lower California.

Thamnophis ordinoides hueyi Van Denburgh and Slevin

Thamnophis ordinoides hueyi Van Denburgh and Slevin
Proc. Calif. Ac. Sci., Ser. 4, Vol. 13, July 25, 1923, p. 2.

TYPE LOCALITY: Arroyo Encantado, San Pedro Martir Mountains, Lower California.

RANGE: The San Pedro Martir Range.

Thamnophis ordinoides hydrophila Fitch

Thamnophis ordinoides hydrophila Fitch
Amer. Midl. Natl., Vol. 17, No. 3, May 1936, p. 648.

TYPE LOCALITY: Trail Creek, Jackson County, Oregon.

RANGE: Streams of Rogue River Basin, Oregon.

Thamnophis ordinoides vagrans (Baird and Girard)

Eutainia vagrans Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 35.
Thamnophis ordinoides vagrans, Van Denburgh and Slevin
Proc. Calif. Ac. Sci., Ser. 4, Vol. 8, 1918, p. 240.
Eutaenia elegans vagrans Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1039, fig. 287.

TYPE LOCALITY: California.

RANGE: British Columbia, Washington, Oregon, Idaho, western Montana, south to northern Arizona and eastern California.

Thamnophis radix (Baird and Girard)

Eutainia radix Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 34.
Thamnophis radix Jordan
Man. Vertebr. Anim. North. U. S., Ed. 8, 1899, p. 193.
Eutaenia radix Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1026, fig. 279.

TYPE LOCALITY: Racine, Wisconsin.

RANGE: Illinois and the Great Plains from Kansas and Missouri to Wisconsin and the Canadian Northwest.

Thamnophis sauritus sauritus (LINNÉ)

RIBBON-SNAKE

Coluber saurita LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 385.
Thamnophis sauritus sauritus BLANCHARD
Papers Mich. Ac. Sci. Arts Letters, Vol. 4, 1924, p. 18.
Eutaenia saurita COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1020, fig. 276.

TYPE LOCALITY: Carolina.

RANGE: Michigan, Ontario, and Maine, south to Mississippi, Alabama, and Georgia.

Thamnophis sauritus proximus (SAY)

Coluber proximus SAY
Long's Exp. Rocky Mts., Vol. 1, 1823, p. 187.
Thamnophis sauritus proximus RUTHVEN
Bull. U. S. Nat. Mus., No. 61, 1908, p. 98.
Thamnophis proximus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 115.
Eutaenia proxima COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1022, fig. 277.

TYPE LOCALITY: Stone quarry on west side of Missouri River, 3 miles above the mouth of Boyer's River.

RANGE: Colorado to Nebraska, northern Iowa and southern Wisconsin, south to Louisiana and Texas and through Mexico to the coastal region of Yucatan and southward to Costa Rica.

Thamnophis sauritus sackenii (KENNICOTT)

Eutaenia sackenii KENNICOTT
Proc. Ac. Nat. Sci. Phila., 1859, p. 98.
Thamnophis sackenii STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 102.
Thamnophis sauritus sackeni RUTHVEN
Bull. U. S. Nat. Mus., No. 61, 1908, p. 107.
Eutaenia sackenii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1019, fig. 275.

TYPE LOCALITY: Florida.

RANGE: Central and northern Florida to southern Mississippi.

Thamnophis sirtalis sirtalis (LINNÉ)

Coluber sirtalis LINNÉ
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 222.
Thamnophis sirtalis GARMAN
Bull. Essex Inst., Vol. 24, 1892, p. 104.
Eutaenia sirtalis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1064, figs. 298–303.

TYPE LOCALITY: Canada.

RANGE: Eastern United States and Canada, north to about the 52nd degree of latitude, west to Minnesota, Missouri, southward to eastern Texas.

Thamnophis sirtalis concinnus (HALLOWELL)

Tropidonotus concinnus HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 182.
Thamnophis sirtalis concinnus RUTHVEN
Bull. U. S. Nat. Mus., No. 61, 1908, p. 173.
Eutaenia sirtalis concinna COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1081, fig. 306.

TYPE LOCALITY: Oregon.

RANGE: Southern British Columbia, Vancouver Island, Washington, and Oregon, west of the Sierra Nevada.

Thamnophis sirtalis infernalis (BLAINVILLE)

Coluber infernalis BLAINVILLE
Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 291, pl. 26, figs 3–3a.
Thamnophis sirtalis infernalis VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 8, 1918, p. 198.

TYPE LOCALITY: California.

RANGE: Southern Oregon, western Nevada, and California (except desert areas).

Thamnophis sirtalis parietalis (SAY)

Coluber parietalis SAY
Long's Exp. Rocky Mts., Vol. 1, 1823, p. 186.

Thamnophis sirtalis var. *parietalis* JORDAN
Man. Vertebr. Anim. North. U. S., Ed. 8, 1899, p. 193.
Eutaenia sirtalis parietalis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1077, fig. 304.

TYPE LOCALITY: Stone quarry on west side of Missouri River, 3 miles above the mouth of Boyer's River.

RANGE: Iowa and Minnesota, Missouri westward to Utah, eastern Nevada, through southern Idaho to Oregon, Washington, Alberta and Manitoba.

Thamnophis sirtalis pickeringii (BAIRD and GIRARD)

Eutainia pickeringii BAIRD and GIRARD
Cat. No. Amer. Rept., 1853, p. 27.
Eutainia sirtalis pickeringii COPE
Bull. U. S. Nat. Mus., 1. 1875, p. 41.
Thamnophis sirtalis pickeringii JOHNSON
Copeia, 1942, No. 1, p. 17.

TYPE LOCALITY: Puget Sound, Washington.

RANGE: Same as type locality.

Thamnophis sirtalis tetrataenia (COPE)

Eutainia sirtalis tetrataenia COPE
Proc. U. S. Nat. Mus., 14, 1892, p. 664.
Thamnophis sirtalis tetrataenia JOHNSON
Copeia, 1942, No. 1, p. 17.

TYPE LOCALITY: Puget Sound, Washington and Pitt River, California.

RANGE: East and west of the Cascade range, and in the lowlands of the Puget Sound region, Washington.

Tropidoclonion (*GENUS*)

COPE, Proc. Ac. Nat. Sci. Phila., 1860, p. 76
TYPE: *lineatum*

Tropidoclonion lineatum (HALLOWELL)

Microps lineatus HALLOWELL
Proc. Ac. Nat. Sci. Phila., 1856, p. 241.

Tropidoclonion lineatum COPE
Proc. Ac. Nat. Sci. Phila., 1860, p. 76.
Tropidoclonium lineatum COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1011, fig. 273.

TYPE LOCALITY: Kansas.

RANGE: Urbana, Illinois, to Iowa and southeastern South Dakota and through Missouri, Kansas, and Arkansas to Oklahoma and Texas.

Coniophanes (*GENUS*)

HALLOWELL in COPE, Proc. Ac. Nat. Sci. Phila., 1860, p. 248
TYPE: *fissidens*

Coniophanes imperialis imperialis (BAIRD)

Taeniophis imperialis BAIRD
U. S. Mex. Bound. Surv., Vol. 2, 1859, Rept., p. 23, pl. 19, fig. 1.
Coniophanes imperialis COPE
Proc. Ac. Nat. Sci. Phila., 1861, p. 74.
Coniophanes imperialis imperialis BAILEY
Occ. Papers Mus. Zool. Univ. Mich., No. 362, p. 6.
Coniophanes imperialis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1097, fig. 313.

TYPE LOCALITY: Brownsville, Texas.

RANGE: Southern Texas to Vera Cruz, Mexico.

Oxybelis (*GENUS*)

WAGLER, Syst. Amph., 1830, p. 183
TYPE: *aeneus* = acuminatus

Oxybelis microphthalmus BARBOUR and AMARAL

Oxybelis microphthalmus BARBOUR and AMARAL
Proc. New Engl. Zoöl. Club, Vol. 9, Dec. 25, 1926, p. 80.

TYPE LOCALITY: Calabasas Canyon, Arizona.

RANGE: Desert mountain canyons of Arizona near the International Boundary.

Leptodeira (*GENUS*)

Fitzinger, Syst. Rept., 1843, p. 27
TYPE: *annulata*

Leptodeira septentrionalis septentrionalis (Kennicott)

Dipsas septentrionalis Kennicott
in Baird, U. S. Mex. Bound. Surv., Vol. 2, 1859, Rept., p. 16, pl. 8, fig. 1.
Leptodeira septentrionalis Stejneger
Proc. U. S. Nat. Mus., Vol. 14, 1891, p. 505.
Leptodeira septentrionalis septentrionalis Dunn
Proc. Ac. Nat. Sci., Phila., Vol. 22, 1936, p. 692.
Sibon septentrionale Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1107, fig. 316.

TYPE LOCALITY: Matamoros, Mexico, and Brownsville, Texas.
RANGE: Southern Texas and northeastern Mexico.

Hypsiglena (*GENUS*)

Cope, Proc. Ac. Nat. Sci. Phila., 1860, p. 246
TYPE: *ochrorhynchus*

Hypsiglena ochrorhyncha Cope

Hypsiglena ochrorhynchus Cope
Proc. Ac. Nat. Sci. Phila., 1860, p. 246.
Hypsiglena ochrorhynchus texana Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 105.
Hypsiglena ochrorhyncha Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 953, fig. 245.

TYPE LOCALITY: Cape St. Lucas, Lower California.
RANGE: Washington, Idaho, south through California, Nevada, and southwestern Texas to Lower California and northwestern Mexico; east through New Mexico to Oklahoma and Kansas.

Trimorphodon (*GENUS*)

Cope, Proc. Ac. Nat. Sci. Phila., 1861, p. 297
TYPE: *lyrophanes*

Trimorphodon lyrophanes (Cope)

Lycodon lyrophanes Cope
Proc. Ac. Nat. Sci. Phila., 1860, p. 343.

Trimorphodon lyrophanes COPE
Proc. Ac. Nat. Sci. Phila., 1861, p. 297.
Trimorphodon lyrophanes COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1102, fig. 314.

TYPE LOCALITY: Cape St. Lucas, Lower California.

RANGE: Southern Utah to Lower California.

Trimorphodon vandenburghi KLAUBER
Trimorphodon vandenburghi KLAUBER
Bull. Zool. Soc. San Diego, Calif., No. 1, June 1, 1924, p. 17.

TYPE LOCALITY: Wildwood Ranch, near Ramona, San Diego County, California, altitude 1520 feet.

RANGE: Inyo County south throughout California.

Trimorphodon vilkinsonii COPE
Trimorphodon vilkinsonii COPE
Proc. Amer. Philos. Soc., Vol. 23, 1885, p. 285.
Trimorphodon vilkinsonii COPE
Ann. Rep. U. S. Nat. Mus. 1898 (1900), p. 1105.

TYPE LOCALITY: City of Chihuahua, Mexico.

RANGE: Chihuahua, Mexico, and extreme western Texas.

Tantilla (*GENUS*)

BAIRD and GIRARD, Cat. N. Amer. Rept., Pt. 1, 1853, p. 131
TYPE: *coronata*

Tantilla atriceps (GÜNTHER)
Homalocranium atriceps GÜNTHER
Biol. Centr. Amer. Rept., 1895, p. 146, pl. 52, fig. B.
Tantilla atriceps BLANCHARD
Field Mus. Chicago, Zool. Ser., Vol. 20, No. 2, 1938, p. 372.

TYPE LOCALITY: Nuevo Leon, Mexico.

RANGE: Oklahoma, Texas, southeastern Arizona to northern Mexico.

Tantilla coronata coronata (BAIRD and GIRARD)
Tantilla coronata BAIRD and GIRARD·
Cat. N. Amer. Rept., Pt. 1, 1853, p. 131.

Tantilla coronata coronata BLANCHARD
Field Mus. Chicago, Zool. Ser., Vol. 20, No. 28, 1938, p. 369.
Tantilla coronata COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1114, fig. 320.

TYPE LOCALITY: Kemper County, Mississippi.

RANGE: Southeastern United States, from Virginia and Kentucky southward, except peninsular Florida.

Tantilla coronata wagneri (JAN)

Homalocranium wagneri JAN
Archiv. Zool. Modena, Vol. 2, 1862, p. 51.
Tantilla coronata wagneri BLANCHARD
Field Mus. Chicago, Zool. Ser., Vol. 20, No. 28, 1938, p. 370.

TYPE LOCALITY: Florida.

RANGE: The peninsula of Florida.

Tantilla eiseni Stejneger

Tantilla eiseni STEJNEGER
Proc. U. S. Nat. Mus., Vol. 18, April 16, 1896, p. 117.

TYPE LOCALITY: Fresno, California.

RANGE: Southern California, and northern Lower California.

Tantilla gracilis BAIRD and GIRARD

Tantilla gracilis BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 132.
Tantilla gracilis COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1111, fig. 318.

TYPE LOCALITY: Indianola, Texas.

RANGE: Central Missouri and eastern Kansas to eastern Texas.

Tantilla nigriceps nigriceps KENNICOTT

Tantilla nigriceps KENNICOTT
Proc. Ac. Nat. Sci. Phila., 1860, p. 328.
Tantilla nigriceps COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1113, fig. 319.
Tantilla nigriceps nigriceps H. M. SMITH
Copeia, July 8, 1941, No. 2, p. 112.

TYPE LOCALITY: Fort Bliss, "New Mexico" [Texas], and Indianola to Nueces, Texas.

RANGE: Southern Colorado, eastern and central Arizona, New Mexico, and Texas.

Tantilla nigriceps fumiceps (Cope)

Scolecophis fumiceps Cope
Proc. Ac. Nat. Sci. Phila., 1860, p. 371.
Tantilla kirnia Blanchard
Field Mus. Chicago, Zool. Ser., Vol. 20, No. 28, 1938, p. 373.
Tantilla nigriceps fumiceps H. M. Smith
Copeia, July 8, 1941, No. 2, p. 112.

TYPE LOCALITY: No definite locality data.

RANGE: Southern Oklahoma southward through eastern Texas.

Tantilla planiceps (Blainville)

Coluber planiceps Blainville
Nouv. Ann. Mus. Hist. Nat. Paris, Vol. 4, 1835, p. 294, pl. 27, figs. 3–3b.
Tantilla planiceps Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1113.

TYPE LOCALITY: California.

RANGE: Cape Region of Lower California.

Tantilla utahensis Blanchard

Tantilla utahensis Blanchard
Field Mus. Chicago, Zool. Ser., Vol. 20, No. 28, 1938, p. 372.

TYPE LOCALITY: St. George, Washington County, Utah.

RANGE: Southwestern Utah westward into the Sierra Nevada Mountains, California.

Tantilla wilcoxi Stejneger

Tantilla wilcoxi Stejneger
Proc. U. S. Nat. Mus., Vol. 25, Sept. 8, 1902, p. 156.

TYPE LOCALITY: Fort Huachuca, Arizona.

RANGE: Southern Arizona.

ELAPIDAE (*FAMILY*)

Micrurus (*GENUS*)

WAGLER in Spix, Serp. Brazil, 1824, p. 48
TYPE: *spixii*

CORAL SNAKES

Micrurus fulvius fulvius (LINNÉ)

Coluber fulvius LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 381.
Micrurus fulvius STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 106.
Elaps fulvius COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1120, figs. 321, 322.

TYPE LOCALITY: California.

RANGE: North Carolina to Florida; the Gulf States and Mississippi Valley States north to extreme southwestern Indiana.

Micrurus fulvius barbouri SCHMIDT

Micrurus fulvius barbouri SCHMIDT
Bull. Antivenin Inst. Amer., Vol. 2, No. 3, Oct. 1928, p. 64.

TYPE LOCALITY: Royal Palm Hammock, Dade County, Florida.

RANGE: Extreme southern Florida.

Micrurus fulvius tenere (BAIRD and GIRARD)

Elaps tenere BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, pp. 22 and 156.
Micrurus fulvius tenere SCHMIDT
Zool. Series, Field Mus. Nat. Hist. Vol. 20, p. 40.

TYPE LOCALITY: San Pedro of Rio Grande and New Braunfels, Texas.

RANGE: Mississippi to northern Tamaulipas, Mexico.

Micruroides (*GENUS*)

SCHMIDT, Bull. Antivenin Inst. Amer., Vol. 2, No. 3, 1928, p. 63
TYPE: *euryxanthus*

Micruroides euryxanthus (KENNICOTT)

Elaps euryxanthus KENNICOTT
Proc. Ac. Nat. Sci. Phila., 1860, p. 337.

Micruroides euryxanthus Schmidt
Bull. Antivenin Inst. Amer., Vol. 2, No. 3, Oct. 1928, p. 63.
Micrurus euryxanthus Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 119.
Elaps euryxanthus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1125, fig. 324.

TYPE LOCALITY: Sonora.

RANGE: Southern New Mexico and Arizona, northern Mexico and Tiburon Island. Swan Falls, southwestern Idaho on the Snake River.

HYDROPHIDAE (*FAMILY*)

Pelamydrus (*GENUS*)

Stejneger, Proc. U. S. Nat. Mus., Vol. 38, 1910, p. 111
TYPE: *platurus*

Pelamydrus platurus (Linné)
Anguis platura Linné
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 391.
Pelamydrus platurus Stejneger
Proc. U. S. Nat. Mus., Vol. 38, 1910, p. 111.

TYPE LOCALITY: Unknown.

RANGE: Tropical Pacific and Indian Oceans; Gulf of Panama and west coast of Central America, Guayaquil, and Gulf of California near Espiritu Santo Island.

CROTALIDAE (*FAMILY*)

Agkistrodon (*GENUS*)

Beauvois, Trans. Amer. Philos, Soc., Vol. 4, 1799, p. 381
TYPE: *mokeson*

Agkistrodon mokeson mokeson (Daudin)
COPPERHEAD
Cenchris mokeson Daudin
Hist. nat. gèn. et part. des rept. Paris F. Dufart, 1803, vol. 5, p. 358, pl. LX, fig. 25; pl. LXX, fig. 3, 4.

Agkistrodon mokasen Stejneger and Barbour
Check List North American Amph. & Rept., 1917, p. 106 (part).
Agkistrodon mokasen cupreus Stejneger and Barbour
Check List N. Amer. Amph. & Rept., Ed. 4, 1939, p. 144.
Agkistrodon mokeson mokeson Gloyd and Conant'
Bull. Chic. Acad. Sci. 1943, 7, no. 2. p. 150, fig. 1. and 7.

TYPE LOCALITY: Vicinity of Philadelphia, Pennsylvania.

RANGE: Upland areas of eastern Oklahoma, eastern Kansas, and southeastern Nebraska, northwestern Arkansas (Ouachita and Ozark plateaus), Missouri (except southeastern part), north to extreme southeastern Iowa, central Illinois, south-central Indiana, southern and eastern Ohio, Pennsylvania, southeastern New York, Connecticut, and eastern Massachusetts; the Appalachian highlands south to northeastern Alabama and the valley of the Tennessee River in Tennessee and Kentucky.

Agkistrodon mokeson austrinus Gloyd and Conant

Agkistrodon mokeson austrinus Gloyd and Conant
Bull. Chic., Acad. Sci. 1943, 7, no. 2, p. 153, figs. 2 and 8.
Agkistrodon mokasen mokasen Stejneger and Barbour
Check List North Amer. Amph. & Rept., ed. 4, 1939, p. 144, (part).

TYPE LOCALITY: Gentilly, Orleans Parish, Louisiana.

RANGE: Lowland areas of the lower Mississippi Valley and the Gulf and Atlantic Coastal Plains from eastern Texas north to southern Illinois, and probably to southern Maryland; not found in peninsular Florida.

Agkistrodon mokeson laticinctus Gloyd and Conant

Agkistrodon mokasen laticinctus Gloyd and Conant
Occ. Papers Mus. Zool. Univ. Mich. 1934, no. 283, p. 2, 1 pl.
Agkistrodon mokasen laticinctus Stejneger and Barbour
Check List N. Amer. Amph. & Rept., Ed. 4, 1939, p. 145 (part).

TYPE LOCALITY: 26 miles northwest of San Antonio, Bexar County, Texas.

RANGE: Central and north-central Texas and central Oklahoma, north to Cowley County, Kansas.

Agkistrodon mokeson pictigaster GLOYD and CONANT

Agkistrodon mokeson pictigaster GLOYD and CONANT
Bull. Chic. Acad. Sci. 1943, 7, no. 2, p. 156, fig. 10.
Agkistrodon mokasen laticinctus STEJNEGER and BARBOUR
Check List N. Amer. Amph. & Rept., Ed. 4, 1939, p. 145 (part).

TYPE LOCALITY: Maple Canyon, Chisos Mountains, elevation 5200 feet, Brewster County, Texas.

RANGE: Southern part of Jeff Davis County and the Chisos Mountains in Brewster County, Texas.

Agkistrodon piscivorus piscivorus (LACÉPÈDE)

COTTON-MOUTH MOCCASIN

Crotalus piscivorus LACÉPÈDE
Hist. nat. des serp. 1789, 2, table méth. p. 130.
Ancistrodon piscivorus COPE
Proc. Ac. Nat. Sci. Phila., 1859, p. 336.
Agkistrodon piscivorus piscivorus STEJNEGER
Ann. Rep. U. S. Nat. Mus., 1893 (1895), p. 406 (part).
Agkistrodon piscivorus piscivorus GLOYD and CONANT
Bull. Chic. Acad. Sci., 1943, 7, no. 2, p. 166, figs. 6, 14 and 16.
Agkistrodon piscivorus STEJNEGER and BARBOUR
Check List N. Amer. Amph. & Rept., Ed. 4, 1939, p. 145 (part).

TYPE LOCALITY: Carolina.

RANGE: Gulf and Atlantic Coastal Plains from southeastern Alabama, throughout Florida (including coastal islands), north to extreme southeastern Virginia.

Sistrurus (*GENUS*)

GARMAN, Mem. Mus. Comp. Zoöl., Vol. 8, No. 3, 1883, p. 110
TYPE: *miliarius*

Sistrurus catenatus catenatus (RAFINESQUE)

MASSASAUGA

Crotalinus catenatus RAFINESQUE
Amer. Month. Mag. Crit. Rev., Vol. 4, No. 1, Nov. 1818, p. 41.
Sistrurus catenatus GARMAN
Mem. Mus. Comp. Zoöl., Vol. 8, No. 3, 1883, p. 176.

Sistrurus catenatus catenatus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1146, fig. 329.

TYPE LOCALITY: Prairies of the upper Missouri.

RANGE: Central New York and Pennsylvania, through Ohio; eastern Kansas and western Missouri northeastward into Michigan, Minnesota, Wisconsin and Ontario.

Sistrurus catenatus edwardsii (Baird and Girard)[1]

Crotalophorus edwardsii Baird and Girard
Cat. N. Amer. Rept., Pt. 1, 1853, p. 15.
Sistrurus catenatus edwardsii Stejneger
Ann. Rep. U. S. Nat. Mus., 1893 (1895), p. 416.
Sistrurus catenatus edwardsii Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1144, fig. 328.

TYPE LOCALITY: Tamaulipas, Mexico.

RANGE: Southeastern Arizona, the valley of the Rio Grande and the Gulf coast of Texas north through southeastern Colorado and central Oklahoma to eastern Kansas and southeastern Nebraska.

Sistrurus miliarius miliarius (Linne)
GROUND RATTLER

Crotalus miliarius Linné
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 372.
Sistrurus miliarius Garman
Mem. Mus. Comp. Zoöl., Vol. 8, No. 3, 1883, p. 177.
Sistrurus miliarius miliarius Gloyd
Occ. Papers Mus. Zool. Univ. Mich., No. 322, Oct. 31, 1935, p. 7.
Sistrurus miliarius Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1141, fig. 327.

TYPE LOCALITY: Carolina.

RANGE: North and South Carolina through the higher coastal plain of Georgia and Alabama.

Sistrurus miliarius barbouri Gloyd

Sistrurus miliarius barbouri Gloyd
Occ. Papers Mus. Zool. Univ. Mich., No. 322, Oct. 31, 1935, p. 2.

---

[1] We prefer the use of this name rather than *tergeminus* of Say as proposed by Klauber and Gloyd. Nothing is gained by making the change, and there is no valid reason for so doing.

TYPE LOCALITY: Royal Palm Hammock, Dade County, Florida.

RANGE: Florida, lower southern coastal plain to the Mississippi Valley.

Sistrurus miliarius streckeri GLOYD

Sistrurus miliarius streckeri GLOYD
Occ. Papers Mus. Zool. Univ. Mich., No. 322, Oct. 31, 1935, p. 4.

TYPE LOCALITY: Imboden, Lawrence County, Arkansas.

RANGE: From western Mississippi and southwestern Tennessee into southeastern Missouri, Arkansas, Oklahoma, Louisiana, to central Texas.

Crotalus (*GENUS*)

LINNÉ, Syst. Nat., Ed. 10, Vol. 1, 1758, p. 214
TYPE: *horridus*

RATTLESNAKES

Crotalus adamanteus BEAUVOIS

DIAMOND-BACK RATTLER

Crotalus adamanteus BEAUVOIS
Trans. Amer. Philos. Soc., Vol. 4, 1799, p. 368.
Crotalus adamanteus adamanteus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1161, fig. 333.

TYPE LOCALITY: United States.

RANGE: Southern North Carolina to Florida, westward along the Gulf on to southern Mississippi, not in Louisiana or Arkansas.

Crotalus atrox (BAIRD and GIRARD)[1]

Crotalus atrox BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 5.
Crotalus atrox atrox BROWN
Proc. Ac. Nat. Sci. Phila., 1901, p. 103.
Crotalus adamanteus atrox COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1164, fig. 334.

TYPE LOCALITY: San Pedro, Texas.

---

[1] Klauber proposes the name *cinereous* Hallowell (Proc. Ac. Nat. Sci. Phila., Vol. 6, No. 5, 1852, pp. 177–182) for this form. The name was an English characterization and was not given or intended to be a specific name.

RANGE: Arkansas, Oklahoma and Texas; Arizona, New Mexico, northern Mexico, Colorado, southern Nevada, southern California, and extreme northeastern California, Tiburon Island.

Crotalus cerastes HALLOWELL

SIDEWINDER

Crotalus cerastes HALLOWELL
Proc. Ac. Nat. Sci. Phila., Vol. 7, 1854, p. 95.
Crotalus cerastes COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1196, fig. 347.

TYPE LOCALITY: Mojave Desert.

RANGE: Northeastern Lower California, southern California, southern Nevada, southern and western Arizona, southwestern Utah.

Crotalus enyo (COPE)

Candisona enyo COPE
Proc. Ac. Nat. Sci. Phila., 1861, p. 293.
Crotalus enyo COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 33.
Crotalus enyo COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1189, fig. 343.

TYPE LOCALITY: Cape St. Lucas, Lower California.

RANGE: Extreme southern Lower California and adjacent islands.

Crotalus exsul GARMAN

Crotalus exsul GARMAN
Mem. Mus. Comp. Zoöl., Vol. 8, No. 3, 1883, p. 114.

TYPE LOCALITY: Cerros Island, Lower California.

RANGE: Cerros Island and perhaps other islands in the Gulf of California.

Crotalus horridus horridus (LINNÉ)

BANDED RATTLESNAKE, BLACK RATTLESNAKE, TIMBER RATTLESNAKE

Crotalus horridus LINNÉ
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 214.

Crotalus horridus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1185, fig. 324.

TYPE LOCALITY: America.

RANGE: From east central Oklahoma, eastern Kansas, southeastern Nebraska, western Arkansas, north to Wisconsin and east to Maine. Not in Louisiana or Texas.

Crotalus horridus atricaudatus (Latreille)

CANEBRAKE RATTLESNAKE

Crotalus atricaudatus Latreille
Hist. Nat. Rept., Vol. 3, Pt. 2, 1802, p. 209.
Crotalus horridus atricaudatus Gloyd
Copeia, 1935, No. 4, Dec. 31, p. 176.

TYPE LOCALITY: Carolina.

RANGE: Southeastern Texas, northward to southeastern Missouri and Jackson County, Illinois, and the southeastern coastal plain, except peninsular Florida.

Crotalus lepidus lepidus (Kennicott)

Caudisona lepida Kennicott
Proc. Ac. Nat. Sci. Phila., 1861, p. 206.
Crotalus lepidus Cope
Proc. Ac. Nat. Sci. Phila., 1883, p. 13.
Crotalus lepidus lepidus Gloyd
Occ. Papers Mus. Zool. Univ. Mich., No. 337, July 7, 1936, p. 4.
Crotalus lepidus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1191, fig. 344.

TYPE LOCALITY: Presidio and Eagle Pass, Texas.

RANGE: El Paso County, Texas.

Crotalus lepidus klauberi Gloyd

Crotalus lepidus klauberi Gloyd
Occ. Papers Mus. Zool. Univ. Mich., No. 337, July 7, 1936, p. 2.

TYPE LOCALITY: Carr Cañon, Huachuca Mountains, Arizona.

RANGE: Southeastern Arizona, southern New Mexico and north central Mexico.

Crotalus lucasensis Van Denburgh

Crotalus lucasensis Van Denburgh
Proc. Calif. Ac. Sci., Ser. 4, Vol. 10, Aug. 6, 1920, p. 29, pl. 3.

Crotalus atrox lucasensis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 133.

TYPE LOCALITY: Agua Caliente, Lower California.

RANGE: Southern Lower California.

Crotalus mitchellii mitchellii (COPE)

Caudisona mitchellii COPE
Proc. Ac. Nat. Sci. Phila., 1861, p. 293.
Crotalus mitchellii COPE
Wheeler's Surv. W. 100 Mer., Vol. 5, 1875, p. 535.
Crotalus mitchellii mitchellii KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 235, fig. 91.
Crotalus mitchellii COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1193, figs. 345, 346.

TYPE LOCALITY: Cape St. Lucas, Lower California.

RANGE: Southern Lower California, Ceralvo, Espiritu Santo, San José, and Santa Margarita Islands.

Crotalus mitchellii pyrrhus (COPE)

Caudisona pyrrha COPE
Proc. Ac. Nat. Sci. Phila., 1866, p. 308.
Crotalus mitchellii pyrrhus KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 236, fig. 92.

TYPE LOCALITY: Fort Whipple, Arizona.

RANGE: Southern California, southern Nevada, western Arizona, northern Lower California, Angel de la Guarda Island, northwestern Sonora.

Crotalus mitchellii stephensi KLAUBER

Crotalus confluentus stephensi KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 6, No. 3, Feb. 28, 1930, p. 108, pl. 10.
Crotalus mitchellii stephensi KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 19, May 29, 1936, p. 162, pl. 20.

TYPE LOCALITY: Panamint Mountains, Inyo County, California.

RANGE: Southwestern Nevada and adjacent areas in eastern California.

Crotalus molossus molossus (BAIRD and GIRARD)

Crotalus molossus BAIRD and GIRARD
Cat. N. Amer. Rept., Pt. 1, 1853, p. 10.
Crotalus molossus molossus KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 249.
Crotalus molossus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1154, fig. 330.

TYPE LOCALITY: Fort Webster, New Mexico.

RANGE: Western Texas to southern Arizona, southern New Mexico to northern Coahuila, and San Esteban Island.

Crotalus ruber (COPE)

Crotalus adamanteus ruber COPE
Proc. U. S. Nat. Mus., Vol. 15, 1892, p. 690.
Crotalus ruber COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1167, fig. 335.
Crotalus atrox elegans STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 133.

TYPE LOCALITY: Southern California.

RANGE: The Californias from Riverside County southward, Angel de la Guarda, Pond, South San Lorenzo, San Marcos and Monserrate Islands.

Crotalus scutulatus (KENNICOTT)

Caudisona scutulata KENNICOTT
Proc. Ac. Nat. Sci. Phila., 1861, p. 207.
Crotalus scutulatus KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 237, fig. 84.
Crotalus adamanteus scutellatus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1158, fig. 332.
Crotalus atrox atrox (part) STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 132.

TYPE LOCALITY: Not stated.

RANGE: Mojave Desert, California, southern Nevada, southwestern Utah, western and southern Arizona, extreme southwestern New Mexico, southern Texas, southward to the Mexican Plateau.

Crotalus tigris KENNICOTT

Crotalus tigris KENNICOTT
in BAIRD, U. S. Mex. Bound. Surv., Vol. 2, 1859, Rept., p. 14, pl. 4.
Crotalus tigris COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1181, fig. 341.

TYPE LOCALITY: Deserts of the Gila and Colorado Rivers, Arizona.

RANGE: Central Arizona southward into Sonora.

Crotalus tortugensis VAN DENBURGH and SLEVIN

Crotalus tortugensis VAN DENBURGH and SLEVIN
Proc. Calif. Ac. Sci., Ser. 4, Vol. 11, Dec. 17, 1921, p. 398.
Crotalus atrox tortugensis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 133.

TYPE LOCALITY: Tortuga Island, Lower California.

RANGE: Same.

Crotalus triseriatus pricei (VAN DENBURGH)

Crotalus pricei VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 2, Vol. 5, 1895, p. 856.
Crotalus triseriatus pricei KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 248, fig. 99.

TYPE LOCALITY: Huachuca Mountains, Arizona.

RANGE: Mountains of southeastern Arizona and northwestern Mexico.

Crotalus viridis viridis RAFINESQUE

PRAIRIE RATTLER

Crotalus viridis RAFINESQUE
Amer. Month. Mag. Crit. Rev., Vol. 4, No. 1, Nov. 1818, p. 41.
Crotalus viridis viridis KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 241, fig. 85.
Crotalus confluentus confluentus COPE
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1170, figs. 336–338.
Crotalus confluentus confluentus STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 133.

TYPE LOCALITY: Upper Missouri River.

RANGE: The Great Plains, from about the 95th Meridian to the Rocky Mountains and from southern Canada to extreme northern Mexico; west through gaps in the Rocky Mountains to eastern Idaho, southeastern Utah, and northeastern Arizona.

Crotalus viridis abyssus (KLAUBER)

Crotalus confluentus abyssus KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 6, No. 3, Feb. 28, 1930, p. 114, pl. 11, fig. 1.
Crotalus viridis abyssus KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 242, fig. 87.

TYPE LOCALITY: Tanner Trail 300 feet below south rim of Grand Canyon, Coconino County, Arizona.

RANGE: Grand Canyon of the Colorado River, Arizona.

Crotalus viridis concolor[1] (WOODBURY)

YELLOW RATTLESNAKE

Crotalus concolor WOODBURY
Bull. Univ. Utah, Vol. 20, No. 6, Dec. 1, 1929 [p. 3], figs. 1–2.
Crotalus viridis concolor KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 242, fig. 89.
Crotalus confluentus concolor STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 134.

TYPE LOCALITY: King's Ranch, Garfield County, near base of Henry Mountains, Utah.

RANGE: The Henry Mountains region, Wayne and Garfield Counties, Utah, southwestern Wyoming, and part of western Colorado.

Crotalus viridis lutosus (KLAUBER)

Crotalus confluentus lutosus KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 6, No. 3, Feb. 28, 1930, p. 100, pl. 10, fig. 1.
Crotalus viridis lutosus KLAUBER
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 242, fig. 88.

---

[1] We do not follow Gloyd in substituting *decolor* for *concolor*. Spec. Publ. No. 4, Chic. Ac. Sci., 1940, p. 216, 217.

Crotalus confluentus lutosus Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 134.

TYPE LOCALITY: 10 miles northwest of Abraham on the road to Joy, Millard County, Utah.

RANGE: Plateau region from the Rockies to the Sierras, including Utah west of the 111th Meridian, northern and central Nevada, northern California east of the Sierras, southeastern Oregon, southern Idaho and south to the northern rim of Grand Canyon in Arizona.

Crotalus viridis nuntius (Klauber)

Crotalus confluentus nuntius Klauber
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 13, Aug. 24, 1935, p. 78.
Crotalus viridis nuntius Klauber
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 242, fig. 89.

TYPE LOCALITY: Cañon Diablo, Coconino County, Arizona.

RANGE: High prairies of northeastern Arizona and southwestern Utah.

Crotalus viridis oreganus (Holbrook)

Crotalus oreganus Holbrook
N. Amer. Herp., Ed. 1, Vol. 4, 1840, p. 115, pl. 29 [= 24].
Crotalus viridis oreganus Klauber
Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 20, Dec. 7, 1936, p. 243, figs. 90, 109, 110.
Crotalus confluentus lucifer Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 1176, fig. 330.
Crotalus confluentus oreganus Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 134.

TYPE LOCALITY: Columbia River.

RANGE: British Columbia to southern California, western Idaho, Nevada, mountains of central and southern Arizona, and northwestern Lower California; also Morro Rock, Catalina and Los Coronados Islands.

Crotalus willardi Meek

Crotalus willardi Meek
Field Columb. Mus. Publ. Zoöl., Vol. 7, No. 1, Jan. 1906, p. 18, pl. 3.

TYPE LOCALITY: Ramsay Canyon, 7,000 feet elevation, Huachuca Mountains, Arizona.

RANGE: Santa Rita Mountain region, Arizona, and northern Mexico.

SYNAPSIDA (*SUBCLASS*)

OSBORN, Science, N. S., Vol. 17, Feb. 13, 1903, p. 276

TESTUDINATA (*ORDER*)

OPPEL, Ordn. Rept., 1811, p. 3

KINOSTERNIDAE (*FAMILY*)

Sternotherus (*GENUS*)

GRAY, Ann. Philos., N. S., Vol. 10, Sept. 1825, p. 211
TYPE: *odoratus*

STINK-POTS, MUSK-TURTLES

Sternotherus carinatus (GRAY)

Aromochelys carinata GRAY
Proc. Zool. Soc. London, 1855 (Jan. 22, 1856), p. 199.
Sternotherus carinatus STEJNEGER
Proc. U. S. Nat. Mus., Vol. 62, art. 6, 1923, p. 2.
Kinosternon carinatum STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 111.

TYPE LOCALITY: Louisiana.

RANGE: Mississippi River drainage, from Arkansas and Oklahoma, south; west into southeastern Texas.

Sternotherus minor (AGASSIZ)

Goniochelys minor AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 424.
Sternotherus minor STEJNEGER
Proc. U. S. Nat. Mus., Vol. 62, art. 6, 1923, p. 2.

TYPE LOCALITY: Mobile, Alabama; Columbus, Georgia; New Orleans, Louisiana.

RANGE: North and Central Florida, south to Lake County, Florida, Georgia, Alabama and upper Tennessee.

Sternotherus odoratus (LATREILLE)

Testudo odorata LATREILLE
Hist. Nat. Rept., Vol. 1, 1801, p. 122.
Sternothaerus odoratus BELL
Zool. Journ., Vol. 2, 1825, p. 307.
Kinosternon odoratum STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 112.

TYPE LOCALITY: Carolina.

RANGE: Eastern and southern North America from Canada south; west to southeastern Kansas, Oklahoma and southern Texas.

Kinosternon (*GENUS*)

SPIX, Testud. Brasil, 1824, p. 17
TYPE: *longicaudatum* = scorpioides

STINK-POTS, MUSK-TURTLES, MUD-TURTLES

Kinosternon baurii baurii (GARMAN)

Cinosternum baurii GARMAN
Bull. Essex. Inst., Vol. 23 ,1891, p. 141.

TYPE LOCALITY: Key West, Florida.

RANGE: Florida.

Kinosternon baurii palmarum STEJNEGER

Kinosternon bauri palmarum STEJNEGER
Journ. Wash. Ac. Sci., Vol. 15, No. 20, Dec. 4, 1925, p. 463.

TYPE LOCALITY: Royal Palm State Park, Dade County, Florida.

RANGE: The Park area only.

Kinosternon flavescens (AGASSIZ)

Platythyra flavescens AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 430; Vol. 2, pl. 5, figs. 12–15.
Cinosternum flavescens COPE
Bull. U. S. Nat. Mus., No. 1, 1875, p. 52.

TYPE LOCALITY: Texas; Arizona.

RANGE: Texas, north to Colorado and Nebraska, west to Arizona and southern Utah; in Illinois River, Illinois, between Mendosia Bay and Peoria.

Kinosternon sonoriense LE CONTE

Kinosternum sonoriense Le Conte
Proc. Ac. Nat. Sci. Phila., 1853, p. 184.

TYPE LOCALITY: Tucson, Arizona.

RANGE: Southwestern Texas through southern New Mexico and Arizona into southeastern California; northern Mexico.

Kinosternon steindachneri SIEBENROCK

Cinosternum steindachneri SIEBENROCK
Zool. Anz., Vol. 30, Oct. 16, 1906, p. 727.
Kinosternon steindachneri STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 155.
Kinosternon subrubrum steindachneri CARR
Univ. Fl. Biol. ser. 3, No. 1, 1940, p. 99.

TYPE LOCALITY: Orlando, Florida.

RANGE: Central and southern Florida.

Kinosternon subrubrum subrubrum[1] (LACÉPÈDE)

Testudo subrubra LACÉPÈDE
Hist. Nat. Quadr. Ovip. Serp., Vol. 1, 1788, synops. méth. tabl. between pp. 618 and 619 (comp. p. 132).
Kinosternon subrubrum subrubrum STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 112.

TYPE LOCALITY: Pennsylvania.

RANGE: Eastern United States from Connecticut south to the northern counties of Florida, west to Indiana, Illinois, and Tennessee.

Kinosternon subrubrum hippocrepis (GRAY)

Kinosternon hippocrepis GRAY
Proc. Zool. Soc. London, 1855 (Jan. 22, 1856), p. 198.

---

[1] This is the species usually known as *Kinosternon pensilvanicum* (Gmelin) 1789. Both names are based on the same figure in Edward's "Glanures."

Kinosternon subrubrum hippocrepis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 112.

TYPE LOCALITY: New Orleans, Louisiana.

RANGE: Southern Alabama to Texas, north in the Mississippi Valley to Oklahoma and southeastern Missouri.

CHELYDRIDAE (*FAMILY*)

Macrochelys (*GENUS*)

GRAY, Proc. Zool. Soc. London, 1855 (Jan. 22, 1856), p. 200
TYPE: *temminckii*

Macrochelys temminckii (TROOST)
ALLIGATOR-SNAPPER

Chelonura temminckii TROOST
in Harlan's Med. Phys. Res., 1835, p. 158, footnote.
Macrochelys temminckii GRAY
Proc. Zool. Soc. London, 1855 (Jan. 22, 1856), p. 200.

TYPE LOCALITY: Tributary stream of the Mississippi above Memphis, in western Tennessee.

RANGE: Texas east to southern Georgia and northwestern Florida, as far south as the Suwanee River drainage system, north in the Mississippi basin to central Illinois.

Chelydra (*GENUS*)

SCHWEIGGER, Königsberg. Arch. Naturw. Math., Vol. 1, 1812, Pt. 3, p. 292
TYPE: *serpentina*

Chelydra serpentina serpentina (LINNÉ)[1]
COMMON SNAPPER

Testudo serpentina LINNÉ
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 199.
Chelydra serpentina SCHWEIGGER
Königsberg. Arch. Naturw. Math., Vol. 1, 1812, Pt. 3, p. 293.

---

[1] Carr reports intergradation with the following in Northern Florida. (Univ. of Fla. Biol. Sci. Series, Vol. III, No. 1, 1940, p. 99.)

Chelydra serpentina serpentina Stejneger
Copeia, 1914, No. 6, May 15 [p. 4].

TYPE LOCALITY: "Warmer regions."

RANGE: Eastern North America, except peninsular Florida, from southern Canada and Nova Scotia to the Gulf of Mexico and west to the Rocky Mountains.

Chelydra serpentina osceola (Stejneger)
FLORIDA SNAPPER

Chelydra osceola Stejneger
Proc. Biol. Soc. Wash., Vol. 31, June 24, 1918, p. 39.
Chelydra serpentina osceola Rust
Blätt. Aquar. Terrarienk., Vol. 45, No. 4, February 1934, p. 59.

TYPE LOCALITY: Clearwater, Pinellas County, Florida.

RANGE: Peninsular Florida.

TESTUDINIDAE (*FAMILY*)

Clemmys (*GENUS*)

Ritgen, Nova Acta Ac. Leopold.-Carol., Vol. 14, Pt. 1, 1828, p. 272
TYPE: *punctata* = *guttata*

Clemmys guttata (Schneider)
SPOTTED TURTLE

Testudo guttata Schneider
Schr. Ges. Naturf. Freunde Berlin, Vol. 10, 1792, p. 264.
Clemmys guttata Strauch
Mém. Ac. Sci. St. Pétersbourg, Ser. 7, Vol. 5, No. 7, 1862, p. 107.

TYPE LOCALITY: Unknown.

RANGE: Eastern North America from Canada and Maine to West Virginia and northern Florida; in northern part west to Wisconsin and north to southern Michigan and Ontario.

Clemmys insculpta (Le Conte)
WOOD-TURTLE

Testudo insculpta Le Conte
Ann. Lyc. Nat. Hist., New York, Vol. 3, 1830, p. 112.
Clemmys insculpta Fitzinger
Ann. Wien Mus., Vol. 1, 1835, p. 124.

TYPE LOCALITY: [Northern] [United] States.

RANGE: Eastern North America from Nova Scotia to Virginia, west to Michigan, Wisconsin, and Iowa; southwestern Ontario. Not found in Ohio, Indiana and Illinois.

Clemmys marmorata (BAIRD and GIRARD)

Emys marmorata BAIRD and GIRARD
Proc. Ac. Nat. Sci. Phila., Vol. 6, 1852, p. 177.
Clemmys marmorata STRAUCH
Mém. Ac. Sci. St. Pétersbourg, Ser. 7, Vol. 5, No. 7, 1862, p. 108.

TYPE LOCALITY: Puget Sound, Washington.

RANGE: Pacific slope from British Columbia to San Diego, California.

Clemmys muhlenbergii (SCHOEPFF)

Testudo muhlenbergii SCHOEPFF
Hist. Testud., Pt. 6, 1801, p. 132, pl. 31.
Clemmys muhlenbergii FITZINGER
Ann. Wien. Mus., Vol. 1, 1835, p. 124.

TYPE LOCALITY: Lancaster, Pennsylvania.

RANGE: New Jersey, Pennsylvania, New York, north to Lakes George, Ontario and Erie, Rhode Island south through Maryland and Virginia to mountains of western North Carolina.

Emys (*GENUS*)

DUMÉRIL, Zool. Anal., 1806, p. 76
TYPE: *europea*

Emys blandingii (HOLBROOK)
BLANDING'S TURTLE

Cistuda blandingii HOLBROOK
N. Amer. Herp., Ed. 1, Vol. 3, 1838, p. 35, pl. 5.
Emys blandingii STRAUCH
Mém. Ac. Sci. St. Pétersbourg, Ser. 7, Vol. 5, No. 7, 1862, p. 28.

TYPE LOCALITY: Fox River, Illinois.

RANGE: Northern Illinois, Indiana and Wisconsin, west and north into Iowa, Minnesota, Michigan and southern Canada; east into Pennsylvania, New England and New Jersey; Long Island.

Terrapene (GENUS)

MERREM, Tent. Syst. Amph., 1820, p. 27
TYPE: *clausa* = carolina

BOX-TURTLES

Terrapene bauri TAYLOR[1]

Terrapene bauri TAYLOR
Proc. U. S. Nat. Mus., Vol. 17, May 11, 1895, p. 576.

TYPE LOCALITY: Florida.

RANGE: Peninsular Florida.

Terrapene carolina (LINNÉ)[1]

Testudo carolina LINNÉ
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 198.
Terrapene carolina BELL
Zool. Journ., Vol. 2, 1825, p. 309.

TYPE LOCALITY: Carolina.

RANGE: Eastern United States from Maine to Georgia, west to Tennessee, southern Illinois, and northwards to southern Wisconsin and central Michigan.

Terrapene major (AGASSIZ)[1]

Cistudo major AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 445.
Terrapene major BAUER
Science, Vol. 17, April 3, 1891, p. 190.

TYPE LOCALITY: Mobile, Alabama; Florida.

RANGE: Northern Florida and southern Georgia, west into southeastern Texas.

Terrapene ornata (AGASSIZ)

Cistudo ornata AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 445.
Terrapene ornata BAUR
Science, Vol. 17, April 3, 1891, p. 191.

---

[1] The Junior author inclines to agree with Carr in the arrangement proposed (Univ. of Fla. Biol. Sci. Series, Vol. III, No. 1, Jan. 1940, p. 100–101). He has himself collected intergrades—or hybrids—in the areas Carr outlines.

TYPE LOCALITY: The Upper Missouri, and Iowa.

RANGE: Territory between the Rocky Mountains and the Mississippi and Missouri Rivers, north to the Yellowstone River, east into Iowa, western Wisconsin, Illinois and Indiana, south to the Gulf of Mexico; southwest into New Mexico, southern Arizona and northern Mexico.

Terrapene triunguis (Agassiz)

Cistudo triunguis Agassiz
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 445.
Terrapene triunguis Baur
Amer. Nat., Vol. 27, July 1893, p. 677.

TYPE LOCALITY: New Orleans, Louisiana.

RANGE: Coastal plain except peninsular Florida, from southern South Carolina and southeastern Texas, north in the Mississippi basin to Missouri, west into eastern Kansas, Oklahoma and Texas.

Malaclemys (*GENUS*)

Gray, Cat. Tort. Brit. Mus., 1844, p. 28
TYPE: *concentrica*

DIAMOND-BACK TERRAPINS

Malaclemys centrata centrata (Latreille)

Testudo centrata Latreille
Hist. Nat. Rept., Vol. 1, 1802, p. 145.
Malaclemys centrata Loennberg
Proc. U. S. Nat. Mus., Vol. 17, Nov. 15, 1894, p. 319.

TYPE LOCALITY: Carolina.

RANGE: Coast strip from neighborhood of Cape Hatteras, south to Florida.

Malaclemys centrata concentrica (Shaw)

Testudo concentrica Shaw
Gen. Zool., Vol. 3, 1802, p. 43, pl. 9.
Malaclemmys centrata concentrica W. P. Hay
Bull. U. S. Bur. Fish., Vol. 24, 1904, p. 16.

TYPE LOCALITY: Philadelphia markets.

RANGE: Coast strip from Buzzards Bay to North Carolina, Delaware and Chesapeake Bays.

Malaclemys pileata pileata (WIED)

Emys pileata WIED
Nova Acta Ac. Leopold.-Carol., Vol. 32, 1865, p. 17, pl. 1, figs. 2, 3.
Malaclemmys pileata W. P. HAY
Bull. U. S. Bur. Fish., Vol. 24, 1904, p. 17.

TYPE LOCALITY: New Orleans, Louisiana.

RANGE: Coast from mouth of Mississippi River eastwards to Florida.

Malaclemys pileata littoralis (W. P. HAY)

Malaclemmys littoralis W. P. HAY
Bull. U. S. Bur. Fish., Vol. 24, 1904, p. 18, pls. 8, 9, 12, figs. 2, 3.
Malaclemys pileata littoralis STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 117.

TYPE LOCALITY: Rockport, Texas.

RANGE: Coast of Texas and outlying islands.

Malaclemys pileata macrospilota (W. P. HAY)

Malaclemmys macrospilota W. P. HAY
Bull. U. S. Bur. Fish., Vol. 24, 1904, p. 16, pls. 6, 7, 11, fig. 1.
Malaclemys pileata macrospilota STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 117.

TYPE LOCALITY: Charlotte Harbor, Florida.

RANGE: Western coast of Florida.

Graptemys (*GENUS*)

AGASSIZ, Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 436
TYPE: *geographica*

MAP-TURTLES

Graptemys barbouri CARR and MARCHAND

Graptemys barbouri CARR and MARCHAND
Proc. N. Engl. Zool. Club, Vol. 20, Sept. 12, 1942, p. 98, pls. 14, 15.

TYPE LOCALITY: Chipola River, near Marianna, Jackson County, Florida.

RANGE: Chipola River, Jackson and Calhoun Counties, Florida.

Graptemys geographica (LE SUEUR)

Testudo geographica LE SUEUR
Journ. Ac. Nat. Sci. Phila., Vol. 1, Pt. 1, 1817, p. 86, pl. 5.
Graptemys geographica AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 436.

TYPE LOCALITY: Marsh on the border of Lake Erie.

RANGE: Mississippi Valley north to Iowa, southern Wisconsin, Illinois, southern Michigan, east to Pennsylvania and New York, Canada north to Ottawa River, shores of Lake Ontario, Vermont, Lake George and Lake Champlain; eastern Tennessee and southwestern Virginia, west to eastern Kansas, southwestern Missouri, eastern Oklahoma, and eastern Texas.

Graptemys oculifera (BAUR)

Malaeoclemmys oculifera BAUR
Science, Vol. 16, No. 7, 1890, p. 262.
Graptemys oculifera BAUR
Amer. Nat., Vol. 27, July, 1893, p. 675.
Graptemys pseudogeographica oculifera STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 145.

TYPE LOCALITY: Mandeville, Louisiana.

RANGE: Southern Louisiana, west into Texas.

Graptemys pseudogeographica pseudogeographica (GRAY)

Emys pseudogeographica GRAY
Syn. Rept., 1831, p. 31 ("Le Sueur" in synonymy).
Graptemys pseudogeographica GRAY
Ann. Mag. Nat. Hist., Ser. 3, Vol. 12, Sept. 1863, p. 180.

TYPE LOCALITY: Wabash River, New Harmony, Indiana.

RANGE: Mississippi Valley, east to Alabama and Ohio, north to Wisconsin and northern Iowa, west to eastern Kansas and Oklahoma.

Graptemys pseudogeographica kohnii (BAUR)

Malaeoclemmys kohnii BAUR
Science, Ser. 1, Vol. 16, Nov. 7, 1890, p. 263.

Graptemys pseudogeographica kohnii STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 117.

TYPE LOCALITY: Bayou Lafourche, B. Teche, and St. Martinsville, Louisiana.

RANGE: Gulf strip from Pensacola to eastern Texas.

Graptemys pseudogeographica versa STEJNEGER

Graptemys pseudogeographica versa STEJNEGER
Journ. Wash. Ac. Sci., Vol. 15, No. 20, Dec. 1925, p. 463.

TYPE LOCALITY: Austin, Texas.

RANGE: Recorded from type locality and southern fork of Llano River, northeastern Edwards County, Texas.

Chrysemys (*GENUS*)

GRAY, Cat. Tort. Brit. Mus., 1844, p. 27
TYPE: *picta*

PAINTED TURTLES, SOLDIER TURTLES

Chrysemys bellii bellii (GRAY)

Emys bellii GRAY
Syn. Rept., 1831, p. 31.
Chrysemys bellii bellii RUTHVEN
Science, Vol. 59, Apr. 11, 1924, p. 340.
Chrysemys marginata bellii STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 134.
Chrysemys marginata treleasi STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 124.

TYPE LOCALITY: Unknown.

RANGE: From western Illinois, southern Wisconsin and the Mississippi, northwest into Washington and British Columbia east of Cascade Mountains, southwest into New Mexico and Texas.

Chrysemys bellii marginata (AGASSIZ)

Chrysemys marginata AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 439; Vol. 2, pl. 1, fig. 6, pl. 5 figs. 1–4.
Chrysemys bellii marginata RUTHVEN
Science, Vol. 59, Apr. 11, 1924, p. 340.

Chrysemys marginata marginata Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 133.

TYPE LOCALITY: Wisconsin, Michigan, Indiana, Iowa.

RANGE: From the Allegheny Mountains west through southern Ontario, southern Michigan, Ohio, Indiana, eastern Illinois, southern Wisconsin, Kentucky, and Tennessee.

Chrysemys picta picta (Schneider)

Testudo picta Schneider
Naturg. Schildkr., 1783, p. 348.
Chrysemys picta (part) Gray
Cat. Shield Rept. Brit. Mus., Pt. 1, March 8, 1856, p. 32.
Chrysemys picta picta Bishop and Schmidt
Field Mus. Nat. Hist. Zool. Ser., Vol. 18, No. 4, 1931, p. 136.

TYPE LOCALITY: Unknown, said to have been England.

RANGE: Eastern North America from New Brunswick to Florida.

Chrysemys picta dorsalis (Agassiz)

Chrysemys dorsalis Agassiz
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 440.
Chrysemys picta dorsalis Bishop and Schmidt
Field Mus. Nat. Hist. Zool. Ser., Vol. 18, No. 4, 1931, p. 136.
Chrysemys marginata dorsalis Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 2, 1923, p. 134.

TYPE LOCALITY: Mississippi and Louisiana.

RANGE: Mississippi Valley north to southern Illinois.

Pseudemys (*GENUS*)

Gray, Proc. Zool. Soc. London. 1855 (Jan. 22, 1856), p. 197
TYPE: *concinna*

SLIDERS OR COOTERS

Pseudemys alabamensis (Baur)[1]

Pseudemys alabamensis Baur
Proc. Amer. Philos. Soc., Vol. 31, July 1893, p. 224.
Pseudemys rubriventris alabamensis Barbour and Stejneger
Check List No. Amer. Amph .and Rept., Ed. 4, 1939, p. 166.

---

[1] See Carr, Occ. Papers, Boston Soc. Nat. Hist., Vol. 8, June 9, 1938, p. 306 footnote.

TYPE LOCALITY: Mobile Bay, Alabama

RANGE: Gulf coast from northwestern Florida to Louisiana.

Pseudemys bangsi Babcock

Pseudemys rubriventris bangsi Babcock
Occ. Papers Boston Soc. Nat. Hist., Vol. 8, 1937, p. 293.

TYPE LOCALITY: Boot Pond, Plymouth County, Massachusetts.

RANGE: Eleven ponds, all in Plymouth County, Massachusetts.

Pseudemys concinna concinna (Le Conte)

Testudo concinna Le Conte
Ann. Lyc. Nat. Hist. New York, Vol. 3, 1830, p. 106.
Pseudemys concinna Gray
Cat. Shield Rept. Brit. Mus., Pt. 1, 1856, p. 34.

TYPE LOCALITY: Rivers of Georgia and Carolina above Augusta and Columbia.

RANGE: East of the Alleghenies, from Maryland and south to Alabama.

Pseudemys concinna hieroglyphica (Holbrook)

Emys hieroglyphica Holbrook
N. Amer. Herp., Ed. 1, Vol. 1, 1836, p. 47, pl. 2.
Pseudemys hieroglyphica Gray
Ann. Mag. Nat. Hist., Ser. 3, Vol. 12, Sept. 1863, p. 182.

TYPE LOCALITY: Cumberland River, Tennessee.

RANGE: West of the Alleghenies, from southern Indiana and Illinois, Kentucky and Tennessee to the Mississippi.

Pseudemys concinna hoyi (Agassiz)

Ptychemys hoyi Agassiz
Contr. Nat. Hist. U. S., Vol. 1, 1851, p. 433.
Pseudemys concinna hoyi Stejneger
Proc. Biol. Soc. Wash., Vol. 51, Aug. 23, 1938, p. 175.

TYPE LOCALITY: Southwestern Missouri.

RANGE: Southeastern Kansas, Missouri south of the Missouri River, Arkansas, northern Louisiana, Oklahoma and northeastern Texas.

Pseudemys concinna mobilensis (Holbrook)

Emys mobilensis Holbrook
N. Amer. Herp., Ed. 1, Vol. 2, 1838, p. 53, pl. 9.
Pseudemys mobilensis True
Bull. U. S. Nat. Mus., No. 24, 1883, p. 32.

TYPE LOCALITY: Mobile, Alabama.

RANGE: Gulf coast from Florida to eastern Texas.

Pseudemys concinna suwannensis (Carr)

Pseudemys floridana suwannensis Carr
Occ. Papers Mus. Zool. Univ. Mich., No. 348, 1937, p. 4, pl. 1.

TYPE LOCALITY: Suwannee River at Manatee Springs, Levy-Dixie County Line, Florida.

RANGE: "Rivers of the Gulf drainage and coastal waters in Florida from Citrus and Sumter Counties to Appalachicola."

Pseudemys floridana floridana (Le Conte)

Testudo floridana Le Conte
Ann. Lyc. Nat. Hist. New York, Vol. 3, 1830, p. 100.
Pseudemys floridana Baur
Proc. Amer. Philos. Soc., Vol. 31, 1893, p. 223.
Pseudemys floridana floridana Carr
Copeia, 1935, No. 3, Oct. 15, p. 147.

TYPE LOCALITY: St. John's River, Florida.

RANGE: "Coastal plain from North Carolina to Alabama and northern Florida."

Pseudemys floridana peninsularis Carr[1]

Pseudemys floridana peninsularis Carr
Copeia, 1938, No. 3, Sept. 24, p. 105

TYPE LOCALITY: Crystal Springs, Pasco County, Florida.

RANGE: "Peninsular Florida, from southern Marion County to Key Largo."

Pseudemys gaigeae (Hartweg)

Pseudemys scripta gaigeae Hartweg
Occ. Papers Mus. Zool., No. 397, Dec. 7, 1938, pp. 1–4.

---

[1] Carr has proposed a somewhat different arrangement. Copeia, 1938, No. 3, Sept. 24, f. 107. Which the junior author rather prefers.

TYPE LOCALITY: Boquillas Rio Grande River, Brewster County, Texas.

RANGE: Brewster County, Texas.

Pseudemys nebulosa (VAN DENBURGH)

Chrysemys nebulosa VAN DENBURGH
Proc. Calif. Ac. Sci., Ser. 2, Vol. 5, 1895, p. 83, pl. 4–6.
Pseudemys ornata nebulosa STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 120.
Pseudemys ornata nebulosa STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 165.

TYPE LOCALITY: Los Dolores, abreast of San José Island, Lower California.

RANGE: Southern Lower California.

Pseudemys nelsoni CARR

Pseudemys nelsoni CARR
Occ. Papers Boston Soc. Nat. Hist., Vol. 8, 1938, p. 307.

TYPE LOCALITY: Fellsmere, Indian River County, Florida.

RANGE: Peninsular Florida.

Pseudemys rubriventris (LE CONTE)

Testudo rubriventris LE CONTE
Ann. Lyc. Nat. Hist. New York, Vol. 3, 1830, p. 101.
Pseudemys rubriventris JORDAN
Man. Vertebr. Anim. North. U. S., Ed. 8, 1899, p. 209.
Pseudemys rubriventris rubriventris BABCOCK
Occ. Papers Boston Soc. Nat. Hist., Vol. 8, 1937, p. 293.
Pseudemys rubriventris rubriventris STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 4, 1939, pp. 165–166.

TYPE LOCALITY: Delaware River, near Trenton, New Jersey.

RANGE: Atlantic coast from northeastern Florida to Long Island, New York.

Pseudemys scripta (SCHOEPFF)[1]

Testudo scripta SCHOEPFF
Hist. Testud., Pts. 1–2, 1792, p. 16, pl. 3, figs. 4, 5.

---

[1] Cf. Carr, Herpetologica, Vol. 1, No. 3, July 15, 1937, p. 75, pl. 7.

Pseudemys scripta Jordan
Man. Vertebr. Anim. North. U. S., Ed. 8, 1899, p. 209.
TYPE LOCALITY: Unknown.
RANGE: Northern Florida to Princess Anne County, Virginia.

Pseudemys texana Baur
Pseudemys texana Baur
Proc. Amer. Philos. Soc., Vol. 31, July, 1893, p. 223.
TYPE LOCALITY: San Antonio, Texas.
RANGE: Southwestern Texas.

Pseudemys troostii troostii (Holbrook)[1]
Emys troostii Holbrook
N. Amer. Herp., Ed. 1, Vol. 1, 1836, p. 55, pl. 4.
TYPE LOCALITY: Cumberland River, Tennessee.
RANGE: Upper reaches of Cumberland and Tennessee Rivers.

Pseudemys troostii elegans (Wied)
Emys elegans Wied
Reise Nord-Amer., Vol. 1, Pt. 4, 1838, p. 213.
Pseudemys elegans Cope
Bull. U. S. Nat. Mus., No. 1, 1875, p. 53.
TYPE LOCALITY: Fox River at New Harmony, Indiana.
RANGE: Mississippi basin north to Kansas, Iowa, northern Indiana and Illinois, southeastern Ohio, Tennessee, south through Louisiana and Texas to the Gulf and northeastern Mexico.

Deirochelys (*GENUS*)

Agassiz, Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 441
TYPE: *reticulata* = reticularia

Deirochelys reticularia (Latreille)
CHICKEN-TURTLE
Testudo reticularia Latreille
Hist. Nat. Rept., Vol. 1, 1801, p. 124.

---

[1] *Emys troostii* of Holbrook, 1836, is apparently the melanistic phase of Holbrook's later *Emys cumberlandensis* (N. Amer. Herp., Ed. 1, Vol. 4, 1840, p. 55, pl. 8; type locality — Cumberland River, Tennessee; Professor Troost, collector).

Deirochelys reticularia (part) Gray
Suppl. Cat. Shield Rept. Brit. Mus., Pt. 1, 1870, p. 39.

TYPE LOCALITY: "Carolina." (Based on a drawing sent by Bosc, French Consul at Charleston, S. C.)

RANGE: Coastal plain from Beaufort, North Carolina, to and including the Mississippi alluvial plain; north to Oklahoma; south to southern Florida; west to Texas.

Gopherus (*GENUS*)

Rafinesque, Atlantic Journ., Vol. 1, No. 2, 1832, p. 64
TYPE: *polyphemus*

GOPHER-TURTLES

Gopherus agassizii (Cooper)

Xerobates agassizii Cooper
Proc. Calif. Ac. Sci., Vol. 2, 1863, p. 120.
Gopherus agassizii Stejneger
N. Amer. Fauna, No. 7, May 31, 1893, p. 161.

TYPE LOCALITY: Mountains near Fort Mojave, California.

RANGE: Deserts of southwestern Arizona, and southeastern California into Nevada and Utah; south into Sonora; Tiburon Island, Lower California.

Gopherus berlandieri (Agassiz)

Xerobates berlandieri Agassiz
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 447; Vol. 2, pl. 3, figs. 17–19.
Gopherus berlandieri Stejneger
N. Amer. Fauna, No. 7, May 31, 1893, p. 161.

TYPE LOCALITY: Brownsville, Cameron County, Texas.

RANGE: Southwestern corner of Texas into northeastern Mexico.

Gopherus polyphemus (Daudin)[1]

Testudo polyphemus Daudin
Hist. Nat. Rept., Vol. 2, 1803, p. 258.
Gopherus polyphemus Stejneger
N. Amer. Fauna, No. 7, May 31, 1893, p. 161.

---

[1] Harper (Amer. Midland Natl., Vol. 23, 1940, p. 644 et seq.) would change the authority to Bartram (Travels, 1791, p. 18-182-3) but obviously writing from memory he confuses this species with a Terapene and his binominal is a purely fortuitous one.

TYPE LOCALITY: Savannah and Altamaha Rivers, Georgia.
RANGE: Coast from southern South Carolina to Florida and the Mississippi River north into southern Arkansas.

CHELONIIDAE (*FAMILY*)

Chelonia (*GENUS*)

LATREILLE, Hist. Nat. Rept., Vol. 1, 1801, p. 22
TYPE: *mydas*

GREEN-TURTLES

Chelonia agassizii BOCOURT
Chelonia agassizii BOCOURT
Ann. Sci. Nat., Ser. 5, Zool., Vol. 10, Pts. 1–3, 1868, p. 122.
TYPE LOCALITY: Guatemala, mouth of Nagualate in the Pacific.
RANGE: Pacific Ocean, north to coasts of Lower California and southern California.

Chelonia mydas (LINNÉ)
Testudo mydas LINNÉ
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 197.
Chelonia mydas SCHWEIGGER
Königsberg. Arch. Naturw. Math., Vol. 1, 1812, Pt. 3, p. 412.
TYPE LOCALITY: Ascension Island, etc.
RANGE: Atlantic Ocean; Gulf of Mexico, occasionally as far north as Massachusetts.

Eretmochelys (*GENUS*)

FITZINGER, Syst. Rept., 1843, p. 30
TYPE: *imbricata*

SHELL-TURTLES, HAWKS-BILLS

Eretmochelys imbricata (LINNÉ)
Testudo imbricata LINNÉ
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 350.

Eretmochelys imbricata AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 381.

TYPE LOCALITY: American seas.

RANGE: Florida and Gulf coasts; occasionally as far north as Massachusetts.

Eretmochelys squamata AGASSIZ

Eretmochelys squamata AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 382.
Eretmochelys squamosa STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 3, 1933, p. 151.

TYPE LOCALITY: Indian and Pacific Oceans.

RANGE: Pacific Ocean; coast of Lower California.

Caretta (*GENUS*)

RAFINESQUE, Specchio Sci., Palermo, Vol. 2, No. 9, Sett. 1, 1814, p. 66
TYPE: *nasuta* = caretta

LOGGERHEAD TURTLES

Caretta caretta (LINNÉ)

Testudo caretta LINNÉ
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 197.
Caretta caretta STEJNEGER
Ann. Rep. U. S. Nat. Mus., 1902 (1904), p. 715.

TYPE LOCALITY: "About the American Islands."

RANGE: Atlantic Ocean, breeding as far north as Beaufort, North Carolina; north occasionally to coast of Massachusetts.

Lepidochelys (*GENUS*)

FITZINGER, Syst. Rept., 1843, p. 30
TYPE: *olivacea*

THE RIDLEY

Lepidochelys kempii (GARMAN)
RIDLEY, BASTARD-TURTLE

Thalassochelys (Colpochelys) kempii GARMAN
Bull. Mus. Comp. Zoöl., vol. 6, 1880, p. 123.

Lepidochelys kempii Baur
Amer. Natural., vol. 24, 1890, p. 487.
Caretta kempii Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 170.

TYPE LOCALITY: Gulf of Mexico.

RANGE: Northern part of Gulf of Mexico north to Cape Hatteras, and accidentally, to the coast of Massachusetts, the Azores, and the coast of Ireland.

Lepidochelys olivacea (Eschscholtz)

Chelonia olivacea Eschscholtz
Zool. Atlas, Pt. 1, 1829, p. 2, pl. 3.
Lepidochelys olivacea Girard
Herpet. U. S. Expl. Exped., 1858, p. 435.
Caretta olivacea Stejneger and Barbour
Check List N. Amer. Amph. Rept., Ed. 4, 1939, p. 170.

TYPE LOCALITY: Manila Bay, Philippine Islands.

RANGE: Tropical Pacific and Indian Oceans; West Coast of Mexico, straggling to the Californian Coast.

DERMOCHELIDAE (*FAMILY*)

Dermochelys (*GENUS*)

Blainville, Bull. Soc. Philom. Paris, 1816, p. 111 bis [= 119]
TYPE: *coriacea*

Dermochelys coriacea (Linné)

Testudo coriacea Linné
Syst. Nat., Ed. 12, Vol. 1, 1766, p. 350.
Dermochelys coriacea Boulenger
Cat. Chel. Brit. Mus., 1889, p. 10.

TYPE LOCALITY: Mediterranean Sea.

RANGE: Atlantic Ocean; occasionally on entire coast as far north as Nova Scotia.

Dermochelys schlegelii (Garman)

Sphargis coriacea var. *schlegelii* Garman
Bull. U. S. Nat. Mus., No. 25, 1884, p. 303.

Dermochelys schlegelii STEJNEGER
Bull. U. S. Nat. Mus., No. 58, 1907, p. 485.

TYPE LOCALITY: Tropical Pacific and Indian Ocean.

RANGE: Tropical Pacific Ocean; coasts of Lower California and southern California, north to British Columbia.

TRIONYCHIDAE (*FAMILY*)

Amyda (*GENUS*)

SCHWEIGGER in Geoffroy, Ann. Mus. Hist. Nat. Paris, Vol. 14, 1809, p. 1
TYPE: *javanicus* = cartilagineus

SOFT-SHELLED TURTLES

Amyda agassizii (BAUR)
Platypeltis agassizii BAUR
Amer. Nat., Vol. 22, 1888, p. 1121.

TYPE LOCALITY: Georgia.

RANGE: Rivers of Georgia and South Carolina; North into southern North Carolina.

Amyda emoryi (AGASSIZ)
Aspidonectes emoryi AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 407; Vol. 2, pl. 6, figs. 4, 5.
Amyda emoryi STEJNEGER and BARBOUR
Check List N. Amer. Amph. Rept., Ed. 1, 1917, p. 124.

TYPE LOCALITY: Rio Grande River, near Brownsville, Texas.

RANGE: Rivers of Texas, north into southern Oklahoma and Arkansas, west (introduced?) to southeastern California, the adjacent portion of Lower California, and Clark County, Nevada; east to western Louisiana; northern Mexico.

Amyda ferox (SCHNEIDER)
Testudo ferox SCHNEIDER
Naturg. Schildkr., 1783, p. 330.
Amyda ferox OKEN
Lehrb. Zool., Vol. 2, 1816, p. 348.

TYPE LOCALITY: Savannah River, Georgia.

RANGE: Florida north to South Carolina and west along Gulf Coast to Louisiana.

Amyda mutica (LE SUEUR)

Trionyx muticus LE SUEUR
Mém. Mus. Hist. Nat. Paris, Vol. 15, 1827, p. 263, pl. 7.
Amyda mutica AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 399.

TYPE LOCALITY: Wabash River at New Harmony, Indiana.

RANGE: Mississippi River and tributaries; north to South Dakota and Minnesota; east to western Pennsylvania; west to Kansas, Oklahoma and Texas. Recorded from northern localities on the Trinity, Brazos and Colorado Rivers.

Amyda spinifera spinifera (LE SUEUR)

Trionyx spiniferus LE SUEUR
Mém. Mus. Hist. Nat. Paris, Vol. 15, 1827, p. 258, pl. 6.
Amyda spinifera HURTER
Trans. Ac. Sci. St. Louis, Vol. 20, 1911, p. 251.

TYPE LOCALITY: Wabash River at New Harmony, Indiana.

RANGE: Mississippi River and tributaries, west to Colorado, north to Montana; St. Lawrence River and tributaries; east to Vermont, western New York, and Pennsylvania.

Amyda spinifera aspera (AGASSIZ)

Aspidonectes asper AGASSIZ
Contr. Nat. Hist. U. S., Vol. 1, 1857, p. 405.

TYPE LOCALITY: Lake Concordia, Louisiana.

RANGE: Lower Mississippi tributaries in Louisiana and Mississippi, rivers of eastern Mississippi and Alabama.

INTRODUCED FORMS

Hyla septentrionalis BOULENGER

Hyla septentrionalis BOULENGER
Cat. Batr. Sal. Brit. Mus., 1882, p. 368.

TYPE LOCALITY: Cuba and San Domingo. [Restricted to Cuba.]

RANGE: Cuba, Bahama Islands. (Now common in Key West, and Lower Matacumbe Key, Florida.)

Eleutherodactylus ricordii (Duméril and Bibron)

Hylodes ricordii Duméril and Bibron
Erp. Gén., Vol. 8, 1841, p. 623.
Eleutherodactylus ricordii Stejneger
Shattuck's Bahama Islands, 1905, p. 331.
Lithodytes ricordii Cope
Bull. U. S. Nat. Mus., No. 34, 1889, p. 318.

TYPE LOCALITY: Cuba.

RANGE: Bahama Islands, Cuba. (Florida, north to Alachua County, probably accidentally introduced.)

Gonatodes fuscus (Hallowell)

Stenodactylus fuscus Hallowell
Journ. Ac. Phila., (2), iii, 1855, p. 33.
Gonatodes albogularis var. *fuscus* Bou.
Cat. Lizards, 1, 1885, p. 59.
Gonatodes fuscus Carr
Copeia, 1939, No. 4, p. 232.

TYPE LOCALITY: Nicaragua.

RANGE: Colombia; Central America; West Indies; Key West; Florida.

Hemidactylus turcicus (Linne)

Lacerta turcica Linné
Syst. Nat., Ed. 10, Vol. 1, 1758, p. 202.
Hemidactylus turcicus Boettger
Ber. Offenbach. Ver. Naturk., 1876, p. 57.

TYPE LOCALITY: In Oriente.

RANGE: Borders of Red and Mediterranean Seas, northwestern India. (Key West and the Miami area, Florida.)

Sphaerodactylus cinereus Wagler

Sphaerodactylus cinereus Wagler
Syst. Amph., 1830, p. 143.

TYPE LOCALITY: Haiti.

RANGE: Haiti, Cuba, Isla de Pinos, Key West and Key Largo, Florida.

Sphaerodactylus notatus Baird

Sphaerodactylus notatus Baird
Proc. Ac. Nat. Sci. Phila., 1858, p. 254.
Sphaerodactylus notatus Cope
Ann. Rep. U. S. Nat. Mus., 1898 (1900), p. 462, fig. 85.

TYPE LOCALITY: Key West, Florida.

RANGE: Bahama Islands, Cuba, also southern Florida and the Keys (perhaps introduced by commerce).

Leiocephalus carinatus virescens (Stejneger)

Leiocephalus virescens Stejneger
Proc. U. S. Nat. Mus., Vol. 23, 1900, p. 471.
Leiocephalus carinatus virescens Barbour
Bull. Mus. Comp. Zool., Vol. 82, No. 2, 1937, p. 135.

TYPE LOCALITY: Green Key, Bahamas.

RANGE: Same. (See Barbour, Copeia, 1936, No. 2, July 31, p. 113. Miami, Florida.)

INDEX

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
Vol. XCIII, No. 2

THE ANTS OF THE IMATONG MOUNTAINS, ANGLO-EGYPTIAN SUDAN

By Neal A. Weber

With Sixteen Plates

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
December, 1943

No. 2—*The Ants of the Imatong Mountains, Anglo-Egyptian Sudan*

By Neal A. Weber

CONTENTS

Part I Biology

Part II Taxonomy

PART I—BIOLOGY

INTRODUCTION

Rising out of the Central African plain a few degrees on both sides of the Equator and extending to the eastern boundary of West Africa is a series of isolated mountain masses rising 10,000 to 19,317 feet above sea level. These include the snow-capped peaks of Ruwenzori (16,791 feet), Kenya (17,040 feet) and Kilimanjaro (19,317 feet). The life on several of these has been comparatively well studied and there are a number of ant records.

A mountain mass of this region which has but recently been known is that of the Imatong Mountains in the Anglo-Egyptian Sudan. These, highest (10,458 feet) in the Sudan, lie across Latitude 4° North and extend just over the Uganda frontier (Plates 1, 2). The first map to refer to the Imatongs by name was issued as recently as 1929 (Chipp, 1929, p. 177). No white man had visited them until similarly recent years. Only the lower slopes are inhabited and these by natives of the Lango, Latuka and Acholli tribes. On a safari July and August 1939 with the Economic Botanist of the Sudan, Dr. J. G. Myers, I was able to study and collect the ant and other faunas.

Early in the safari it became evident that the ants were confined to well defined zones of altitude and plant life. Altitudes were determined partly by reference to the largest and latest official Sudan contour map and partly by the use of an aneroid barometer which had been officially calibrated in Khartoum. After leaving Africa the collections were studied briefly in the British Museum (Natural History) and more intensively in the Museum of Comparative Zoölogy, American Museum of Natural History and United States National Museum with particular reference to the relationships of the ant species. The studies in the American museums were made through grants from the American Academy of Arts and Sciences and the American Philosophical Society. I am also indebted to the authorities of these museums and the British Museum for facilities for work and courtesies extended. The following study has thus been made from two points of view, distribution of the ants with reference to plant zones and altitude, and the origin of the ant fauna. The latter study unfortunately has been hampered by the scarcity of identified African ants in the United States and the incomplete descriptions in the literature. What was learned of the general biology of the species in the limited time available is included since in practically all cases it represents everything recorded on the biology of the species and in the few other cases additional information on known species from a country (Anglo-Egyptian Sudan) whose ant fauna has hardly been touched. Also given under each species are its affinities or, if a known species, its range in Africa.

The first compilation of the mountain ants of the world has been included. Though on equatorial mountains the temperate fauna may start at 1500 meters (4920 feet)[1] only the ants listed from 2000 meters (6560 feet) are given. This arbitrarily selected altitude tends to eliminate tropical ants ranging above their usual zone where local or edaphic conditions, such as a warm, dry and sunny south slope, may permit such an extension. Some of the ants on tropical mountains at the 2000 meter elevation, however, are unusually adaptable tropical species. The list shows nevertheless the general nature of the mountain ant faunas and the height to which ants ascend in various parts of the world.

PLANT ZONES AND FLORA OF THE IMATONG MOUNTAINS

Our approach to the Imatongs was from the east (Plate 2) and as we climbed the steep slopes to Mt. Kineti the zonation of plants was particularly striking. The descent was by the same route and we then retraced our way to the native village of Molongori. From here we again climbed the east slopes and traversed the entire massif. On the western descent the zonation was also apparent but included a more luxuriant flora.

The zonation of the slopes may be characterized as follows:

East Lower Montane Slopes

These lower montane slopes are clothed with mesophytic grass-woodland. The slopes are in places so steep, rocky, and exposed to the blistering sun as to present local xerophytic conditions. The soil is bright orange or red clay. Of Trinidad, B.W.I., soils, which are familiar to me and appear superficially similar, Hardy (1940, p. 154)

---

[1] In Carpenter's study (1935) of the Rhopalocera of Abyssinia the 1500 m. contour was chosen as the lower limit of the Abyssinian fauna. Below this level the Rhopalocera were largely characteristic of Somaliland. Hutchinson (1930) and Hesse, Allee and Schmidt (1937) use other African altitude zones for insect distribution but these do not apply to ants.

states "uniformly bright red or orange colours generally indicate extensive leaching, low lime status and high acidity, but a fair to high degree of aeration, implying good natural drainage." This zone extends from the surrounding plains (2500–2800 feet) to 6000 feet. The climate is tropical.

West Lower Montane Slopes

Plates 3, 7

The west lower slopes differ from the east in having a more luxuriant mesophytic grass-woodland and, in ravines chiefly, rain forest. The soil of the grass-woodland is often black humus though elsewhere reddish clay. The forest soils are black humus. This zone extends from the surrounding plains (about 3000 feet) to an upper limit which is not as distinct as on the eastern slopes but appears to be about 5600 feet. The climate is tropical.

Acacia abyssinica Zone

Plate 4

This zone is particularly distinct on the eastern slopes and often distinct on the west because of the presence of the striking and abundant tree, *Acacia abyssinica.* Alternating with *Acacia* forests are grassy areas with cycads and aloes. The soil is a rich black humus and there is no heavy moss and lichen growth on the trees. The altitudinal range is from 6000 to 7200 feet on the east slopes and from about 5600 to an upper limit not definitely determined but probably about 7200 feet on the west slopes. The zone is often bathed in clouds and has a temperate climate.

Cloud Forest—Mountain Meadow Zone

Plate 5

Above the *Acacia abyssinica* Zone extends the Cloud Forest—Mountain Meadow Zone. It is characterized by forests of *Podocarpus* and other trees with heavy moss or lichen growth alternating with meadows which grow abruptly to the forest edge. Bordering the forests often is a tall species of mountain bamboo (*Arundinaria*). The soil is a rich black humus in the forests as well as in the meadows. The zone is in clouds much of the day and the climate is temperate or subalpine and distinctly colder than the next lower zone. The altitudinal range is 5600–6000 feet to about 10,250 feet.

Mt. Kineti Summit

Plate 6

This zone, which may be called alpine, consists of the top two hundred feet or so of Mr. Kineti whose rocky outcrops are covered with heavy lichen growth. Between the rocks grow low grasses and herbs in rich black humus. The top is cold and damp since clouds cover it most of the time. It is probably several thousand feet too low for permanent snow and there was no evidence of snowfalls at the time of our visit.

Flora of the Imatong Mountains

Because of the war the determinations of the plants collected by Dr. Myers are not available nor is it known whether the collection is safe but fortunately the general features of the flora, especially of the west slopes, are on record.

In February 1929 Mr. T. F. Chipp visited this region and collected one hundred specimens of plants which were deposited in the Royal Botanic Gardens, Kew. In his study (Chipp, 1929) he included the determinations made at Kew by Miss M. B. Moss and her conclusions on the phyto-geographical affinities of the flora. The specific determinations and quotations below are from this paper. Mr. Chipp approached the Imatongs from Rejaf on the Bahr-el-Jebel by way of Opari and then east northeast to the Lotti Forest. Our approach differed in that we proceeded from Juba, downstream several miles from the now abandoned Rejaf, to Torit, headquarters of the Sudan Equatorial Corps, which is near the northern base of the mountains. He went from the Lotti Forest to the Laboni Forest and Issore, then climbed Mt. Kineti from the southwest and descended the east slopes to Longoforok. Our journeys followed his path closely, though in reverse, and in addition we crossed the entire range in the northern half, a region not traversed by him. The flora seen and collected by him therefore is similar to the flora associated with the greater part of the ant collections.

Flora of the Surrounding Plains

The flora of the plains surrounding the Imatongs differs from that bordering the Bahr-el-Jebel or Upper White Nile River to which the Imatong rivers flow. For some miles back from the Bahr-el-Jebel the vegetation consists of dwarf trees belonging to the genera "*Acacia, Terminalia, Euphorbia, Tamarindus, Kigelia, Zizphus* and *Balanites.*"

Eastward to the Imatongs the ground rises to 2000 feet or more. "Here the tree constituents of the vegetation changed, and representatives of the next southern great transcontinental belt of vegetation took their place. Noticeable amongst them were species of *Erythrina, Dombeya, Afzelia,* and *Butyrospermum.* The general physiognomy of the vegetation remained the same." *Erythrina tomentosa* R. Br. and *Dombeya reticulata* Mast. were in flower in February.

Flora of the West Lower Montane Slopes

Plates 3, 7

The Lotti Forest is referred to by Chipp as "closed fringing forest." Dr. Myers considered it in conversations at the time as an edaphic type of gallery forest. Both "gallery" and "fringing" terms refer to the type of forest extending along the banks of rivers or in valleys like the forests along the rivers of the western United States. The "closed" condition refers to the closeness of the canopy caused by the crowns of the large trees touching one another. The Lotti Forest appeared to be in a pocket on the western slopes and had an elevation of 3200–3300 feet which was slightly above that of the surrounding plains, from which it was separated by a ridge. This forest "is the northern limit, in these parts, of the great Cameroons-Congo forest, which crosses the Rift Valley in places, penetrates the ravines, and pushes along the valleys of Uganda towards Abyssinia." Largest trees included "*Alstonia, Entandrophragma macrophyllum* A. Chev., *Khaya grandifoliola* C. DC., and *Chlorophora excelsa* Benth. & Hook. Wild coffee, *Coffea robusta* Linden, and Rubiaceous and Acanthaceous shrubs helped to form the lowest stratum of the canopy." A fungus, *Polystictus xanthopus* Fries, grew from a dead log.

Alternating with closed and open types of forest were grassy areas, chiefly of *Hyparrhenia cymbaria* Stapf and *Pennisetum purpureum* Schum. Often these were ten or more feet high and referred to as elephant grass. A striking area of bamboo, *Oxytenanthera abyssinica* Munro, was traversed on the west slopes by Chipp and by ourselves.

Myrmicaria congolensis, *Acantholepis capensis* ssp. and *Polyrhachis* (*Myrma*) *schistacea divina* were among the few ants found in this rather sterile habitat. Herbs found in the grassy areas included *Ruellia sudanica* Lind., *Crotalaria senegalensis* Bacle, *Trichodesma physaloides* A. DC., *Sonchus Elliotianus* Hiern, *Scutellaria pauciflora* Baker, *Peristrophe usta* C. B. Cl., and *Clerodendron cordifolium* A. Rich. Scattered trees included *Combretum laboniense* M. B. Moss.

High forest followed ravines and included a characteristic tree, *Khaya grandifoliola* C. DC. A striking tree was *Dracaena fragrans* Gawl. and occurred in damp ravines with a rich ant fauna (Plate 7).

Flora of the *Acacia abyssinica* Zone

This zone is perhaps not as clearly delimited on the west slopes as on the east and was not characterized by Chipp. Above Issore on the west slopes at an elevation of above 4600 feet he crossed a neck of higher ground from which "it was seen that the Combretaceous trees of the Tall Grass-Woodland were replaced rather higher up the mountain side by a conspicuously flat-topped *Acacia* (*A. abyssinica Hochst.*)." At what was probably the lower limit of this zone he found the bracken fern, *Pteridium aquilinum* Schott., common and the first giant *Lobelia*, *L. Giberroa* Hemsl., 18 feet tall.

Unfortunately his descent of the east slopes was so hurried "that it was not found possible to make any further collection of the zones of mountain vegetation."

Chipp records *Protea abyssinica* Willd from 6000 feet. Wheeler's "Ants of the Belgian Congo" Plate IX, contains an excellent photograph of a tree of this genus with the legend "on the buds of which this ant (*Myrmicaria salambo*) attends scale insects." At 6200 feet in the Imatongs a tree, doubtless *P. abyssinica*, was found in flower and photographed in color. Search was made unsuccessfully for ants associated with it.

Flora of the Cloud Forest-Mountain Meadow Zone

This zone was not characterized by Chipp. Many collections, however, were made and he mentions the mountain vegetation being reached at about 8000 feet.

The "ravine forests were composed principally of *Podocarpus milanjianus* Rendle, and festooned with mosses, chief amongst which was *Pilotrichella ampullacea* Broth." A bamboo, *Arundinaria* sp.

near *alpina* K. Schum., "appeared as a fringe to the forests." *Protea abyssinica* Willd occurred at 8000 feet and in *Podocarpus* forest were collected the giant *Lobelia, Rubus Steudneri* Schw., *Lycopodium clavatum* L. and *Cyperus derreilema* Steud.

Plants of the Mountain Meadows:

Grasses
Digitaria uniglumis Stapf.
Exotheca abyssinica Anderss.
Setaria sphacelata Stapf. & Hubbard

Herbs
Athrixia rosmarinifolia Oliv. & Hiem.
Coreopsis tripartita M. B. Moss

Herbs
Delphinium candidum Hemsl.
Hebenstreitia dentata L.
Hypoxis urceolata Nel.
Justicia Whytei S. Moore
Lactuca capensis Thunb.
Moraea diversifolia Baker.

Plants bordering the Ravine Forests:

Bothriocline Schimperi Oliv.
Cineraria kilimandscharica Engl.
Clematis sp.
Coleus sp.
Cyathula Schimperiana Moq.
Hyparrhenia cymbaria Stapf
Kalanchoe Petitiana A. Rich.
Leonotis velutina Fenzl.
Tephrosia atroviolacea E.G.B.
Vigna Schimperi Baker

Just below the summit of Mr. Kineti a dense growth of prickly scrub was passed which contained brambles, *Dipsacus pinnatifidus* Steud. and species of *Solanum*. Woody species nearest the summit were *Hypericum lanceolatum* Lam., *Anthospermum usambarense* K. Sch., *Lasiosiphon glaucus* Fres., *Brayera anthelmintica* Kth., and *Tephrosia atroviolacea* E. G. Baker.

Flora of Mt. Kineti Summit

Much of the summit is of rock outcrops on which the lichens, *Usnea florida* Webb and its variety *rubiginea* Ach., were collected by Chipp. Short grass and herbs grown in the black humus between the outcrops.

The herbs collected were:

Asparagus asiaticus v. *scaberulus* Engl.
Carduus Theodori R.E.F.
Coreopsis Chippii M. B. Moss
Helichrysum argyranthum O. Hoffm.
" *fructicosum* Vatke
Lactuca capensis Thunb.
Lobelia dissecta M. B. Moss
Micromeria biflora Bth.
Ramphicarpa recurva Oliv.

Phyto-Geographical Affinities of the Flora

It appears from Miss Moss' analysis of the plants collected by Chipp that there are East, West and South African elements in the flora of the Imatongs, as in the case of the ants.

The grass-woodland lower montane slope contained a few trees with a westerly distribution as far as Nigeria and two common trees which extend from the Sudan to Rhodesia. "The herbaceous vegetation is more widely distributed throughout Tropical Africa, some of it extending into South Africa." Several species, however, are East African.

The closed equatorial forest of the lower montane slopes contained "a number of species of woody plants, some of which are apparently undescribed." This zone also contained many new species of ants. Some of the plants are local, others "with a remarkably disconnected distribution." Such is *Hormogyne altissima* A. Chev., known only from French Guinea and the Gold Coast. In a footnote Miss Moss states that this genus was originally known only from Australia. In this same type of forest a colony of ants close to the subgenus *Odontopelta* of *Leptogenys* was found which has been known only from Australia. A few plants are widely distributed.

"The fringing forest, above the closed equatorial forest, consists mainly of typically East African plants such as *Lobelia Giberroa* . . ." This fringe forest presumably is found in the zone from 5000 feet to 8000 feet.

What corresponds in part to the *Acacia abyssinica* Zone is the zone referred to as "tall grass-fire-swept-woodland, 5000 feet to 8000 feet." This "is composed of the local *Acacia abyssinica* Hochst. and the widespread bulbous *Urginea micrantha* Golms-Laub."

Corresponding to the cloud forest part of the Cloud Forest-Mountain Meadow Zone is the zone of "mountain ravines, 8000 to 10,000 feet." This contains "the only gymnosperm, *Podocarpus milanjianus* Rendle, which extends southwards to Gazaland. Here, however, representatives of both the northern and southern floras meet, and it would appear probable that this flora represents the most ancient type."

Regarding the mountain meadows "the north and south element is also repeated in the herbaceous vegetation of the mountain meadows, *Delphinium candidum* being the only northern representative, whilst *Hebenstreitia dentata, Moraea diversifolia, Lactuca capensis, Hypoxis urceolata* and *Cyrtanthus* sp. have a strong southern flavour. Of the grasses . . . *Digitaria uniglumis* has been recorded from Eritrea, Abyssinia, Uganda—including Mt. Ruwenzori, Kenya, and southwards to Rhodesia. *Setaria aurea* is common throughout Tropical Africa, and on Mt. Kilimanjaro up to 11,000 feet. *Exotheca abyssinica* occurs on the mountains from Eritrea and Abyssinia to north Nyasaland."

"The flora of the mountain tops, 10,000–10,414 feet, shows similar affinities, with the cosmopolitan *Asparagus asiaticus* and *Micromeria biflora,* whilst *Hypericum lanceolatum* and *Carduus Theodori* represent the northern, and *Lasiosiphon glaucus* the southern floras."

Cause of Zonation

The factors including reduced air pressure and decreased heat received from the earth, which accompany increase in altitude, must be among the primary causes of zonation on Central African Mountains. A direct result of lowering temperature is the increase in rainfall in cooler zones because of the precipitation of moisture-laden air rising from hot lowlands and losing its capacity to hold moisture as it becomes chilled. These conditions result in the restriction of most plant species to climatic zones for which they are fitted.

Local conditions in the Imatong Mountains, however, affect the zones here as in other mountains. Winds coming from the dry plains to the east carry little moisture; what is not intercepted by the Abyssinian Highlands beginning 200 miles away may be intercepted by the small Dongotonas ten miles distant. The east lower montane slopes consequently are mesophytic or, where the sun exposure and drainage are considerable, xerophytic. The winds coming from the west have passed over the lush forests of the Congo basin and are moist. The west lower montane slopes are consequently much wetter than the east.

PLANT ZONATION ON OTHER CENTRAL AFRICAN MOUNTAINS

Plant zonation on the Imatong Mountains is probably similar in large part to that on other mountains of this equatorial region. Dr. Bequaert (in Wheeler, 1922, pp. 19–21) summarizes briefly zonation on other and higher mountains as follows: "Tropical plant and animal life stops at about the 1500 m. level-line; between 1500 and 2500 to 3000 m. extends a warm temperate belt, which may conveniently be called the lower mountain region . . . On all Central African mountains reaching above 4000 m. there is between 2000 and 3000 m. a belt of very moist and cool forest, which for many hours of the day is often enveloped in clouds . . . On Mt. Kenia and Mt. Ruwenzori, the alpine region above the cloud forest up to the snowline (about 4500 m.) is mainly covered with a peculiar swampy heath-and-bog-formation . . . Mt. Kilimanjaro, Mt. Meru, and the Aberdare Range, owing to their more eastern location, present, however, very different conditions: the usual cloud forest extends from 1800 to 2600 m. on the eastern and to 3000 m. on the west slopes; then begins a rather dry, alpine, steppe formation, with short grass growing in tussocks." Bamboo forests are referred to at elevations of 2200–2500 m. (7200–8200 feet) on Mt. Ruwenzori and up to 3000 m. (9840 feet) on Mt. Kenia (*loc. cit.*). Photographs of vegetation on the mountains of Parc National Albert in the Belgian Congo show vegetation similar to that in the Imatongs but extending to higher altitudes. Bamboo is shown at 2800 m. (9200 feet) on Mt. Karisimbi, a giant *Lobelia* growing abundantly on an open slope at 4127 m. (13,537 feet) on Mt. Muhavura and the site of Carl Akeley's tomb at 3300 m. (10,800 ft.) on Mt. Mikeno is in typical cloud forest.

In Moreau's study (Moreau and Sclater, 1937) of the avifauna of mountains three to four degrees south of the equator along the Rift Valley in Tanganyika, the plant zonation may be summarized as follows:

Highland Evergreen Forest—5500–7500 ft.
Mountain Bush-replacing the above forest when the latter is removed.
Acacia Forest—a belt at 5600 ft. and another at 4400 ft.
Savannah—4500–5500 ft.
Mountain Grassland—glades in the Highland Forest.
Moorland or subalpine scrub—above 10,000 ft. and patches from 9500 ft. and upwards.

Some of above zones have been altered markedly by fire and cultivation. The *Acacia* of the Acacia Forest is *A. xanthophloea*. From 7000 to 7700 ft. *Podocarpus* and bamboo are co-dominant. Many of the plant species and genera of these mountains were not found in the Imatongs.

Table 1.—Species of Ants found in the Imatong Mountains with their General and Zonal Distribution

	General	DISTRIBUTION Imatong Mountains Zones					
		E. Lower Slopes	W. Lower Slopes	Acacia abyssinica	Cloud Forest	Mountain Meadows	Summit Mt. Kineti
DORYLINAE							
Dorylus (*Anomma*) *nigricans burmeisteri* v. *molestus* Gerst.	E. Afr.	x	x	x	x	x	
Aenictus mentu Weber	Imatong Mts.		x				
Aenictus rotundatus v. *merwei* Santschi	S. Afr.	x					
CERAPACHYINAE							
Cerapachys (*C.*) *pigra* Weber	Imatong Mts.	x					
Cerapachys (*C.*) *sudanensis* Weber	Imatong Mts.	x					
PONERINAE							
Platythyrea cribrinodis (Gerst.)	E. Afr.	x					
Paltothyreus tarsatus (Fabr.)	Afr.		x				
Megaponera foetens (Fabr.)	Afr.	x	x				
Opthalmopone berthoudi pubescens Weber	S. Afr.	x					
Phrynoponera gabonensis (E. André)	W. Afr.		x				
Phrynoponera gabonensis v. *umbrosa* Wheeler	B. Congo		x				

Table 1.—Species of Ants found in the Imatong Mountains with their General and Zonal Distribution—*Continued*

	General	Distribution Imatong Mountains Zones					
		E. Lower Slopes	W. Lower Slopes	Acacia abyssinica	Cloud Forest	Mountain Meadows	Summit, Mt. Kineti
Bothroponera pachyderma (Emery)	W. Afr., Tanganyika		x				
Bothroponera soror (Emery)	W. Afr., Rhodesia	x	x				
Euponera (*Brachyponera*) *sennaarensis* (Mayr)	Afr.	x					
Euponera (*Mesoponera*) *ingesta* Wheeler	B. Congo	x	x				
Euponera (*Mesoponera*) *subiridescens* Wheeler	B. Congo		x				
Euponera (*Mesoponera*) *dentis* Weber	Imatong Mts.		x				
Euponera (*Mesoponera*) *flavopilosa* Weber	Imatong Mts.		x				
Ponera coarctata imatongica Weber	(species) Holarctic, S., E. Afr.		x	x		x	
Ponera mesëpinotalis Weber	Imatong Mts.			x			
Ponera muscicola Weber	Imatong Mts.			x			
Ponera lotti Weber	Imatong Mts.		x				
Ponera ambigua Weber	Imatong Mts.		x				
Leptogenys (*L.*) *maxillosa sericeus* Weber	(species) Indian Ocean, Rhodesia, Cuba	x					
Leptogenys (*L.*) *stuhlmanni* Mayr	S., E. Afr.		x				
Leptogenys (*L.*) *africanus* Weber	Imatong Mts.		x				
Anochetus sp. 1443, 1448	Imatong Mts.		x				
Anochetus sudanicus Weber	Imatong Mts.	x					

Table 1.—Species of Ants found in the Imatong Mountains with their General and Zonal Distribution—*Continued*

	Distribution							
	General		Imatong Mountains Zones					
			E. Lower Slopes	W. Lower Slopes	Acacia abyssinica	Cloud Forest	Mountain Meadows	Summit, Mt. Kineti
Odontomachus haematoda (L.)		Tropicopol.	x					
Odontomachus assiniensis v. *furvior* Wheeler		B. Congo	x	x				
MYRMICINAE								
Messor barbarus galla v. *rufula* Forel	(species)	N. Afr., Afr.			x			
Pheidole megacephala (Fabr.) ssp. A	(species)	Tropicopol.			x			
Pheidole megacephala (Fabr.) ssp. B	(species)	Tropicopol.			x			
Pheidole megacephala (Fabr.) ssp. nr. *punctulata* (Mayr)	(subspecies)	Afr.					x	
Pheidole sp. nr. *liengmei* Forel		Imatong Mts.	x					
Pheidole sp. 1406		Imatong Mts.		x				
Myrmicaria eumenoides opaciventris v. *congolensis* Forel		Equat. Afr.	x	x	x			
Crematogaster (*C.*) *castanea inversa* v. *flaviventris* Santschi		B. Congo, Uganda			x			
Crematogaster (*C.*) *castanea* F. Smith, ssp.		Imatong Mts.	x					
Crematogaster (*C.*) *chiarinii* Emery, ssp.	(species)	E. Afr., Congo	x					
Crematogaster (*C.*) sp. 1369		Imatong Mts.	x					
Crematogaster (*C.*) *latuka* spec. nov.		Imatong Mts.	x					
Crematogaster (*Decacrema*) *lango* spec. nov.		Imatong Mts.	x					

Table 1.—Species of Ants found in the Imatong Mountains with their General and Zonal Distribution—*Continued*

	General	DISTRIBUTION Imatong Mountains Zones					
		E. Lower Slopes	W. Lower Slopes	Acacia abyssinica	Cloud Forest	Mountain Meadows	Summit, Mt. Kineti
Crematogaster (*Orthocrema*) *sordidula molongori* subsp. nov.	(species) Palaearctic, Afr.	x					
Crematogaster (*Orthocrema*) sp. 1378	Imatong Mts.	x					
Crematogaster (*Atopogyne*) *africana polymorphica* subsp. nov.	(species) W. Afr., Rhodesia		x				
Crematogaster (*Atopogyne*) *depressa* Latr. v. *fuscipennis* Em.	W. Afr.		x				
Crematogaster (*Sphaerocrema*) *gambiensis* (E. André), ssp.	(species) Afr.			x			
Crematogaster (*Sphaerocrema*) sp. 1366	Imatong Mts.	x					
Crematogaster (*Sphaerocrema*) *lotti* spec. nov.	Imatong Mts.		x				
Crematogaster (*Sphaerocrema*) *zonacaciae* spec. nov.	Imatong Mts.			x			
Monomorium (*M.*) *minutum kineti* subsp. nov.	(species) Cosmopol.				x	x	x
Monomorium (*M.*) *minutum arboreum* subsp. nov.	Imatong Mts.			x			
Monomorium (*M.*) *minutum* Mayr, ssp. 1365	Imatong Mts.	x					
Monomorium (*M.*) *estherae* spec. nov.	Imatong Mts.			x			
Monomorium (*Xeromyrmex*) *bicolor* ssp. nr. *nitidiventre* Emery	(subspecies) Aden, Egypt, Afr.			x			r
Solenopsis punctaticeps juba subsp. nov.	(species) S., E. Afr.			x		x	
Ancleus politus Santschi	Kenya			x			
Paedalgus sudanensis spec. nov.	(genus) Ceylon, W. Afr.	x					
Hylidris myersi Weber	(genus) S. A.-E. Sudan		x				

Table 1.—Species of Ants found in the Imatong Mountains with their General and Zonal Distribution—*Continued*

	Distribution						
	General	Imatong Mountains Zones					
		E. Lower Slopes	W. Lower Slopes	Acacia abyssinica	Cloud Forest	Mountain Meadows	Summit, Mt. Kineti
Meranoplus nanus scoriculus Wheeler	B. Congo		x				
Calyptomyrmex (*C.*) *brevis* spec. nov.	(genus) W. Afr., Rhodesia		x				
Macromischoides viridis spec. nov.	(genus) W. Afr.		x				
Ocymyrmex weitzeckeri celer subsp. nov.	(species) S. Afr., Tanganyika	x					
Tetramorium guineense medje Wheeler	B. Congo	x					
Tetramorium sericeiventris arenarium Santschi	fringes of Sahara, Ethiopia	x					
Tetramorium simillimum (F. Smith)	Tropicopol.			x			
Tetramorium simillimum isis subsp. nov.	Imatong Mts.		x	x		x	
Tetramorium squaminode nubis subsp. nov.	(species) Kilimanjaro; S. Afr.					x	
Tetramorium brevis spec. nov.	Imatong Mts.		x				
Tetramorium jeanae spec. nov.	Imatong Mts.			x			
Tetramorium viticola spec. nov.	Imatong Mts.		x				
Xiphomyrmex weitzeckeri Emery	S. Afr., Congo		x				
Xiphomyrmex weitzeckeri edithae subsp. nov.	Imatong Mts.		x	x			
Xiphomyrmex minusculus amen subsp. nov.	(species) Cameroon		x				
Xiphomyrmex zonacaciae spec. nov.	Imatong Mts.			x			
Triglyphothrix gabonensis E. André	W. Afr.		x				

Table 1.—Species of Ants found in the Imatong Mountains with their General and Zonal Distribution—*Continued*

	General	DISTRIBUTION Imatong Mountains Zones					
		E. Lower Slopes	W. Lower Slopes	Acacia abyssinica	Cloud Forest	Mountain Meadows	Summit Mt. Kinzti
Triglyphothrix mucidus Forel	B. Congo		x				
Triglyphothrix cinereus spec. nov.	Imatong Mts.	x					
Cataulacus traegaordhi Santschi	Zululand, Congo, Uganda		x				
Cataulacus pygmaeus E. André, ssp.	(species) W., S. Afr.	x					
Cataulacus sp. 1445	Imatong Mts.		x				
Cataulacus sp. 1445, 1447	Imatong Mts.		x				
Strumigenys (*Cephaloxys*) *escherichi lotti* subsp. nov.	(species) W., S. Afr.		x				
DOLICHODERINAE							
Axinidris acholli Weber	(genus) Imatong Mts.		x	x			
Tapinoma carinotum spec. nov.	Imatong Mts.	x					
Tapinoma sp. 1447a	Imatong Mts.		x				
Tapinoma sp. 1447b	Imatong Mts.		x				
Technomyrmex albipes truncicolus subsp. nov.	(species) Tropicopol.			x			
Technomyrmex moerens Santschi, ssp.	(species) W. Afr.		x				
Technomyrmex incisus spec. nov.	Imatong Mts.		x				
Technomyrmex longiscapus spec. nov.	Imatong Mts.		x				

Table 1.—Species of Ants found in the Imatong Mountains with their General and Zonal Distribution—*Continued*

	General	DISTRIBUTION Imatong Mountains Zones					
		E. Lower Slopes	W. Lower Slopes	Acacia abyssinica	Cloud Forest	Mountain Meadows	Summit Mt. Kineti
FORMICINAE							
Plagiolepis (*P.*) *sudanica* spec. nov.	Imatong Mts.			x			
Acantholepis capensis anceps Forel	B. Congo	x					
Acantholepis capensis minuta Forel	Transvaal	x					
Acantholepis capensis simplex Forel	E., S. Afr.			x			
Acantholepis capensis validiuscula Emery	Afr.		x			x	
Acantholepis capensis thoth subsp. nov.	Imatong Mts.	x					
Acantholepis capensis issore subsp. nov.	Imatong Mts.			x			
Acantholepis capensis acholli subsp. nov.	Imatong Mts.	x		x			
Oecophylla longinoda (Latr.)	Afr., exc. S.	x					
Camponotus (*Dinomyrmex*) *longipes* (Gerst)	F. Afr., Rhodesia	x					
Camponotus (*Dinomyrmex*) *pompeius cassius* Wheeler	B. Congo		x				
Camponotus (*Myrmoturba*) *maculatus melanocnemis* Santschi	Equat. Afr., Natal	x	x	x			
Camponotus (*Myrmoturba*) *maculatus brutus* Forel	W. Afr.		x				
Camponotus (*Myrmoturba*) *maculatus aegyptiacus* Emery	Egypt, Eritrea	x					
Camponotus (*Myrmoturba*) *maculatus nubis* subsp. nov.	Imatong Mts.					x	
Camponotus (*Myrmoturba*) *maculatus sudanicus* subsp. nov.	Imatong Mts.			x			
Camponotus (*Myrmoturba*) *acrapimensis* Mayr	W., E. Afr.	x					
Camponotus (*Myrmosericus*) *rufoglaucus cinctellus rufigenis* Forel	B. Congo	x					

Table 1.—Species of Ants found in the Imatong Mountains with their General and Zonal Distribution—*Concluded*

	Distribution General	Imatong Mountains Zones E. Lower Slopes	W. Lower Slopes	Acacia abyssinica	Cloud Forest	Mountain Meadows	Summit, Mt. Kineti
Camponotus (*Myrmosericus*) *rufoglaucus flavomarginatus* (Mayr)	Afr.	x	x	x			
Camponotus (*Myrmamblys*) *chapini ganzii* subsp. nov.	(species) B. Congo	x					
Camponotus (*Myrmamblys*) *hāpi* spec. nov.	Imatong Mts.			x			
Camponotus (*Orthonotomyrmex*) *sericeus* (Fabr.)	E., S. Afr. Indomalaya	x					
Camponotus (*Orthonotomyrmex*) *vividus cato* Forel	W., E. Afr.		x				
Camponotus (*Myrmotrema*) *bayeri* Forel	B. Congo	x					
Camponotus (*Myrmotrema*) sp.	Imatong Mts.	x					
Camponotus (*Myrmopiromis*) *tricolor* spec. nov.	Imatong Mts.		x				
Camponotus sp. 1447	Imatong Mts.		x				
Camponotus sp. 1442, 1445	Imatong Mts.		x				
Polyrhachis (*Myrma*) *schistacea divina* Forel	E. Afr., Congo	x					
Polyrhachis (*Myrma*) *cubaënsis imatongica* subsp. nov.	(species) S., E. Afr.	x					
Pseudolasius myersi spec. nov.	Imatong Mts.		x				
Prenolepis (*Nylanderia*) *albipes* Emery, ssp.	(species) Cameroon		x				
Prenolepis (*Nylanderia*) sp.	Imatong Mts.		x				
	Totals	49	58	31	2	9	1
	In one zone only		89	21		3	0

OTHER CENTRAL AFRICAN MOUNTAIN ANTS

There are few records of ants on other Central African mountains; most of these have been collected by expeditions of Alluaud and Jeannel and described by Santschi (1914). Disregarding the winged castes, Dr. Bequaert (in Wheeler, 1922, pp. 20–21) has summarized the Alluaud and Jeannel records, from 1500–2850 m. on Mts. Kenya, Kilimanjaro, Ruwenzori and the Aberdare Range, as follows:

Dorylus (Dorylus)	2 spp.	Xiphomyrmex	1 sp.
Dorylus (Anomma)	1 sp.	Engramma	1 sp.
Bothroponera	1 sp.	Tapinoma	1 sp.
Monomorium	3 spp.	Technomyrmex	1 sp.
Messor	2 spp.	Plagiolepis	1 sp.
Pheidole	5 spp.	Acantholepis	1 sp.
Oligomyrmex	1 spp.	Camponotus	6 sp.
Crematogaster	3 spp.		

Most of these thirty species were taken below 2000 m. and all were taken in what would correspond in the Imatongs to either the lower montane slopes or the *Acacia* zone.

In what would correspond roughly to the mountain meadow part of the Cloud Forest-Mountain Meadow Zone of the Imatongs the following ants were taken above 2600 (east slopes) or 3000 m. (west slopes) (*loc. cit.*):

Melissotarsus emeryi pilipes Santschi (Mt. Kilimandjaro, 2740 m.)
Tetramorium squaminode Santschi (Mt. Kilimandjaro, 2600–3800 m.)
Tetramorium caespitum altivagans Santschi (Mr. Kinangop, 3100 m.)
Engramma ilgi stygium Santschi (Mt. Kilimandjaro, 2740 m.)
Camponotus maculatus kersteni (Gerst.) (Mt. Kilimandjaro, 2500–3000 m.)

On Mt. Ruwenzori *Dorylus brevipennis* and *D. nigricans burmeisteri molestus* were taken at 1600 m. and the latter occurred commonly to 2500 m. *D. molestus* was abundant on Mt. Kenya to 3000 m. and was observed on Mt. Meru up to 3000 m. (*loc. cit.*).

On the Abyssinian highlands, Scott (1933) records the following species, the winged male ants being omitted:

Dorylus (Anomma) nigricans burmeisteri molestus Gerst.	8000–9000 ft.
Bothroponera crassa Emery	7000–8000 ft.
Tetraponera scotti Donisthorpe[1]	8000–9000 ft.

---

[1] This record must be taken with caution. It consisted of one dealate female without its antennae and clasping in its legs the head of a worker. It could possibly have been carried to this elevation by air currents while still winged.

Messor barbarus galla Emery	8000 ft.
Pheidole megacephala ilgi Forel	8000 ft.
Crematogaster (Acrocoelia) neuvillei Forel	7000–8000 ft.
Monomorium crawleyi Santaschi	8000 ft.
Solenopsis punctaticeps erythraea Emery	8000 ft.
Acantholepis capensis Mayr, subspecies	6500–8000 ft.
Camponotus (Paramyrmamblys) moderatus Santschi	8000 ft.
Camponotus (Myrmoturba) ligea Donisthorpe	9000 ft.
Camponotus (Myrmoturba) maculatus pulvinatus Mayr	8000 ft.
Camponotus (Myrmoturba) thraso assabensis Emery	9000 ft.
Camponotus (Myrmotrema) carbo honorus Forel	8000 ft.

Although Dr. Scott's expedition went to 12,000–13,000 ft. in the highlands no ants were found above 9000 ft. except for the one dealate female. It could possibly have been carried to this elevation by air currents while still winged.

Isolated Saharan Mountains

In a collection of ants made by Peyerimhoff and Seurat in the Central Saharan massif of Hoggar (Ahaggar), which straddles the Tropic of Cancer, Santschi (1934) determined 32 forms. Since only three of these were tropical forms Santschi concludes that the massif is at the extreme south of the range of the palaearctic fauna. Thirteen were Saharan, nine were Atlas forms, five were common to the Sahara and the Atlas, one was common to Sahara and Egypt, and one was an Ethiopian form which is becoming cosmopolitan. One species, the tropical *Camponotus* (*Orthonotomyrmex*) *sericeus* (Fabr.), is common to this massif and the Imatong Mts. A new variety, *Camponotus* (*Myrmoturba*) *compressus thoracicus tahatensis* Santschi is of particular interest since it was taken on the summit of Tahat, highest peak of the massif, at an elevation of 3000 m. (9840 ft.). Santschi refers to his new variety *tibestiensis*, of the same subspecies, from the other great massif of the Sahara, the Tibesti, which rises about 500 miles east southeast to a height of 11,201 ft. He considers (p. 172) that the desert separating the two massifs "est suffisant pour intercepter tout passage de cette fourmi monticole et leur permettre une évolution indépendante." The other endemic ants belong to the genera *Messor, Leptothorax, Tetramorium* and *Cataglyphis*. Of these, *Messor, Tetramorium* and *Camponotus* had endemic forms in the Imatong Mts.

IMATONG ANIMALS OTHER THAN ANTS

1. VERTEBRATES. The plains surrounding the Imatongs contain many of the large mammals for which Africa is famous. Among them were elephant, giraffe, many species of antelope, lion, leopard, and hyaenas. I shot tiang (*Damaliscus tiang*) and waterbuck (*Cobus defassa*) on the plains to the north and unearthed a pigmy shrew at the east base. Few mammals, however, ascend into the temperate zones. Freshly made rootings of a giant forest hog (*Hylochoerus*) were seen nearly every day in the Cloud Forest-Mountain Meadow Zone to 8200 feet. A giant bushbuck was supposed to occur also in this zone. A troop of Colobus (*Colobus caudatus*) was found at the top of a fine stand of *Podocarpus* at 8100 feet. This handsome monkey is a mountain species limited to elevations above 6000 feet. The gorilla found on higher mountains south of the Imatongs appears to be a primate confined to higher elevations or cloud forests. In general the temperate zones had comparatively as few species of mammals as ants.

On the plains also were species of birds which did not ascend into the temperate zones. Guinea fowl were abundant at the base of the mountain, affording us most of our meat, but were not seen above 3500 feet. Francolin, bustard and ostrich seemed also not to ascend the mountains. At 9000 feet, however, were shot sun-birds (*Nectarinia*) and other small birds occurred on the meadows and forest margins. A medium-sized eagle soared over us on the summit of Mt. Kineti and hawks were seen at 8000–9000 feet.

Few of the numerous reptiles of the lower slopes ascended into the temperate zones. In the grass beside a ring of barelegged Acholli boys, dancing by their village at 4700 feet on the west slopes, a demon night adder (*Atractaspis conradsi*) was killed. A puff adder was killed at about 6200 feet in the *Acacia abyssinica* zone. Clinging to short grass stems on the summit of Mt. Kineti chameleons (*Chamaeleo bitaeniatus*) of a new race near the race *ellioti* of Kenya were found.

Amphibians also were scarce and the highest record was of tadpoles in a sparkling, cold pool below a waterfall at an elevation of 8700 feet.

2. ARTHROPODS. Time did not permit extensive collecting of arthropods other than ants and many of the former were collected because of their association with ants. Enough Isoptera and Arachnida, however, were collected and identified to give clues to their distribution.

In Carpenter's study (1935) of the Rhopalocera (Lepidoptera) of Abyssinia several records are included from the Imatong Mountains.

The study is particularly relevant, however, because of the conclusions on the affinities of the fauna of the Abyssinian highlands. Carpenter found that the Rhopalocera "fauna on the whole is of East African type" but with "a large number forms or species with West African affinities." "Some of the most characteristic elements of the typical West African forests are missing or extremely poorly represented in Abyssinia. But examples occur on the chain of mountains along or near the Sudan-Uganda border." These mountains include the Imatongs. It is significant that in insects as comparatively well known as the Rhopalocera the range of West African species eastward should end at the Imatongs. Many of the species of West African ants now have a similar range but the distribution of some of them is incompletely known.

A table is included of the species which are "well defined entities confined to the high levels above 5000 ft." Most of these are palaearctic and the rest East or West African with two exceptions.

Rhopalocera from above 1500 meters were considered "Abyssinian," those below 1500 meters were considered characteristic of Somaliland.

Distribution of the Isoptera

Termites were collected where associated with ants or found at the higher altitudes. They were identified by Professor A. E. Emerson of the University of Chicago. The large, black ant, *Megaponera foetens*, preys regularly on termites. The distribution of this ant and two termites which the ants were actually found to carry here, *Macrotermes jeanneli* and *Odontotermes* (*O.*) *schmitzi*, correspond closely in the Imatongs. All are confined to the zone of lower montane slopes. *M. jeanneli* and *M. natalensis* appear to be the two commonest termites of this zone and the fact that they do not ascend into the *Acacia abyssinica* zone next above doubtless is an important factor restricting the ascent of the *Megaponera*.

As with the ants, the termites are most numerous in the lower zone and scarce in the two higher zones. They were not found on the top of Mt. Kineti, which probably has an environment distinctly unfavorable for them.

The termites are listed below by zones.

Lower Montane Slopes

Acanthotermes (*Pseudacanthotermes*) *spiniger* (Sjöstedt) 2900 ft., in toad stomach.

Amitermes (*A.*) *evuncifer* Silvestri 4200 ft., mound nest containing colonies of *Aenictus mentu* and *Camponotus melanocnemis.*
Anoplotermes (*A.*) n. sp. 4500 ft., in cells within nest of *Polyrhachis divina.*

Cloud Forest-Mountain Meadow Zone

Basidentitermes aurivillii (Sjöstedt) 3200 ft.
Cubitermes (?) sp. 6000 ft., carried alive by *Tetramorium medje*
Glyptotermes n. sp. 3200 ft.
Macrotermes jeanneli (Grassé) to 4100 ft.; in toad stomach; carried by *Megaponera;* chimney type nest
Macrotermes natalensis (Haviland), fungus-grower found to 4640 ft.
Odontotermes (*O.*) *nilensis* Emerson (MS) 2900 ft., in toad stomach
Odontotermes (*O.*) *schmitzi* Emerson 3200 ft., carried by *Megaponera*
Odontotermes (*Cyclotermes*) n. sp. 2900 ft.

Acacia abyssinica Zone

Anoplotermes sp. 6800 ft., carried by *Myrmicaria congolensis;* 7000 ft.
Ceratotermes rhinoceros (Sjöstedt) 6200 ft., carried by *Pheidole megacephala* ssp.

Cloud Forest-Mountain Meadow Zone

Anoplotermes sp. 7570 ft., attacked by *Pheidole megacephala* when chambers of both were exposed
Anoplotermes sp. 8700 ft., chambers anastomosed with those of *Tetramorium simillimum* ssp., no hostility
Anoplotermes n. sp. (same as that at 4500 ft.), 9200 ft.

The occurrence of *Ceratotermes rhinoceros* in the *Acacia* zone is of particular interest, according to Dr. Emerson, since this species and two others are the only members of the genus and all had seemed to be confined to the mouth of the Congo River and French Guinea. They are rare, being known only from one or two collections.

B. DISTRIBUTION OF THE ARACHNIDA

In the limited time available no attempt could be made to collect many representative Arachnida since it would have been at the sacrifice of collecting ants. Thanks are due Dr. W. J. Gertsch of the American Museum of Natural History for his identification of the genera and families of Arachnida. The Imatong spider collection can apparently be identified to species only in Europe, an impossibility because of the war. Since the species unfortunately are not known, no conclusions can be drawn on the affinities of the spider fauna. The genera are for the most part widely distributed in Africa or throughout the world. Spiders are known from considerable elevations on Central African mountains, such as *Diaea albicincta* Pav. and *Xysticus fagei* de Less. from 3000 m. (9840 ft.) in the Mt. Kilimanjaro-Meru region (de Lessert, 1919). Spiders, however, were collected chiefly in the Cloud Forest-Mountain Meadow zone, on the summit of Mt. Kineti, or where associated with ants. Particularly interesting was the ecological niche of spiders in the cloud forest. They were more abundant than ants, largely because they could live in the only dry place in this zone—the dry cavities of the bamboo internodes. Ants were not found in this niche here and I have rarely found ants in bamboo internodes, upright or fallen, in the Neotropical Region. The spiders in bamboo belonged to the genera *Agelena* and *Clubiona*. Another specimen of the *Agelena* was found on Mt. Kineti summit and a different species of *Clubiona* was taken at 8300 feet, also in cloud forest but on a lichen- and moss-covered tree. These genera were not collected elsewhere. In general many of these spiders tolerated situations which were too cold, damp and dark for ants. The Arachnida are listed by zones below.

Lower Montane Slopes—Eastern

Gnaphosidae—*Herpyllus* (=*Scotophaeus*) sp. A dismembered specimen was in the nest of the ant, *Leptogenys* (*L.*) *maxillosa sericeus*, at 4100 ft. Another specimen was under a stone nearby.
Thomisidae—*Thanatus* sp. 3300 ft.

Acacia abyssinica Zone

Gnaphosidae—*Zelotes* sp. Prey of ant, *Dorylus* (*Anomma*) *nigricans burmeisteri molestus*, 6200 ft.
Ctenidae—*Ctenus* sp., Prey of the above ant, 6200 ft.
Theridiidae—*Theridion* sp., 6800 ft.
Theridiidae—*Theridion* another sp., 7100 ft.
Linyphiidae—*Microneta* sp., 6800 ft.
Phalangiidae—juvenile specimen, 6800 ft.
Acarina—small mite, 6800 ft.

Cloud Forest—Mountain Meadow Zone

Agelenidae—*Agelena* sp. in bamboo, 8780 ft.
Clubionidae—*Clubiona* sp. in bamboo, 8780 ft.
Clubionidae—*Clubiona* sp. from mossy tree, 8300 ft.

Gnaphosidae—Drassyllus sp. in grass, 9200 ft.
Thomisidae—Thomisus sp. in grass, 7940 ft.
Saltieidae—females in grass, 9200 ft.
Argiopidae—Leucauge sp. from mossy tree, 8300 ft.; from ground in forest, 8780 ft.
Linyphiidae—Linyphia sp. from mossy tree, 8300 ft.

Mt. Kineti Summit, 10458 ft.

Barychelidae—Leptopelma sp. in grassy hummock
Agelenidae—Agelena sp. in grassy hummock
Gnaphosidae—Herpyllus sp. near *Monomorium* nest

DISTRIBUTION OF MISCELLANEOUS ARTHROPODS

Mr. J. A. G. Rehn has recently (1942, Proc. Acad. Nat. Sc. Phila., 94: 287–306, Pl. 26–27) described a new Orthopteran, *Parasphena imatongensis* Rehn, which I collected on the Summit of Mt. Kineti. He states (p. 288) that the "distribution of *Parasphena* is particularly interesting . . . . . . In East Africa it is generally found frequenting mountain or plateau grassland areas, usually at considerable elevations . . . . . . The Ranges of at least certain of the species appear to be completely and widely separated . . . . . . No lowland humid tropical types of the genus are known."

The tick, *Rhipicephalus bursa* Canestrini and Fanzago (det. Dr. J. Bequaert), was found in the Cloud Forest-Mountain Meadow zone on hummocky grass at an elevation of about 8700 feet. It may feed on the bushbuck or giant forest hog. On the plains at the east base of the Imatongs was found on two occasions the tick, *Rhipicephalus simus* Koch (det. Bequaert). One tick was on my arm when I returned to camp from hunting big game, another was hanging to a grass stem about one foot from the ground.

BIOLOGY OF THE ANTS OF THE IMATONG MOUNTAINS

DORYLINAE

DORYLUS

DORYLUS (ANOMMA) NIGRICANS BURMEISTERI V. MOLESTUS (Gerst.)

Plate 8

Driver or legionary ants are distributed throughout Africa. This variety, which is terrestrial like the other Anommas, is confined to

East Africa, from Abyssinia to Mozambique and Rhodesia. The Imatong and other records obtained on the way to this region add the southern part of the Anglo-Egyptian Sudan to its range.

Dorylus molestus was found abundantly in places from 6200 to 9000 feet and also occurred on the surrounding eastern plains and lower slopes. It was particularly abundant in the *Acacia abyssinica* zone but was widespread in the cloud forest-mountain meadow zone to 9000 feet. If we had camped on top of Mt. Kineti (10,458 ft.) we should probably have found it eventually. The ants would have encountered enough insects on the very top to make an occasional marauding expedition feasible from the forests a few hundred feet below. Sjöstedt found this variety on Mt. Meru at 3000 m., Alluaud and Jeannel took it on Mts. Kenya, Kilimanjaro, Ruwenzori and Aberdare to 3000 m. and Dr. Bequaert collected what was probably this variety on Mt. Ruwenzori between 2200 and 2500 m. (Bequaert, in Wheeler, 1922, pp. 20–21).

Not only is this purely carnivorous insect the dominant ant of the Imatong Mountains but it is unquestionably one of the clearly dominant animals. While the largest mammals have been known to succumb to their legions, they play a far more important role in the lives of terrestrial invertebrates, especially other insects. None of these can escape when surrounded by the hordes of *Dorylus* unless they are able to fly outside the range of the marauders. Commonly, winged insects, when started up by these ants, take but a short flight and often alight on a twig or leaf soon to be explored by part of the same horde. They are thus literally driven from pillar to post.

Other species of ants fall prey to the *Dorylus*. The booty carried by them or their congeners, the army ants of the New World tropics, is as likely to be the brood of some other ant as any other kind of animal. It appears very probable that the scarcity of terrestrial ants in the *Acacia abyssinica* and cloud forest zones is due in part to the activities of this *Dorylus*. It is worth noting that the most abundant ants in these zones are the small or very small *Tetramorium*, *Solenopsis*, and *Monomorium* whose minute brood is of a size commonly ignored by terrestrial army and legionary ants of both hemispheres. Their brood is usually safe under rocks, or in soil chambers. The larger ants of the genus *Camponotus,* one of the most abundant ants in species and individuals the world over, are remarkably scarce here and only scattered colonies are found. These nested out in the grass of open meadows where their chances of being encountered by the *Dorylus* would be less than on the more open forest floor. The legionary ants of the size of this species find difficulty in scattering through dense, fine grass and in the mountain meadows they often followed trails made by the large mammals.

The ant of comparable size which ranked with the *Dorylus* in abundance was *Myrmicaria eumenoides congolensis.* It was remarkable how they tolerated one another. Similar tolerance is exhibited between the army ant, *Eciton burchelli,* and the fungus-growers, *Atta* and *Acromyrmex,* in South and Central America. Both the *Dorylus* and the *Myrmicaria* have the habit of building narrow trenches across game trails and erecting crater entrances to subterranean diggings. The permanent craters of *Myrmicaria* and temporary craters of the *Dorylus* were occasionally close together, even contiguous, with no sign of hostility between the ants. Or the crater of one and a trench built across a trail by the other may be contiguous with no apparent hostility. The following observations taken from my field notes illustrate their relationships: "A *Dorylus* file had erected a temporary crater, 15 cm. in diameter and 5 cm. high, 20 cm. from a trench across the trail dug by a *Myrmicaria* colony. These workers were occasionally wandering through the trench while the *Dorylus* were bringing up soil from below to the crater rim. Every now and then a *Myrmicaria* wandered to the rim of the *Dorylus* crater and slowly walked down with antennae outspread. It would soon encounter a *Dorylus.* There was no hurry on either side. Both were slow and deliberate in their movements. They would touch antennae, the *Dorylus* with mandibles outspread, then the *Myrmicaria* would slowly retreat, the *Dorylus* staying in the crater. A *Myrmicaria* tumbled down the slope of loose soil of the crater. It was not molested and slowly made its way through a seething mass of *Dorylus* untouched!" Contradicting these observations, however, was one made later in the day and some miles away. *Dorylus* and *Myrmicaria* files were found close by at the margin of a glade in *Acacia* forest. Several of the *Myrmicaria* were carrying attached to them, in a literal death grip, heads of the *Dorylus.* There were no immediate signs of hostility and the nearby nest of the *Myrmicaria* was intact under a stone.

Acacia, *Podocarpus-Lobelia*, bamboo and all other types of forest except pure *Podocarpus* were inhabited by these ants. In a magnificent stand of pure *Podocarpus* at 8100 feet no ants could be found and the scarcity of life on the gloomy forest floor made it probable that *Dorylus* would not venture here. Open rocky slopes and the margins of meadows were also explored but the ants were seldom seen far from the margins of meadows.

On August 1 at an average elevation of about 6200 feet a remarkable series of *Dorylus* trails was encountered during the day's trek through the mountains. During the morning three *Dorylus* trails were passed, which was nothing unusual. At 12:40 p.m. another but much denser file was encountered. These, mostly minima and media workers, were carrying prey into a hole beside a stone. Larger workers and soldiers formed a dense ring about the hole and formed a cordon on each side of the file. Within less than a mile three more files were encountered (to 1 p.m.). During fairly steady walking (except for a 20 minute stop at 3 p.m.) from 1 to 4:21 p.m. 14 additional files were passed, crossing my path at all angles. At 4:21 three abandoned trenches of *Dorylus* were also found. These had been in process of building less than 24 hours previously as evidenced by the condition in which they were left. During the day 21 files of *Dorylus* were thus encountered along a trek of probably 12 miles length. The way led mostly along ridges but also up and down many small valleys. Seventeen of the files were encountered at an average of 12 minutes apart and over a total distance of about nine miles. Eight files were found in 35 minutes and in all probability belonged to one army whose diameter must have been over one mile. The numbers in such an army must be almost incredibly large, certainly at least in the hundreds of thousands.

It so happened that this day, August 1, followed a night of full moon. It may be more than coincidence that the only other comparable army ant activity I have seen also followed a full moon. In the bright full moonlight of July 3, 1935, I encountered numerous files of the army ant, *Eciton (E.) vagans* Olivier, in the foothills of the Northern Range of Trinidad, B.W.I. While following these files in an endeavor to find the queen an old Trinidad negro passing by remarked in his patois that these ants "come out in de full moon." Certainly there was more army ant activity than I had yet seen in this locality where I often collected. In a temporary bivouac among tree roots much brood, mostly larvae, was found but the queen escaped. The following day I returned to the same small valley. The ants had disappeared but about 100 meters away across a low ridge in the adjoining valley numerous files of a colony of another army ant, *Eciton (E.) burchelli urichi* Forel, were encountered. They had established a bivouac among dense bushes. The queen was found in this colony.

Dr. Schneirla's excellent studies on Panama army ants (1938, p. 87) led him to conclude that "in the rainy season (at least) the queen's ovulation cycle serves as a pacemaker for the alternation of the major conditions of colony activity (i.e., the nomadic and the statary conditions)." He concluded that the queen produces a clutch of eggs at intervals of approximately 36 days. The movements of the resulting larvae rouse the ants to their nomadic condition.

Like the rhythmic cycle of many marine animals perhaps the ovulation cycle of the army ant queen itself coincides with the phases of the moon. Perhaps we have here another example of the fundamental effect light has upon animals. Since in the tropics the amount of daylight each day varies but little according to the season, it is the added moonlight which determines the ovulation cycle. As the moon waxes the total daylight and moonlight builds up to a maximum at full moon which initiates the cycle. Whether this is exactly a 28 day cycle or not may depend upon specific conditions in the individual, such as the length of time necessary to ripen the ova.

Aenictus

Aenictus mentu Weber

This tiny yellow doryline ant belongs to the west lower montane slopes and a colony was found at an elevation of 4200 feet. It is dedicated to the Egyptian war god Mentu.

From a hemispherical hard black carton nest built and occupied by the termite, *Amitermes* (A.) *evuncifer* Silvestri, two species of ants were taken. The termite mound was 75 cm. in diameter and 35 cm. high. When sectioned it illustrated the theory of physiological gradients strikingly in that termite brood, including eggs and nymphs, were concentrated in greatest numbers in the smallest and most compact cells which were at the center. A colony of *Camponotus maculatus melanocnemis* Santschi occupied cells below the center as well as in all directions towards the periphery to within four centimeters of the top. The *Aenictus* evidently were also nesting in the termite mound since they had quantities of brood in cells from two to five centimeters from the top.

In the melee resulting from cutting open the nest termites, *Camponotus* and *Aenictus* were mixed up, brood and all. The *Aenictus* were by far the smallest of the insects but despite their tiny size they attacked the others. The termite workers were comparatively defenseless because of their soft integument and many were killed by both ant species. The soldier termites, however, had efficient mandibles and attacked the ants One soldier pierced the prosternum of a far larger *Camponotus* worker and held fast while another grasped a leg with a bulldog grip. The ant was helpless.

AENICTUS ROTUNDATUS Mayr var. MERWEI Santschi

This small, red variety was originally described from the Cape Province. The species was described from South Africa and has since been recorded from Rhodesia. The Imatong specimens may possibly be a new form but in view of the lack of information on normal variability in the species it seems best to give them this name since they compare well in general habitus with specimens of *A. merwei* in the British Museum.

A dense column of workers was taken on the east slopes at an elevation of about 3000 feet. They were carrying pupae and larvae of a small myrmicine ant whose nest they had evidently raided and were marching above ground over the rocky soil, only to disappear in holes in the soil. It is probable that they are hypogaeic and appeared above ground only where imbedded rocks forced them out.

CERAPACHYINAE

CERAPACHYS

CERAPACHYS (C.) PIGRA Weber

This curious ant, member of a comparatively rare subfamily which links the Dorylinae with the Ponerinae, belongs to the lower montane slopes. It seems unlikely that members of not only the genus but the entire subfamily (Cerapachyinae) will be found to belong to any of the temperate mountain zones.

Workers were found on the east slopes at about 3800 feet travelling slowly in an irregular column, two or three abreast, over wet, stony ground in the shade. When the column was disrupted by my picking up workers they were not aggressive nor did they run at all fast. Rather they moved somewhat sluggishly like Dacetonine ants. They did not or were unable to sting the fingers.

CERAPACHYS SUDANENSIS Weber

This species differs from *C. pigra* in its smaller size, antennal proportions and sculpturing.

A file of workers was taken on the east lower slopes at an elevation of about 6000 ft. At this place the soil was red and the vegetation was grass-woodland; the *Acacia abyssinica* zone extended immediately above.

PONERINAE

PLATYTHYREA

PLATYTHYREA CRIBRINODIS (Gerstaecker)

This species, originally described from Mozambique, is distributed generally in East Africa. A worker from Katanga, Belgian Congo (J. Bequaert) in my collection and the present Imatong records add the southern Sudan and southern Congo to its range.

The large, dull black, foraging workers were encountered from the plains up to an elevation of about 4600 feet on the east slopes. When picked up they stridulate audibly. Entrance to their nests may be in the form of a bare hole under a rock or otherwise secluded. One irregular entrance, 20 mm. in greatest diameter, was found roofed over with pebbles of which some were up to seven millimeters in diameter and were distinctly heavier than the ants themselves. The tunnel led in an irregular manner into earth between rocks. One worker was observed carrying an angular pebble similar to those about the entrance. Another was carrying a dead *Camponotus* worker towards the hole. They are probably general insectivores. One was observed carrying a decapitated worker of its own species minus also its legs. Another carried an empty black pupal case, apparently of the same species, two feet downhill from its nest. These two latter were probably merely "cleaning house."

PALTOTHYREUS

PALTOTHYREUS TARSATUS (Fabr.)

This monotypic genus is distributed generally over Africa and is confined to this continent. The type locality is Senegambia. Because of its large size and habit of stalking over the open floor of the forest it is conspicuous and collected by the most casual collector. The present record, however, adds the Sudan to the definite range.

Since the species can hardly be overlooked it is noteworthy that the workers were not encountered on our route along the east front of the Imatongs, on the trek up Mt. Kineti nor on the traverse of the mountains. It was found only in the Lotti Forest on the lower montane slopes of the west side. It seems therefore to be confined to closed rain forest in the Sudan.

Only stray workers were encountered in the Lotti Forest and these could sometimes be smelled before they were seen. They give off an exceedingly pungent odor, much stronger than that of dorylines, which has been likened by Arnold to the odor of an overripe pipe. In the late afternoon they were taken under pieces of rotted wood or other cover on the forest floor.

MEGAPONERA

MEGAPONERA FOETENS (Fabr.)

The genus *Megaponera* is monotypic and *M. foetens* is one of the commonest ants of the Ethiopian Region. *M. foetens* was originally described from Guinea and ranges across the continent from the southern border of the Sahara to Southern Rhodesia. Santschi has described a variety, *rapax*, from Mt. Kilimanjaro (800m.) and Moschi and Kilema, Tanganyika (1400–1500 m.). The Imatong specimens appear transitional between the typical form and this variety.

This ant was found on both eastern and western slopes of the Imatongs but was much more abundant on the eastern slopes. Here it has exactly the range of the common termites (*Macrotermes natalensis* and *M. jeanneli*), being found along the lower slopes and above both Longoforok and Molongori to the *Acacia abyssinica zone* (6000 ft.). This is also the extent of the reddish clay soil. On the descent of the western slopes it was not encountered until the Lotti Forest was reached although doubtless it occurs more generally. It is commonly seen on the plains surrounding the Imatongs, northward to Terakeka on the Bahr-el-Jebel and westward to the Belgian Congo border.

M. foetens carries on well-organized raids on termite nests for the purpose of capturing its chief food, the relatively defenseless soft-bodied termites. The ants travel in columns several abreast and one to two meters long and march quickly and directly towards their objective, the entrance or entrances of termite nests. They stridulate loudly when disturbed. Just above Molongori what seemed to be the beginning of a raid was encountered at 6:50 a.m. of a bright, calm morning. On the west side of the mountains another start of a raid was witnessed at 7 a.m. Above Longoforok at about 3200 ft. the return of a raid was seen at 1:50 p.m. of a bright but cloudy afternoon following a rain. The raid was only partly successful since many workers had no termites. This column was preceded by a single worker at a distance of about 30 cm. from the main body. The ants were photographed with a ciné kodak as they pursued a direct path to the entrance to their nest, a hole about three centimeters in diameter at the base of a large, black rock. Much soil had been brought out from under the rock and heaped against one side. At 5:50 p.m. in the Lotti Forest a particularly successful column of raiders was found. At this time the sun was behind a ridge and it was twilight in the high, dense forest. During the afternoon a heavy rain had fallen but at the present time the weather was calm, clear and warm. When found, the ants were quietly clustered together on a slope and feeding on a large mass of dead termites which they had carried to a well-drained patch of red clay with a scanty covering of moss. About 15 cm. from them was a tiny stream, about 7 cm. wide, of reddish water from the rain, which blocked their way to a clearing. I stood across this stream and started to pick some up with forceps, whereupon a number tried to attack me but the stream was an effective barrier. After about five minutes of my disturbing them the seething mass gradually formed into a column, except those trying to reach me, and picked up as many termites as they could in their jaws. It was astonishing how quickly order came out of the milling workers. Here is probably an example of orientation with respect to head and abdominal tip in ants. They marched in regular column to a position about four meters down the slope and parallel with the stream which they evidently were trying to pass. Here they deposited their loads of termites. At 6:10, when I had to leave, it was fast getting dark. No myrmecophiles were seen in the raiding party.

In excavating a nest of the fungus-growing termite, *Macrotermes natalensis* (Haviland), the Megaponeras were encountered inside the nest and under some of the fungus gardens. During our ascent from the east Dr. Myers took a worker carrying a soldier termite, *Macrotermes jeannelli* (Grassé). The ant was carrying the dead termite under its body and between its legs, head backwards.

OPTHALMOPONE

OPTHALMOPONE BERTHOUDI FOREL subsp. PUBESCENS Weber

The genus *Opthalmopone* consists of five species, of which none have been recorded from the Belgian Congo or Sudan. One, *O. ilgi* is known from Southern Abyssinia and Somaliland. The island of San Thomé in the Gulf of Guinea contains two species (*depilis* and *mocquerysi*), one of which (*mocquerysi*) occurs also in Angola with *O. berthoudi*. *O. berthoudi* is also known from Transvaal, Rhodesia and Mozambique. The fifth species (*hottentota*) is South African.

The present form is closely related to *O. berthoudi* and differs from two workers of this species sent me from Victoria Falls, Rhodesia, by Mr. G. Arnold, in having the median dorsal epinotal groove reduced, the crests of the posterior petiolar margin reduced and the pubescence more abundant.

One worker was taken near Longoforok on the mesophytic grass-woodland plains at an elevation of about 2800 ft. It resembled the common *Megaponera foetens* but was not travelling in a file; under a lens the head is much more elongate and the eyes much larger.

PHRYNOPONERA

PHRYNOPONERA GABONENSIS (E. André)

No genus more clearly illustrates the West African affinities of the Imatongs than *Phrynoponera*. Five species are known, all from a belt of about five degrees north and south of the Equator extending inland from the Atlantic Ocean to the eastern part of the Belgian Congo. All records are in the Belgian Congo except for single French Congo and Cameroons records. Doubtless these ants will be more generally found in these two latter colonies when they become as comparatively well explored as the Belgian Congo.

This species occurs on the west slopes of the Imatongs in rain forest from 3300 to 3500 ft. I found it in the Lotti Forest, walking singly over the ground, and Dr. Myers took it several hundred feet above this forest.

PHRYNOPONERA GABONENSIS var. UMBROSA Wheeler

A worker taken in the Lotti Forest agrees closely with Wheeler's description of the variety *umbrosa* from Medje, Belgian Congo, and runs to this form in his key. It differs from the other Lotti Forest workers in having the mandibles, frontal carinae, and antennal scapes blackish and in having the head and gaster more coarsely sculptured. The worker was walking over the forest floor in an open area after a rain.

BOTHROPONERA

BOTHROPONERA PACHYDERMA (Emery)

This large, coarsely sculptured ant was originally described from Cameroon and it or its forms have since been recorded from the French and Belgian Congo and Tanganyika.

It occurs on the western slopes of the Imatongs, where it was taken at about 4100 ft., above the Lotti Forest, by Dr. Myers (M10574) and in the Lotti Forest by myself. The ant moves sluggishly over the forest floor and is less abundant than *B. soror*.

BOTHROPONERA SOROR (Emery)

This species was originally described from Cameroon and has since been recorded from both French and Belgian Congo and Rhodesia. A subspecies is known from Abyssinia.

B. soror occurs on both the eastern and western slopes of the Imatongs at elevations up to nearly 6000 ft. but was not taken in the *Acacia abyssinica* zone. The workers are found on the ground both in grass-woodland and in rain forest; a colony found in the Lotti Forest was nesting under the bark of a sound tree 36 cm. in diameter resting on the ground. The larvae were lying on their sides and feeding on pieces of an unidentifiable insect. In the stomach of a toad taken at about 4200 ft. were two workers of *B. soror,* other ants and other insects. About half of the bulk consisted of ants.

EUPONERA

EUPONERA (BRACHYPONERA) SENNAARENSIS (Mayr)

This ant is one of the commonest ants of the Ethiopian Region and is widespread. It was originally described from Sennar, less than 700 miles north of the Imatongs in the Sudan. Other Sudan records, including a nest on a Nile steamboat, are given in a recent brief article (Weber, 1940).

Nests of this species were particularly abundant on the sandy flats at the east base of the Imatongs and workers were taken up to the *Acacia abyssinica* zone on the east lower slopes at about 6000 ft.

EUPONERA (MESOPONERA) INGESTA Wheeler

This species is characterized by its broad head, short, trigonal mandibles, finely reticulate integument and sparse pilosity with abundant appressed pubescence. It was originally described from northeastern Belgian Congo.

It occurs on both eastern and western slopes of the Imatongs at elevations of about 4100 ft. and 3300 ft. respectively. One worker found on the eastern slopes was in grass-woodland. A single dealate female was taken in the Lotti Forest under a piece of wood on the ground. Workers were taken in high rain forest above the Lotti Forest and in the Forest itself.

EUPONERA (MESOPONERA) SUBIRIDESCENS Wheeler

This species may easily be recognized by its long, narrow, and reddish mandibles with reduced dentation and the unusually high and narrowly compressed petiole. It was originally described from northeastern Belgian Congo.

It occurs on the western slopes of the Imatongs where workers were taken at an elevation of about 4800 ft. in rain forest and at 3300 ft. in the Lotti Forest.

EUPONERA (MESOPONERA) DENTIS Weber

This species is characterized by the elongate apical tooth of the mandible, the long first joint of the funiculus and the petiolar scale which closely resembles that of the common *Euponera* (*Brachyponera*) *sennaarensis*. The latter, however, has a much broader head and is, in the female caste, much larger.

A single dealate female was taken in the Lotti Forest under leaves on the ground.

EUPONERA (MESOPONERA) FLAVOPILOSA Weber

This species is characterized by its elongate, narrow mandibles, long first joint of the funiculus, shiny brown integument and numerous yellow hairs.

A single dealate female was taken in gallery forest above the Lotti Forest.

PONERA

PONERA COARCTATA (Latr.) subsp. IMATONGICA Weber

P. coarctata was originally described from France and the typical form is European and Mediterranean. The common *Ponera* of the United States is the subspecies *pennsylvanica*. Forel has described a subspecies *bocrorum* from Natal. Santschi has described the species *ursa* and *jeanneli*, the former from Mt. Ruwenzori (2000 m.) and Mt. Elgon (2300 m.), the latter from Mt. Elgon (2100 m.), but the Imatong ant is a distinct, though related, form. The distinctions between many of the species of *Ponera* are slight and not easily conveyed by drawings and descriptions. Unfortunately no specimens of any of the African mountain Poneras are in collections in the United States and it seems advisable provisionally to attach the present ant to *P. coarctata* which it much resembles.

This ant was the commonest *Ponera* in the Imatongs and was found on both eastern and western slopes up to 8500 ft. Some of the workers vary slightly in color and size but the material is insufficient to ascribe any importance to the variation.

On the eastern side workers were found in humus at 6800 ft. and at about 8500 ft. in a mountain meadow.

On the western side workers were found at about 6200, 6100 and 4570 ft. At the highest locality the workers were under a rotted log on the ground in high forest containing *Dracaena fragrans* Those at 6100 ft. were in exactly the same type of habitat. One worker was found at the lowest locality about the roots of a coffee tree.

PONERA MESOËPINOTALIS Weber

This species differs from the other Imatong species in having a distinct meso-epinotal impression and thick petiolar node.

Workers were found on the western slopes of the Imatongs at an elevation of 6400 ft. The ants were under the bark of a fallen tree in forest with numerous lianas and *Podocarpus*.

PONERA MUSCICOLA Weber

This species differs from all *Ponera* found in the Imatongs, except *P lotti*, in its compressed petiole. It differs from the latter in having much paler color and proportionately larger size.

A single dealate female was taken on the east slopes of the Imatongs at 7200 ft. The ant was by itself in wet moss filling the cavity of a reclining tree trunk which was moss- and lichen-covered.

PONERA LOTTI Weber

This species is characterized by its slight meso-epinotal impression, compressed petiole and long antennal scapes.

Workers were found in the Lotti Forest. One was taken carrying an insect larva and was unusually agile. Others were under the bark of a large fallen tree trunk.

PONERA AMBIGUA Weber

This species is noteworthy in being like the genus *Euponera* in general habitus, having comparatively elongate mandibles and depressed metanotum. It is placed with *Ponera* because it has but a single tibial spur instead of the two of *Euponera*.

A worker was found in the Lotti Forest under leaves on the forest floor.

LEPTOGENYS

LEPTOGENYS (L.) MAXILLOSA (F. Smith) subsp. SERICEUS Weber

L. maxillosa was originally described from the island of Mauritius and has since been recorded from Rhodesia and from widely separated localities of the world. I rediscovered the variety *falcata* Roger in Cuba and was sent a worker proving to belong to the variety *vinsonnella* (Dufour) by Mr. D. FitzGerald from Mahé, Seychelles Islands.

The Imatong workers differ from all these and from Kalahari Desert, Guam Is., and specimens from other regions in having a distinctly denser and longer appressed pubescence so that the body appears silky.

These ants were taken twice near Molongori. One worker was taken on the mesophytic grass-woodland plains east of the village crawling on the base of a tall termite chimney mound (*Macrotermes jeanelli* (Grassé)). A colony was found on the eastern slopes above Molongori at an elevation of about 4100 ft. A file of workers was seen returning to what proved to be their nest. Nothing was seen in their mandibles and it may have been an unsuccessful raiding expedition. Their nest was under a flattish stone about 30 x 40 x 10 cm. which was resting on small rocks and a little soil. The ants were exceedingly fast, darting under cover and manoevering away as I tried to pick them up. In the nest were pieces of their prey: Isopods and spiders. Live *Collembola* and *Thysanura* were present in numbers. They evidently fed on what the ants left of their prey. From a cocoon a worker was just emerging. The front legs and one antenna were sticking out. From the position of its mandibles in the cocoon it seemed unlikely that it could have sawed itself out and another worker must have been assisting it. The colony consisted of about one hundred workers.

Dr. Myers took a worker (No. 10545) at the south base of the Lafit Mts. north of the Imatongs, in low thorn-grass-woodland.

LEPTOGENYS (L.) STUHLMANNI Mayr

This species was originally described from Mozambique and has since been recorded elsewhere in East Africa and Natal. Dr. Myers sent me a worker from south of Nelichu, Boma Plateau (No. 10469), near the Ethiopian frontier, and I found it at Mombasa, Kenya.

A worker was taken on the west slopes of the Imatongs at an elevation of about 4200 ft. The ant was in our hut at 6 a.m.

LEPTOGENYS (L.) AFRICANUS Weber

L. africanus is easily distinguished from the other and much commoner species by the petiole which ends in a spine like the ants of the genus *Acanthoponera*. The body is also coarsely sculptured. These ants cannot be mistaken for any other African ants.

All specimens were found on the western slopes in the Lotti Forest. One worker was captured while running down a tree at 30 cm. above ground. A colony was found in the Lotti Forest nesting in a piece of rotted wood 18 x 5 cm. which contained a nest of *Strumigenys escherichi lotti*. Like most *Leptogenys*, the ants were very active and took refuge under leaves and pieces of wood. When these latter were overturned the ants sometimes remained motionless until I tried to pick them up. What seemed to be nearly all the colony was collected and consisted of 25 workers. Perhaps like other species of *Leptogenys sensu strictu* the female is ergatomorphic, externally indistinguishable from a worker. The brood consisted of elongate, elliptical white eggs 1.52 x 0.39 mm., slender larvae with a neck whose body was covered with large tubercles bearing at or close to their apices eight or nine setae like a corona, and dark brown elliptical cocoons 6.9 mm. long.

ANOCHETUS

ANOCHETUS sp.

Over a dozen species of *Anochetus* have been described from Africa. The present species is sufficiently generalized so that it may belong to one of several species. These species are not represented by specimens in the United States and their descriptions are inadequate.

This species was found on the western slopes in the Lotti Forest. There are several hundred workers to the colony and the ants nest in rotted logs in the heavy rain forest.

ANOCHETUS SUDANICUS Weber

This new species is closely related to *A. ghilianii* Spinola of the Mediterranean region. The close relationship suggests that they have arisen from a common ancestor and that one of the species has migrated through the valley of the Nile. It is possible that *A. ghilianii* is the species that has done the migrating and that *A. sudanicus* has remained closer to the ancestral home.

This ant was taken at the eastern base of the Imatongs at an elevation of about 2900 ft. in soil under a tree at Longoforok.

ODONTOMACHUS

ODONTOMACHUS HAEMATODA (L.)

This species is one of the common tropicopolitan ants and was originally described from "America meridionali." It is found throughout Africa.

While found only at the base of the eastern slopes of the Imatongs it has doubtless a wider distribution in these mountains. Workers were found in the vicinity of Molongori and above Longoforok at about 4000 ft. Beside a tributary of the Koss River on June 23 three separate nests were found under logs. Each consisted of a female with her first brood of eggs, larvae, and in one case cocoons. Each female formed a cell of humus under the log with a continuous wall. One cell was 28 mm. in diameter with a height of 5 mm.

ODONTOMACHUS ASSINIENSIS var. FURVIOR Wheeler

This variety of a widespread Ethiopian species has been recorded only from the Belgian Congo.

O. furvior occurs on both east and west slopes of the Imatongs below the *Acacia abyssinica* zone. In ascending the eastern slopes above Longoforok it was encountered only between about 4850 and 5000 ft., which at the time of this ascent was in the clouds. On the western slopes it was found at about 4800 and at 5500 ft. This variety was also collected at Khor Aba in gallery forest on the Nile-Congo divide at about 3700 ft.

MYRMICINAE[1]

MESSOR

MESSOR BARBARUS GALLA var. RUFULA Forel

The typical *barbarus* is found in North Africa. Various forms are recorded from East Africa, the Anglo-Egyptian Sudan and French Equatorial Africa. One subspecies is recorded from former German Southwest Africa. In general the genus belongs to the desert or xero-

---

[1] Formal descriptions of new species and subspecies will be found on pp. 355–379.

phytic plains. Two forms of this and the species *cephalotes* are recorded from comparatively high elevations in Kenya (Naivasha, 1900 m. and Nakuru, 1820 m.). I found both these Kenya localities strangely like the high, dry and rolling plains of Montana and Wyoming though less than one degree from the Equator. *M. barbarus* ssp. *galla* Emery was observed at Nakuru collecting seeds and nesting in similar fashion to its congener in western U.S.A., *Pogonomyrmex occidentalis*. The var. *rufula* was originally described from Eritrea and has since been recorded from Khartoum. The specimens which I collected at Khartoum were identified as *rufula* during my visit to the British Museum. These correspond closely to the Imatong specimens.

This ant occurs at the eastern base of the Imatongs and at 4640 ft. on the slopes. A single nest was also found at 6200 ft., on the southeast slopes of Mt. Garia. A large nest excavated at the village of Longoforok looked exactly like the nest of *Pogonomyrmex occidentalis* on the northwest plains of the United States. Externally the nest appeared as a low cone of gravel in a circular cleared area. In the sandy soil beneath were numerous small, horizontal chambers. Dealate females and a winged female were found in the upper 30 cm. of the chambers and the brood was still deeper.

A nest at 4640 ft. was at the corner of the resthouse above Longoforok and was sheltered by the overhanging thatch roof from vertically-falling rain. A trail led from the nest over which workers were passing in both directions. While I watched, it started to rain. The ants at first paid no attention to the drops and walked as usual. Then when the roof started to shed water a small pool formed on the path 40 cm. from the nest. Pebbles in it were only partly submerged. Some ants crawled through the pool, using the pebbles as stepping stones where they lay in a direct line to the nest. One worker was completely submerged in the pool but walked under water directly towards the nest. Evidently sight plays a part in their travelling. The ants were given Sudan date fruit which they cut up and carried down the nest. They ignored a small *Xylanderia* worker which walked among them.

The nest at 6200 ft. occurred well within the *Acacia abyssinica* zone but in a grassy, rocky area with cycads and aloes. The colony was found under a slab of rock too heavy for three blacks and myself to lift so that the nest could not be excavated. This slab was next to a slab under which a colony of *Camponotus maculatus* ssp. *melanocnemis* Santschi was nesting. Under a small piece of rock Messor workers had excavated tunnels in which both the ants and Thysanurans were running freely.

PHEIDOLE

PHEIDOLE MEGACEPHALA (Fabr.), subsp. near PUNCTULATA (Mayr)

The typical *megacephala* is found throughout the warmer parts of the world and is recorded from all parts of Africa. Eleven or twelve forms are also known from this continent, which is probably the original home of the species. This Imatong form is close to the ssp. *punctulata* (Mayr), described from Caffraria and since recorded from widespread African localities.

One nest was found on the eastern slope in a mountain meadow at an elevation of 7570 ft. Under a triangular rock about 15 cm. high and 20 x 30 x 30 cm. on the sides was a large colony of this small species. While irregular chambers extended into the wet black humus practically all of the brood and callows were stuck to the under surface of the rock. This was one of many lichen-covered rocks in a grassy glade that received sunlight when the skies momentarily cleared. The warming of the rock under sunshine would create a favorably warm encironment for the ant brood and accelerate development. In the soil around the chambers were termites (*Anoplotermes* sp.) which were attacked by the ants when the rock was lifted.

PHEIDOLE MEGACEPHALA (Fabr.), subsp. 1402, 1384

The present form differs from the subspecies described above and the typical form in its larger size and darker color. The head of the soldier also is proportionately broader.

A colony was found on the western slopes at an elevation of about 6800 ft. The ants had an ordinary crater in the soil at the base of a flower stalk which was at the edge of a rock outcrop in a grass-cycad-aloe area. Brood was found in chambers in the crater itself, slightly above the general soil level. Probably the result of the brood being kept this close to the surface was to be warmed more effectively by the sun; the time of development would thus be shortened. Another colony, also found on the west slopes but at an elevation of about 6200 ft., is similar in appearance. Several ants are slightly paler but still distinctly darker than the two forms previously mentioned. The colony was nesting under a simple crater 20 cm. in diameter in black soil; when the nest was exposed workers ran off with live worker termites which were also unearthed. At a distance of only 46 cm. from this nest was a nest of another form of *P. megacephala* (ssp. 1384) which, even to the naked eye, was distinctly smaller in both worker and soldier castes. The ants of the two subspecies mingled together in capturing termites.

PHEIDOLE MEGACEPHALA (Fabr.), subsp. 1384

This form is much the smallest form found in the Imatongs. In addition to the small size of both worker and soldier castes it is characterized by its very dark color and worker thorax being smoother than in the other forms.

A colony was found on the western slopes at an elevation of about 6800 ft. The crater nest of the ants was only 46 cm. from that of the ssp. 1402, 1384. The crater nest was 7.6 cm. in diameter, compared with 20 cm. in the other subspecies. Both sets of workers and soldiers mingled without hostility in capturing termites.

PHEIDOLE sp. near LIENGMEI Forel

This large species runs in Arnold's *Pheidole* keys (1920) to the *sculpturata* group and in this key to *liengmei* Forel. It agrees with his figure of the soldier *liengmei* head in general form except for the occipital corners being less sharply angulate and the transverse rugae being more reticulate. *P. liengmei* was originally described from Portuguese East Africa and it or its several forms have since been recorded from South Africa, Belgian Congo, and Tanganyika.

A soldier and probably conspecific workers were found on the east slopes above Molongori at an elevation of about 3300 ft. The ants were crawling over the ground in sparse grass-woodland.

PHEIDOLE sp. 1406

This dark brown to black species is characterized in the soldier caste by the finely and densely punctuate sides and occiput of the head. It differs from the species in collections in the U. S. and may well be new.

The ants occurred in the vicinity of a nest of *Meranoplus nanus* (*q. v.*) on the west slopes at an elevation of about 4900 ft. The ants were on the ground in the high (10 ft.) grass with scattered trees. The same species was found in humus in high rain forest of Khor Aba on the Sudan-Belgian Congo border west of the Imatongs, and on the plains in Long. 30° 37′ E.

MYRMICARIA

MYRMICARIA EUMENOIDES OPACIVENTRIS var. CONGOLENSIS Forel

Plate 9

This polymorphic variety of a more widespread African species is reported from a belt of about five degrees north to twelve degrees south of the Equator across the continent. The maximum elevation recorded is 1400 m. on Mt. Ruwenzori (Wheeler, 1922, p. 825).

It was taken on the plains surrounding the Imatong Mountains and on the lower montane slopes but was especially abundant in the *Acacia abyssinica* zone. The maximum elevation where it was found nesting was about 7300 ft. which was here the upper margin of the *Acacia*. In this zone the *Myrmicaria* and *Dorylus molestus* (*q.v.*) were the co-dominant ants. It is essentially a forest insect though foraging freely at the margins of meadows and rocky outcrops. While usually the workers forage on the ground they were also observed climbing the *Acacia* trunks. The ant is insectivorous and workers were found carrying parts of adult and larval insects; one worker came to its nest carrying an ant of the genus *Crematogaster* which was still alive though missing its gaster (abdomen) and right hind femur.

The nests are formed either in the shape of earth mounds or simple craters, or under a flattish stone with no mound; all have subterranean galleries and chambers. The largest mound seen was one occupying an elliptical area 65 x 70 cm., having a maximum height of 15 cm. and with chambers extending down 70 cm. The queen and brood were in the bottom 10 cm. zone of chambers. Another large colony estimated to contain about 10,000 workers was found under a rock. The superficial galleries and chambers exposed by overturning the rock occupied a triangular area 30 x 40 x 49 cm. Chambers extended to 45 cm. and the queen was found at 42 cm. The subterranean chambers had a flat floor about 50 mm. in diameter with an arched ceiling a maximum of about 25 mm. high. In the large nests are found many Thysanurans, evidently scavengers usually ignored by the ants. A mound nest was seen which had been freshly trampled by what was probably a giant forest wart hog whose rootings were numerous therebouts.

On the same day when *Dorylus molestus* (*q.v.*) files were unusually numerous, sample counts of *Myrmicaria* trenches across my trail showed them to occur from five to ten times in 1350 ft. of trail, an average of at least 20 to 40 per mile of trail. Every trench represented a colony. The figures do not permit an accurate estimation but indicate a population of several hundred colonies per square mile.

CREMATOGASTER

CREMATOGASTER (C.) CASTANEA INVERSA var. FLAVIVENTRIS Sants.

C. castanea was originally described from Natal and it or its numerous forms are distributed generally throughout South and East Africa. It is apparently uncommon in West Africa. The variety *flaviventris* was originally described from the Belgian Congo and has since been recorded from Uganda.

Specimens agreeing well with Santschi determined Congo specimens except for darker head and thorax were taken in the Imatongs at elevations of about 6200 ft. and 6900 ft. in meadows on the western slopes. Those at 6200 ft. were nesting in the crevice of a rock situated amidst grass, aloes and cycads. They had walled 100 cm. of the crevice on one side and about 50 cm. on the other side with an unusually tough carton.

CREMATOGASTER (C.) CASTANEA F. Smith, subsp.

Workers belonging to an unknown subspecies of *castanea* were taken on the eastern slopes above Molongori at an elevation of about 2800 ft. These were in mesophytic grass-woodland.

CREMATOGASTER (C.) CHIARINII Emery, subsp.

C. chiarinii was originally described from Ethiopia. Varieties and subspecies have since been described from East Africa and the Congo. Khartoum, Sudan, is the type locality of the subspecies *subsulcata* Santschi, and I found a large colony of this ant in that city. The Imatong form differs both from *subsulcata* and workers from Tanganyika determined by Mr. Donisthorpe as *chiarinii*. It is lighter than either and differs in details of sculpture and pilosity.

Workers were taken on the eastern slopes above Molongori at an elevation of about 3300 ft. The ants were nesting in a clay nest of the common termite hereabouts, *Macrotermes natalensis*.

CREMATOGASTER (C.) sp.

This medium-sized dark and shiny species was found at the eastern base of the Imatongs near Molongori. The workers and ants of *Lep-*

togenys sp. were crawling on the base of a tall chimney mound of the termite, *Macrotermes jeanneli*.

CREMATOGASTER (C.) LATUKA spec. nov. (cf. p. 345)

This new species resembles in general habitus *C. gallicola* Forel described from Delagoa and *C. vulcania* Santschi from 2140 m. at Longonot Neck in Kenya. Specimens of the latter which I collected from *Acacia* galls at Nairobi, Kenya, are black and differ also in other characters. It has the color of *gallicola* but differs in spinosity and sculpturing.

A colony of this ant was found above Molongori on the eastern slopes at an elevation of about 4600 ft. The workers were found in a hollow twig 3½ ft. above ground on the slope of a ravine.

CREMATOGASTER (DECACREMA) LANGO spec. nov. (cf. p. 346)

This tiny new species is related to *C. liengmei* Forel of South Africa.

It was found on the eastern slopes above Longoforok at about 4000 ft. on the steep, rocky slopes covered with sparse grass-woodland. A worker was taken on a green leaf four feet above ground.

CREMATOGASTER (ORTHOCREMA) SORDIDULA Nyl,
MOLONGORI subsp. nov. (cf. p. 347)

The typical *C. sordidula* occurs in the region of the Mediterranean and in Turkestan and the Caucasus. Several forms are described from South Africa, one of which (*rectinota*) occurs also in Tanganyika.

Workers of the new subspecies were taken on the eastern slopes above Molongori at an elevation of about 4000 ft.

CREMATOGASTER (ORTHOCREMA) sp.

This ant, only 1.8 mm. long, belongs to a subgenus containing but few African ants.

A worker was found on the eastern slopes above Molongori at an elevation of about 4000 ft. in grass-woodland.

CREMATOGASTER (ATOPOGYNE) AFRICANA Mayr, POLYMORPHICA subsp. nov. (cf. p. 347)

C. africana was originally described from Cameroon. Over a dozen varieties and subspecies have since been described but the distribution of them has been entirely West African except for a Rhodesian record. There are several Belgian Congo forms, including *tibialis, fickendeyi schumanni, laurenti,* and *zeta.* The Imatong new subspecies differs from all chiefly in its larger size, and for *Crematogaster,* extreme polymorphism. The genus *Crematogaster* is formally characterized as having monomorphic workers yet the Imatong subspecies is as polymorphic as many polymorphic ants. This striking condition was distinctive in the field and far exceeds that found in any of the hundreds of species of this world-wide genus I have encountered in the field or seen in collections. As they walk, the workers range in size from 3.3 to 6.4 mm. Of the numerous South African Crematogasters described by Arnold only one (*C. acaciae victoriosa* Sant.) has a worker varying as much as two millimeters (3–5 mm.).

A dense file of workers was crossing a log on the western slopes at an elevation of about 4500 ft. in high rain forest.

CREMATOGASTER (ATOPOGYNE) DEPRESSA Latr., var. FUSCIPENNIS Em.

C. depressa was originally described from the Guinea Coast and it and its two varieties are recorded from only West African localities. The subgenus itself is West African.

Workers of *fuscipennis* were taken on the western slopes of the Imatongs at an elevation of about 4700 ft. The ants were about 30 ft. up in a tree and had erected carton sheds between small lianas and the tree trunk. Their bite could be felt distinctly and made my position in the tree uncomfortable. They were seen only in one khor of high rain forest and some were striking in appearance because of their dark brown head and thorax and bright yellow gaster. In others the gaster (abdomen) was darker and contrasted less with the rest of the body.

CREMATOGASTER (SPHAEROCREMA) GAMBIENSIS (E. André), subsp.

The typical *gambiensis* is recorded from West and East Africa. A variety is known from Natal and the var. *transversiruga* Santschi is described from Lado and Redjaf on the upper White Nile.

Workers of this sub-species and *Pheidole* came to a nest of *Myrmicaria congolensis* which I was observing. The nest was found at 6790 ft. in the *Acacia abyssinica* zone.

CREMATOGASTER (SPHAEROCREMA) sp.

Workers of this unknown species were taken at Longoforok at the eastern base of the Imatongs at an elevation of about 3200 ft. The ants may be recognized by their shiny, ferruginous body with stout. recurved epinotal spines.

CREMATOGASTER (SPHAEROCREMA) LOTTI spec. nov. (cf. p. 358)

This dark, shiny species with a smoothly concave pronotum is related to *C. bequaerti*. It appears to be common in the Lotti Forest and was taken a number of times. A colony was found at a height of 80 cm. in a hollow stub of a branch. The stub was eight centimeters long and contained a queen with 66 workers, pupae, larvae and eggs. These workers were mostly much paler than those collected elsewhere in the forest.

CREMATOGASTER (SPHAEROCREMA) ZONACACIAE spec. nov. (cf. p. 359)

This species is close to *C. bequaerti*, *kneri* and *striatula*, all described from West Africa. Varieties of *bequaerti* and *kneri* have since been described from East and South Africa. It might perhaps be attached to any one as an extreme subspecies. From *striatula* var. *obstinata* Santschi of the Congo it differs chiefly in distinctly larger size and darker color.

Workers were taken on both the eastern and western slopes of the Imatongs. At an altitude of 6800 ft., well within the *Acacia abyssinica* zone, several were under a stone in a clearing. One was taken as it came to a nest of *Myrmicaria congolensis* which I was examining. To this same nest a *Myrmicaria* worker came with a *Crematogaster* which was still alive though its gaster and right hind leg were missing. At an altitude of about 4700 ft. on the western slopes a colony was found nesting in a hollow liana from 60 to 90 cm. above ground.

A female, doubtless conspecific with the above workers, was taken on the eastern slopes at 6400 ft. She was in a rotted twig 30 cm. above a boulder beside a waterfall and starting her colony. The twig was 12 mm. in diameter with a central cavity 5.5 mm. in diameter and 18 mm. long. Several elliptical white eggs 0.57 x 0.34 mm. and nine small larvae were found.

Monomorium

Monomorium (M.) minutum Mayr, kineti subsp. nov. (cf. p. 359)

Plate 10

M. minutum was originally described from Italy. One of the numerous subspecies and varieties since described is the subspecies *minimum* Buckley which is common and widespread in North America. Other forms have been described from as widely separated localities as Hawaii, Brazil, and Java. Several forms have been described in Africa, from Eritrea to South Africa.

The only ant extending to the top of the highest peak in the Imatongs, Mt. Kineti (10,458 ft.), proved to be a new subspecies of *minutum*. It is related to the subspecies *pallidipes* Forel of Eritrea, Kenya, and the lower Sudan but clearly distinct from the latter and other forms. *M. pallidipes* was recorded from 1700 m. (5576 ft.) in Kenya. No other species of *Monomorium* has been recorded before from over 2800 m. (9190 ft.) in Africa but this is probably due to the small size and inconspicuousness of the ants. It is probably a characteristic ant of higher altitudes in African mountains in general.

M. kineti was abundant on the very top of Mt. Kineti. Immediately after reaching and photographing the cairn at the highest point on the peak I sought for ants in the turfy ground. Most of the time the sun was hidden by low clouds which eventually enveloped us and the temperature was so cool that it seemed unlikely that ants would be scurrying about. Only after some search was the first colony found. It was nesting 10 ft. from the south base of the cairn at the base of a ten-inch dead, woody stem. None of the ants were above ground and it was only by pulling up the stem that the ants were discovered. They occupied cavities in the rotted base which was one to three centimeters in the soil, or in irregular chambers in the surrounding rich, black soil. Besides brood the nest contained a single male, a winged female and two dealate females. After discovering that ants were not exposing themselves to the clouds of Mt. Kineti but were in their nests, seven more nests of *Monomorium* were found on the summit during a systematic search. These nests were in the soil under small stones or among roots of grasses growing as small hummocks with a south, east or open exposure. Five of the nests were about roots of several species of grasses on which the ants were pasturing coccids and at depths up to seven centimeters. In some cases the coccids were in the same chambers as the brood of the ants; in other cases the two were separate but in adjacent chambers. When one nest was exposed the ants sluggishly carried away their own brood and left the coccids in an adjacent chamber to walk away by themselves. Six queens were taken from this nest and there were possibly more. In another nest the exposed tunnels reached a depth of nine centimeters and went down still deeper; most of the coccids here were in rootless chambers with ant brood and on bare rock forming one of the walls.

About 200 ft. below the top of Mt. Kineti on the west slope a colony was found, pasturing coccids on the roots of a moderately coarse grass. At an elevation of about 250 ft. still lower, workers were found running at four to five feet over damp, decayed bark of a tree standing in grass about 100 feet from cloud forest on the steep west slope. In the forest itself a large colony was seen on the southwest side of a tree in dead wood at a height of three feet.

At an elevation of 8785 ft. this subspecies was found running on a moss-lichen covered tree trunk four to five feet above the ground in cloud forest that contained no terrestrial ants. The ants crawled sluggishly. Careful search in the surrounding soil revealed only snails, earthworms, spiders, centipedes, beetles and an ichneumon-like wasp. Though mid-day the air was cool and except in direct sunlight the ground was cold.

The lowest elevation at which this ant was found was 8180 ft. Four nests were found at the edge of a *Podocarpus* forest. Three were in herbaceous stems in the margin of the mountain meadow. One of these was in a stem 15 mm. in diameter lying in bracken. The inside of the brood cavity was wet. Another was in a vertical stem. The ants occupied various parts of the rotted pithy cavities to a height of 25 cm. One of the four nests was in a rotted knot of a lichen-covered dead tree at a height of five feet.

The coccids from the Mt. Kineti nests have been identified by Dr. Harold Morrison as a probable new species belonging to what European workers have regarded as the genus *Ripersia*. The coccids are closely related to *Ripersia glandulosa* James of Nyeri, Kenya. The same species of coccid was tended by the ant, *Tetramorium squaminode nubis* (*q. v.*) at an elevation of 9200 ft.

MONOMORIUM (M.) MINUTUM Mayr, ARBOREUM subsp. nov. (cf. p. 360)

The palest *Monomorium* found in the Imatongs proved to be this new subspecies. A single colony was taken at an elevation of about 6200 ft. on the west slopes in forest of moderate height but of a peculiar open type. The ants were nesting in humus about the roots of a large fern plant growing from a tree at a height of about 16 ft. A single worker of the remarkable new dolichoderine genus, *Axinidris acholli* Weber, was also found here.

MONOMORIUM (M.) MINUTUM Mayr, subsp. 1365

This form was taken once at an elevation of 4640 ft. on the east slope of the Imatongs. While I was taking refuge from a rain under the thatch of the resthouse above Longoforok a worker crawled over my hand and another was observed on the mud wall. The yellow-tipped antennae contrast with the dark shiny body which is darker than that of *kincti*. The color, even and feebly convex basal surface of the epinotum and the proportions of the postpetiole distinguish it from the other forms of *minutum*.

MONOMORIUM (M.) ESTHERAE spec. nov. (cf. p. 361)

This new species is close to *minutum* but differs from the forms of *minutum* found in the Imatongs in shape of head and pedicel, in length of scape, and in color.

A single colony was found on the west slopes at the lower level of the *Acacia abyssinica* zone at an elevation of about 5000 ft. The ants had formed a tiny crater in the soil of an open grass-woodland slope. A single worker which appears to be this species was taken on the west slopes in heavy forest at an elevation of about 6100 ft. The forest was characterized by the presence of *Dracaena fragrans*. The ant was under the bark of a log on the ground.

MONOMORIUM (XEROMYRMEX) BICOLOR, near subsp. NITIDIVENTRE Emery

This bicolored small *Monomorium* was originally described from Aden, Arabia, and has since been reported from Egypt to the Orange Free State. I took it at Atbara (Lat. 17° 40′) on the Nile and at Ed Dueim (Lat. 13° 59′) on the White Nile. A single worker, now headless, taken in the Imatongs appears to be a small form close to *nitidiventre*. It was found at an elevation of about 6000 ft. on the western slopes in the lower limit of the *Acacia abyssinica* zone.

SOLENOPSIS

SOLENOPSIS PUNCTATICEPS Mayr, JUBA subsp. nov (cf. p. 362)

Plate 11

The typical *punctaticeps* is known from various parts of South Africa with one record from the southern part of the Belgian Congo. Seven varieties or subspecies are known from South and East Africa.

This new and tiny yellow subspecies, dedicated to Juba, king of Numidia in Pompey's time, is one of the most abundant and characteristic ants of the meadows of the cloud forest-mountain meadow zone. A number of nests were found under or beside rocks in exposed grassy situations at elevations of 7570 to about 9200 ft. One colony was taken in the upper margin of the *Acacia abyssinica* zone at 6790 ft. under a stone in a grassy area, a habitat consistent with those higher up. It evidently demands a cool, moist and open situation and was never found in forests or under heavy shrubbery. As is true of many species of *Solenopsis,* this species is probably clestobiotic for galleries of their nests were found anastomosing with galleries of *Tetramorium simillimun isis*, *Tetramorium squaminode nubis* and *Camponotus maculatus nubis*. They may rob the larger ants of food and brood, be simple carnivores, or may "milk" coccids which lived on the roots of grasses extending into at least one nest. While they showed no hostility towards the sluggish *Tetramorium*, one *Camponotus* was firmly gripped on each mesothoracic leg by two *Solenopsis* when the two nests were exposed. The colonies are sometimes very large, certainly of many thousands, and the numerous galleries may ramify through an area of several square feet. Commonly the brood is kept in the superficial chambers immediately beneath a rock and segregated according to size and stage (egg, larva or pupa). Alate and dealate females were taken in one nest July 28 at about 9200 ft. The workers have the habit of holding the gaster upright at about a 45° angle when disturbed, like *Crematogaster*.

ANELEUS

ANELEUS POLITUS Santschi

This species has been known only from the original collection made in Kenya at an elevation of 1520 m. Nothing on the ecology is recorded.

At higher elevations, 6200 to 6400 ft., this ant was found upon several occasions in the Imatongs. While the localities were in the

Acacia abyssinica zone the forest in these localities was of a different nature and appeared more like rain forest. Lianas, mostly less than 10 cm. in diameter, festooned the medium-sized trees and looped to the ground. The conifer, *Podocarpus,* occurred but was nowhere dominant. Also characterizing the forest was the palm-like liliaceous plant, *Dracaena fragrans* (Plate 7).

In this moist habitat the *Anelcus* occurred under bark of rotted logs on the ground. Occupying the same micro-habitat were *Tetramorium simillimum* and *Ponera mesoëpinotalis.* All were comparatively sluggish and of small size.

PAEDALGUS

PAEDALGUS SUDANENSIS spec. nov. (cf. p. 365)

Two species of the genus *Paedalgus* are known from Africa, *infimus* Santschi of French Guinea and *termitolestes* Wheeler of the Belgian Congo. Only one other species, *escherichi* Forel, is recorded in the *Genera Insectorum.* This is the genotype and is from Ceylon. The two African species are known only in the worker castes and are 0.8 to 1.0 mm. in length.

What is probably a female of this genus was taken at the east base of the Imatongs at an elevation of 2530 ft. Since no African females are known, it is impossible to correlate it with either of the two species. It agrees with paratype workers of *termitolestes* in general sculpturing of the head and thorax and in the structure of the pedicel but is, of course, much larger, is much darker, has differently shaped funicular joints though 10 in number, epinotal tubercles, gastic sculpturing and pilosity. The whole ant is covered with a fine, dense, whitish pilosity which is very short and upright. The ant was captured as it crawled about in the evening and had probably been attracted by the camp light.

HYLIDRIS

HYLIDRIS MYERSI Weber

I recently described this distinct new genus and species from specimens which I found in Khor Aba on the Belgian Congo-Anglo-Egyptian Sudan border. These ants were in humus on the floor of high gallery forest.

One worker was collected in the Lotti Forest. The ant was crawling over an open place in the forest floor after the regular afternoon rain.

MERANOPLUS

MERANOPLUS NANUS subsp. SORICULUS Wheeler

M. nanus was originally described from the French Congo and the subspecies *soriculus* from the Belgian Congo.

A polymorphic colony was taken on the western slopes of the Imatongs at an elevation of 4900 ft. The slopes were covered with grass over ten feet high with scattered trees, including *Acacia*. The ants looked like hairy spiders because their telescoped thorax made the body resemble the cephalothorax of spiders. They were nesting at the base of a clump of grass and had their brood in a chamber 35 mm. below the entrance. The hairy larvae stuck to the sides of the small chamber; the ants moved slowly and had it not been for approaching rain and a long trek ahead the colony could easily have been collected in entirety.

CALYPTOMYRMEX

CALYPTOMYRMEX (C.) BREVIS spec. nov. (cf. p. 366)

The genus *Calyptomyrmex* includes two subgenera, *Calyptomyrmex s. str.* and *Dicroaspis*. Both include rare and tiny ants with the general habitus and behaviour of *Strumigenys* except for normal myrmicine mandibles. The resemblance is the more marked because of the large, squamate body hairs.

The species of *Calyptomyrmex s. str.* are West African except for a Rhodesian species. The present species appears related to *C. piripilis* Santschi, judging from the original description, but is smaller and with epinotal and petiolar structural differences.

Collections of this species were made twice on the western slopes of the Imatongs at elevations of about 3300 and 4200 ft. Workers were taken in the Lotti Forest in a rotted log on the ground. The ants were in red clay filling the hollow shell and above the general soil level. A colony was taken at 4200 ft. in the grass-woodland margin of a khor filled with rain forest. The ants were nesting in the red clay above the brood chambers of a colony of the large ant *Camponotus* (*Dinomyrmex*) *pompeius cassius*. The *Calyptomyrmex* nested several centimeters beneath the soil in irregular tiny chambers. They were slow-moving, "feigning death" momentarily when disturbed and greatly resembled neotropical dacetonines.

MACROMISCHOIDES

MACROMISCHOIDES VIRIDIS spec. nov. (cf. p. 367)

The genus *Macromischoides* was erected by Wheeler in 1920 for two closely related and distinctive species (*aculeatus* and *africanus*) which Mayr in 1866 described and placed in the neotropical genus *Macromischa*. These species were placed by Emery in 1896 in the genus *Tetramorium*. They differ from *Tetramorium* morphologically and in their habit of building carton nests in trees. Both are recorded from various West African localities and the basin of the Congo. Santschi has recently (1937) recorded a third species from Cameroon.

The present new species was taken to the British Museum on my return from Africa and my colleague, Mr. Donisthorpe, and I endeavored to determine it. He had received workers from the Musée Belge from the Congo and determined these as new. Mine appeared conspecific and in view of the fact that I had taken male, female and worker castes he suggested that I describe them.

This species is notable in having the gaster (abdomen) a distinct metallic bluish-green in color. The color is more noticeable in life than when preserved dry or in alcohol though it is not alcohol-soluble and is probably a structural color.

The species occurs on the western slopes of the Imatongs where it was taken at elevations of about 4200 and about 4700 ft. Carton nests of five colonies were found in rain forest. Five nests were on leaves of *Afromum* and two on leaves of a large tree, *Pseudospondias microcarpa.*

Three nests were found on leaves of a plant 2 meters high of *Afromum*, one at a height of about 1.5 m. Four other nests were on leaves of other specimens of the same species of plant. This plant grew in a rank growth of herbs, small trees, vines, and scattered large trees in a khor that was elsewhere covered with high rain forest. The *Macromischoides* was the dominant ant as well, perhaps, as the dominant insect in an area of this rank, low growth about 7.5 m. long and 2 m. wide. They overran the vegetation in large numbers and stung viciously. The ants did not make for the head especially as a related species has been reported to do in the Belgian Congo (Wheeler, 1922, p. 189). The sting of the ants in this locality lasted only momentarily, hardly a minute, but those nesting in *Pseudospondias* some miles away stung much more fiercely.

The nests in *Afromum* were chiefly on the underside but also on top of the long leaves. They varied in length from 95 to 300 mm. and in width from 40 to 110 mm. with an average length and width of 195 x 76 mm. The carton was vegetal in origin and some gave off a green color in alcohol. Plant fibers of varous kinds were used. The next consisted of walls and either a top or bottom of carton, depending upon whether the leaf afforded a floor or a roof. The height of the space thus available varied from 0 to 13 mm. Much brood was found in several nests, also winged males which did not attempt flight when the nests were disturbed. The plant was so dependent on a constant water supply for its turgidity in this humid khor that, when one was cut and taken out to a clear area for photographing, the leaves curled up in the five or ten minute interval. While hunting hornbills about one-half mile distant many plants of *Aframum* were examined but they contained no ants.

The two nests on the *Pseudospondias* tree were 2.1 and 2.4 meters above the ground. Many other nests were seen higher up on the tree on the same west side. The ants used a curled-up leaf for nesting, walling up the openings with carton, or suspended a nest of carton from the under surface of a fresh green leaf.

The stings of these ants were more painful and more virulent than those on *Aframum*. A number stung me at 12 noon and from 12 to 12:40 p.m. a score of lesions became apparent on the medial surface of the right forearm where the hair was comparatively scanty. The lesions were 3–5 mm. in diameter and in color like a mosquito "bite." At 1:30 p.m. the pain was gone but the lesions still apparent.

OCYMYRMEX

OCYMYRMEX WEITZECKERI Emery, CELER subsp. nov. (cf. p. 368)

The genus *Ocymyrmex* has not hitherto been recorded from this part of Africa, being known only from about 15° S. Lat. southwards and from a strip of East Africa extending to the Gulf of Aden. The present record extends the range markedly towards the West African rain forest. The range of the genus, however, still includes only the deserts and dry plains. The ants are particularly well adapted to life in these regions because of the rapidity with which they can move over the hot ground and because of the psammophore or beard of long hairs which probably tends to reduce evaporation from the mouth.

O. weitzeckeri was originally described from Basutoland and has since been recorded generally from South Africa, except the southern part, and up to Angola and Tanganyika.

This new subspecies inhabits the dry plains with scanty, short grass and thorn scrub immediately to the north of the Imatongs and may well be found on the dry lower slopes. They were collected at Torit, Muragatika, and several miles north of the northern base of the mountains.

The ants form a crater type of nest on the plains. One crater was 21 cm. in diameter and 15 mm. high, with brood kept in chambers deep in the soil. A nest was excavated to a depth of 40 cm. without finding brood. At a depth of only 3.8 cm. in another nest, however, a small chamber was found containing flower parts and remains of eight workers of *Euponera* (*Brachyponera*) *sennaarensis* (Mayr). This is evidence that they not only are harvesters, as has been supposed, but also insectivorous.

Astonishingly "intelligent" behavior was exhibited by workers of one colony. On a calm, hot and clear afternoon at 4:35 p.m. when I came to within 27 cm. of their nest they ran for their crater nest entrance in great agitation and disappeared down it. I then stood still with the forward foot 27 cm. from the entrance but my shadow was cast toward it. One worker quickly rushed out and began dragging down pebbles (3–4 mm.) in diameter up to half the length of the ant. After several minutes of this frenzied activity it not only filled up the hole but made a slight mound above. The ant stood with its posterior end toward the hole and, using its fore legs as a dog would, sent a shower of sand and small pebbles towards this entrance. It actually cleared away all loose soil on the side of the nest opposite from me in the form of a semicircle. At 4:45 I moved to a point 100 cm. away. At 4:48 it circled the top of the mound several times. At 4:53 a native called my attention to something and when I momentarily looked away the ant disappeared. After an intensive search it seemed possible the ant had gone down a small hole nearby which may have been a side entrance. The original hole, of course, was entirely filled up. The ant may, however, have wandered off to spend the night under any shelter available until the nest would be reopened by the ants in the nest.

A possible interpretation of this behavior is that ordinarily the setting sun causes scrub on the west side to cast a shadow over the entrance, and stimulates the ants to fill it up for the night. When I cast a shadow at 4:35, when the sun was already low in the sky, this was the same kind of stimulus but merely premature. The ants, however, responded so quickly that they seemed to act in a purposeful or "intelligent" manner to protect their nest from the threatened danger.

TETRAMORIUM

TETRAMORIUM VITICOLA spec. nov. (cf. p. 372)

This species is remarkable in being an arboreal species, the species of *Tetramorium* being terrestrial like *Myrmica* of the Holarctic Region and closely resembling the latter also in appearance. The genus *Leptothorax,* resembling both genera, contains many twig inhabiting species and is found rarely in Africa. That the present anomalous species cannot belong to *Leptothorax* is indicated by the sharply trenchant ridge of the clypeus in front of the antennal insertions.

A colony was found on the western slopes of the Imatongs at an elevation of about 4700 ft. The ants nested in high rain forest of a khor in a dead hollow liana attached to a tree at a height of 30 feet above the ground.

TETRAMORIUM SIMILLIMUM (F. Smith)

The Imatong specimens agree well with specimens from Java, Fiji, Queensland, Jamaica and Cuba of this tropicopolitan species except in slightly darker color. No less than six varieties and subspecies from African localities are recorded in the Wheeler catalogue and in addition, recorded in the *Genera Insectorum,* are an Indian subspecies and varieties each in Ceylon and Madagascar. The preponderance of African forms points to Africa as the original home of this tropicopolitan species, and this is further attested by the present and other Central African records. All of the Imatong specimens were found on the west slopes at elevations of 6100 to 6600 ft. While within the *Acacia abyssinica* zone the ants were not found in this forest but always in a peculiar type with *Dracaena fragrans, Podocarpus* and other trees with numerous lianas looping to the ground.

A colony was found nesting in the juicy white stump of a *Dracaena* about two feet from the ground. Part of the nest was under moss in humus filling the depressed upper end of the stump. Another colony was nesting under the mossy bark of a fallen tree. A third colony, also under bark of a fallen tree, had irregular chambers in which larvae were scattered and held in place by their hairs. The workers "feign death" momentarily but can move comparatively fast.

TETRAMORIUM SIMILLIMUM (F. Smith) ISIS subsp. nov. (cf. p. 373)

This new subspecies of *simillimum,* dedicated to the Egyptian goddess Isis, is distinctly darker than the typical form and differs in details of structure. It also occurs mostly at higher elevations in the Imatongs, and on both slopes, though colonies were found at elevations from 4900 ft. to 8700 ft.

At 4900 ft. a colony nested in a grass-woodland area with grass 10 ft. high and scattered *Acacia* trees. The nest was under thin moss on dark red slippery soil 11 cm. from the nest of *Meranoplus soriculus* (*q.v.*). The *Tetramorium* occupied superficial galleries 2–4 cm. down. Workers at 6800 ft. were crawling on wet ground in weedy growth of an open area in *Acacia abyssinica* forest.

Those ants found at 8500–8700 ft. were in grassy areas or on lichen-covered rocks of rocky outcrops. Several nests were in the form of irregular chambers in the black humus under flattish rocks.

Tetramorium squaminode Santschi, nubis subsp. nov. (cf. p. 369)

This new subspecies and the typical form are of particular interest in that they seem to be confined to cloud forests at comparatively high altitudes. Alluaud and Jeannel made a number of collections of *squaminode* in the alpine zone of Mt. Kilimanjaro (2600–3800 m.). The highest collections were recorded from the "zone des bruyeres superieures, altitude" 3,800 m. (Santschi, 1910, p. 356). There are three additional forms of this species (ssp. *do* Forel, vars. *flaviceps* and *mus* Arnold) from hills in Rhodesia, the altitudes not being stated but presumably being much lower.

The Imatong collection was made at about 9200 ft. in a meadow. The ants were nesting in black humus beside a rock. Their galleries were exposed to a depth of 70 mm. and a breadth also of 70 mm. On grass roots (Myers No. 11580) penetrating the galleries were coccids tended by the ants. The coccids, "*Ripersia*" probably n. sp. near *glandulosa* James, were of the same species as those tended by *Monomorium kineti* (*q.v.*).

In the nest was a small ferruginous beetle, evidently a myrmicophile, which had trichomes or coarse hairs bordering the head and pronotum.

Tetramorium sericeiventris var. arenarium Santschi

The variety *arenarium* of a widespread African species was described from Tunis and has since been recorded from Algeria, Senegambia and Abyssinia. Santschi also has recorded both this variety and his variety *hori* from Khartoum, Anglo-Egyptian Sudan. As probably only one variety occurs in this city and as both were described originally at the same time and on the same page the name of the first one is used. My specimens from the Imatong region and those I took at Khartoum are of the same form.

This ant is an ant of the xerophytic plains and was found on the plains immediately north of the Imatongs. Like *Ocymyrmex* it probably occurs on the dryer slopes. At Khartoum it had the curious habit of using the feces of small birds, especially the Sudan race of *Passer domesticus,* on its craters. Probably the function of the small bird feces was to act as a barrier to the swirling sand of the desert which would tend to fill the nest entrance.

TETRAMORIUM GUINEENSE subsp. MEDJE Wheeler

The subspecies *medje* of the cosmopolitan *guineense* was described from Medje, Belgian Congo. It occurs on the eastern slopes only in the sparse grass-woodland of the lower slopes to 6000 ft., the level of the *Acacia abyssinica.* Workers were found at 6000 ft., carrying live nymphs of the termite, *Cubitermes* (?) sp.

TETRAMORIUM JEANAE spec. nov. (cf. p. 371)

This distinct new species with comparatively smooth integument belongs to the distinctive ant fauna of the peculiar forest of *Podocarpus, Dracaena* and lianas on the west slopes. The species was taken at an elevation of about 6400 ft. Other ants occurring here were *Ponera mesoëpinotalis, Tetramorium simillimum, Anelcus politus,* and *Plagiolepis sudanica.*

TETRAMORIUM BREVIS spec. nov. (cf. p. 370)

An unusually small worker found at an elevation of about 5600 ft. on the western slopes proved to represent a new species. The ant was among grass more than six feet tall.

XIPHOMYRMEX

XIPHOMYRMEX WEITZECKERI Emery

This species was originally described from Natal and has since been recorded from Rhodesia, Angola, and the Belgian Congo. Two forms are present in the Imatongs, one of which is probably the typical form or very close to it. The latter is distinct from the new subspecies in having shorter antennal scapes, smaller size and paler color.

A dealate female was found on the western slopes at an elevation of about 3500 ft. The ant was in high rain forest above the Lotti Forest and was under leaves on the forest floor. A worker which agrees well with the female except for naturally smaller size was taken on the western slopes at an elevation of about 4800 ft. It was in open forest on the ground among leaves.

XIPHOMYRMEX WEITZECKERI Emery, EDITHAE subsp. nov. (cf. p. 375)

The present new subspecies, as mentioned above, differs from the typical form in having longer antennal scapes and much darker color. Compared with Orange Free State specimens it has also the sides of the petiolar node less convex, the postpetiolar node thicker and the hairs distinctly longer. The size is about the same.

This ant occurs on the western slopes of the Imatongs at the lower edge of the *Acacia abyssinica* zone (about 5700 ft.) and at about 4800 ft. Like other *Xiphomyrmex*, it is terrestrial.

XIPHOMYRMEX MINUSCULUS Santschi, ÅMEN subsp. nov. (cf. p. 376)

X. minusculus was described from Cameroon and has not been recorded elsewhere. The present ant, dedicated to the Egyptian god Åmen, agrees well with Santschi's description and figures, being similar in small size, dark color and general habitus. It differs, however, in shape of the epinotal spines, acute metasternal angles and proportions of the pedicel.

A worker was taken on the western slopes of the Imatongs at an elevation of about 4200 ft. The ant was found while excavating the nests of the *Calyptomyrmex-Camponotus cassius* association in grass-woodland near a khor of high rain forest.

XIPHOMYRMEX ZONACACIAE spec. nov. (cf. p. 376)

This new species appears to be one of the *Xiphomyrmex* species transitional to *Pristomyrmex* in having a carinate clypeal margin in front of the antennal insertions and a distinct transverse mesoëpinotal carina. Santschi (1923, p. 286) considers two African species, *fossulatus*

Forel and *orbiceps* Santschi, as belonging to *Pristomyrmex* which has been supposed to be a genus belonging to the Indomalayan, Papuan and Australian Regions. These were originally described as *Xiphomyrmex*. The Imatong species differs markedly from either of these.

The ants belong to the *Acacia abyssinica* zone where they were found at 6800 and 7100 ft. A colony found at the higher elevation was nesting in the soil at the side of an imbedded rock. Irregular chambers extended to a depth of about five centimenters and in one side view extended over an area 40 x 40 mm. The ants were timid and walked moderately slow.

TRIGLYPHOTHRIX

TRIGLYPHOTHRIX GABONENSIS E. André

T. gabonensis was originally described from Gaboon and has since been recorded from Cameroon and the Belgian Congo.

The Imatong ants resemble Congo specimens closely but are slightly darker and somewhat smaller in size. The species occurs in the Lotti Forest. Workers were found walking on the ground after a rain.

TRIGLYPHOTHRIX MUCIDUS Forel

T. mucidus was originally described from the Belgian Congo and has since been recorded from several localities in that country. A Congo new record is just within its boundary with the Anglo-Egyptian Sudan on the Aba-Nile road where I took it in 1939.

Ants agreeing well with Congo specimens were taken in the Lotti Forest. Workers were taken on top of a fallen log. Others were taken crawling on the ground.

TRIGLYPHOTHRIX CINEREUS spec. nov. (cf. p. 377)

This small, coarsely sculptured ant is characterized by the feeble antennal scrobe and the postpetiolar node which, from above, is over two and one-half times wider than long. It resembles *T. marleyi* Forel of Natal in general habitus but is specifically distinct.

The species occurs on the eastern slopes of the Imatongs at elevations of about 3800 and 4100 ft. A colony nested in the soil between rocks on a steep, rocky, grass-woodland slope at the former elevation. Entrance was a simple hole leading to the chambers in the dry soil. They moved with moderate slowness and were gray in appearance because of their dense multifid hairs.

CATAULACUS

CATAULACUS TRAEGAORDHI Santschi

This species was originally described from Zululand and varieties are recorded from the Belgian Congo and Uganda. The Imatong material is insufficient to determine whether it represents a form of *traegaordhi* but it differs in distinct details from the Congo var. *plectroniae* Wheeler and Santchi's figure of the Uganda variety. I have received the same species from Mafia Is., Tanganyika (D. Vesey FitzGerald).

It occurs on the western slopes in the Lotti Forest. A worker was found on a leaf about eight feet above ground.

CATAULACUS PYGMAEUS E. André, subsp.

This species was originally described from Sierra Leone and has since been recorded from the Belgian Congo. A number of subspecies and varieties are recorded from West and South Africa. I took a subspecies in the vast papyrus swamps of the White Nile or Sudd in about Latitude 8°N. which is smaller than the Imatong form (Weber, 1942a).

The present form was taken on the east slopes above Molongori at an elevation of about 4100 ft. The ant was on a dead grass stem at the margin of a bamboo thicket. When I made for it, it shifted to the opposite side of the stem and dropped down to the green grass below.

CATAULACUS sp. 1445

This species is striking because of its triangular head, anteroposteriorly compressed postpetiole, and almost circular outline of the gaster when viewed from above.

A worker was taken in the Lotti Forest on a leaf about eight feet above the ground.

CATAULACUS sp. 1445, 1447

This small species has a distinctive gaster which is elliptical, deeply and regularly rugose, and with numerous short pale bristles contrasting with the black integument.

Workers were taken in the Lotti Forest on leaves of trees.

STRUMIGENYS

STRUMIGENYS (CEPHALOXYS) ESCHERICHI Forel, LOTTI subsp. nov. (cf. p. 378)

The genus *Strumigenys* is cosmopolitan and contains a large number of species. They are small, rare, hypogaeic ants and sometimes are taken while examining leaf mold or rotted wood. There are probably a score of species of the subgenus *Cephaloxys* known afrom all parts of Africa. *S. escherichi* was described from Eritrea and at least five varieties and subspecies have been described from South and West Africa. The species has been taken oftener than any other species of the entire genus in Africa.

The Imatong specimens appear to be a new subspecies differing from a cotype of *escherichi* in the American Museum of Natural History in having the petiolar node less squarish, the median pronotal carina more distinct, the mandibles rougher and the color darker. Several workers were compared in the British Museum with *S. alluaudi* Santschi and this species is also close.

The ants were taken only in the Lotti Forest on the western slopes. They were found twice in rotted wood on the ground. They looked and acted exactly like their neotropical congeners.

DOLICHODERINAE[1]

AXINIDRIS

AXINIDRIS ACHOLLI Weber

This remarkable new genus and species of ant has been recently described (Weber, 1941 a). It differs strikingly from all known ants from Africa or elsewhere and the new tribe *Axinidrini* was proposed for it. It belongs to the subfamily *Dolichoderinae* which contains only one other endemic genus in Africa. Outstanding characteristics are the notched clypeus, six- and four-jointed maxillary and labial palpi, respectively, epinotal spines, and nodiform petiole. The character at once distinguishing it from other ants is the single projection rising from the epinotum, between the spines, which in profile resembles an axe blade, to which the generic name alludes.

It is known only from the Imatong Mountains. Workers were taken on the western slopes at elevations of about 4800 and 6200 ft. One was taken on the leaf of a liliaceous plant about seven feet above the ground. It probably dropped from the surrounding trees which were at

---

[1] Formal descriptions of new species and subspecies will be found on pp. 379–381.

least 100 ft. high. Another worker was taken from a branch which had just fallen 16 ft. from a tree. The forest here consisted of *Podocarpus,* lianas, etc.

TAPINOMA

TAPINOMA CARININOTUM spec. nov. (cf. p. 379)

This pale brown ant, only 1.9 mm. long, is distinctive in having a transverse carina separating the basal and declivous surfaces of the epinotum.

A worker was taken at the eastern base of the Imatongs at Longoforok (elev. 2900 ft.). Others were taken at the eastern base at an elevation of 2500 ft. (Lat. 4°4′N., 32°57′E.).

TAPINOMA sp. 1447a

This large, dark brown *Tapinoma* is distinctive with its white coxae, anterior part of the femora and tarsal joints.

Single workers were taken in the Lotti Forest.

TAPINOMA sp. 1447b

This species resembles sp. 1447a in general habitus, differing in smaller size, paler tibiae and angular epinotum.

It occurs also in the Lotti Forest.

TECHNOMYRMEX

TECHNOMYRMEX ALBIPES (F. Smith) TRUNCICOLUS
subsp. nov. (cf. p. 380)

The typical *albipes,* originally described from Celebes, seems to be spreading throughout the tropics and warmer parts of the world. Three forms have been recorded from Africa, one variety being from 1900 m. at Naivasha, Kenya. After leaving the Sudan I passed through Naivasha; it appeared distinctly more arid, the grass sparser and the temperature fully as cool as the conditions under which the Sudan subspecies was collected.

Two colonies were taken on the west slopes in open areas of the *Acacia abyssinica* zone at 6200 ft. One nested in a twig of a lichen-covered gnarled tree with apple-like leaves. The other nested along about 18 inches of a dead flower stalk. A single worker taken at an elevation of about 4800 ft. on the west slopes appears to be this form and was taken in open forest.

TECHNOMYRMEX MOERENS Santschi, subsp.

T. moerens was originally described from French Congo and has since been recorded from French Guinea and Belgian Congo. The Imatong form is smaller (2 mm.) and differs, according to Santschi's figures (1923, figs. 40–42), in having the mandibles less convex and the epinotum descending more abruptly.

The Imatong form was found only in the Lotti Forest, where a worker was found on a leaf.

TECHNOMYRMEX INCISUS spec. nov. (cf. p. 380)

This species is distinctive in its deeply incised meso-epinotal suture. It is related in this to *T. rusticus* Santschi of the Belgian Congo but is smaller and the head much narrower.

A worker was found in the Lotti Forest on a leaf.

TECHNOMYRMEX LONGISCAPUS spec. nov. (cf. p. 381)

This species is near *T. moerens* Santschi of West Africa but the scapes are much longer and the epinotum lower. It is of the same length (2.6 mm.).

A worker was found in the Lotti Forest on top of a fallen log.

FORMICINAE[1]

PLAGIOLEPIS

PLAGIOLEPIS (P.) SUDANICA spec. nov. (cf. p. 381)

This species is related to *P. (P.) exigua abyssinica* Forel of Abyssinia but is noticeably darker and in other ways different. Africa is the home of at least eight species of this subgenus.

It was taken at elevations of 6400 and 6800 ft. in open situations in the *Acacia abyssinica* zone. The tiny workers forage through grass or over the lichen-covered rocky outcrops of steep slopes.

ACANTHOLEPIS

ACANTHOLEPIS CAPENSIS ANCEPS Forel

A. anceps was described from Belgian Congo and has been recorded from various localities in that country.

---

[1] Formal descriptions of new species and subspecies will be found on pp. 381–389.

Workers of this form were taken on the mesophytic plains at the east base of the Imatongs.

ACANTHOLEPIS CAPENSIS Mayr, ISSORE subsp. nov. (cf. p. 383)

A. issore was found in the *Acacia abyssinica* zone nesting in the dead stub of a branch of this tree at an elevation of 6200 ft. The tree had just fallen, as proven by the freshness of its leaves, and the ant nest was in a branch at the top of the crown. The colony consisted of between 200 and 300 workers, 5 queens and brood.

Workers of this form were found also on the west slopes at about 5100 ft. where the *Acacia* zone dipped down a valley.

ACANTHOLEPIS CAPENSIS MINUTA Forel

A. minuta was described from Transvaal. The Imatong form is either *minuta* or a form very close to it, a question which cannot be settled at the present time by material now in the United States.

Workers were taken on the mesophytic plains at the east base of the Imatongs.

ACANTHOLEPIS CAPENSIS SIMPLEX Forel

This tiny black ant is recorded from widely separated localities along the African East Coast and as far inland as Uganda and Southern Rhodesia.

It was found in the lower part of the *Acacia abyssinica* zone in grassy or rocky outcrops at elevations of 6000 and 6200 ft. Like most *Acantholepis*, *A. simplex* nests in the ground. One colony with brood in a tiny cell lived so close to a colony of *Pheidole megacephala* subspecies that their galleries in places must have anastomosed.

ACANTHOLEPIS CAPENSIS Mayr, THOTH subsp. nov. (cf. p. 383)

The present new subspecies, dedicated to the Egyptian god Thoth, inhabits the eastern base of the Imatongs where a colony was found at 2800 ft. under a rock. The rock, 10 cm. in diameter, was lying on an open ridge of decomposed rock or gravel in a xerophytic area. The queen and brood were in irregular chambers in the well-drained soil.

ACANTHOLEPIS CAPENSIS VALIDIUSCULA Emery

This soil-inhabiting variety, originally described from Abyssinia, seems distributed over a large part of Africa. Arnold reports it very common in the Cape Province and Rhodesia and Wheeler records it from the Belgian Congo.

Workers were found in the Lotti Forest of the west slopes and a nest was found in the cloud forest-mountain meadow zone at an elevation of 7570 ft. The next was in grass surrounding a stone beneath which was a *Solenopsis punctaticeps juba* nest.

ACANTHOLEPIS CAPENSIS Mayr, ACHOLLI subsp. nov. (cf. p. 382)

Plates 12, 13

A. acholli occurs on the east slopes at elevations from 4640 to 6440 ft. Though the lower elevation is below the *Acacia abyssinica* zone the ecological conditions were similar to those above where a number of large colonies were found. The ants were found only in situations having abundant moisture from both rain and clouds. Except for one huge colony found nesting in soil at the base of plants creeping over a boulder the ants nested under flattish rocks in exposed situations. In the photograph (Plate 13) the carton made by the ants shows clearly. This carton, exposed when the small rock covering it was overturned, was strong enough to withstand the intermittent rain that fell while I photographed and collected the nest. It crumbles easily, however, under the finger and is not as tough as *Azteca* and some *Crematogaster* carton. Many queens are found in the large colonies which comprise several thousand workers. The nests may be polydomous, that is under a number of nearby rocks.

OECOPHYLLA

OECOPHYLLA LONGINODA (Latr.)

Ants of the genus *Oecophylla* construct nests by using their larvae as shuttles and weaving together leaves with the silk the larvae emit. The sole African species, *O. longinoda,* is found across Africa from Gambia to Abyssinia and south to Mozambique. The type locality is Senegal.

Though this ant was not found actually in the Imatongs it was common in various mango trees at Torit, a few miles north, and likely will be found on the lower slopes. It was also found directly west, a few miles from the Belgian Congo border, at Kagelu. Scattered nests of this species were numerous on some mango trees and the ants clearly dominated the entire crown. When disturbed they cause a rattling sound like dry peas dropping on a plate by striking their bodies against the leaves and the nest. Such behavior is also exhibited by *Camponotus senex* and *Dendromyrmex apicalis* in the South American Guianas. When the mangos were disturbed the ants swarmed quickly over the intruder, biting human skin appreciably but not drawing blood. In nests were found various prey, mostly insects such as grasshopper, beetle, bee and ponerine ant parts. In one nest were found a Dipterous larva 12 mm. long and 3.5 mm. in diameter when alive and a live adult Dipteran. Quite possibly they were myrmecophilous but the nature of the relationship was not obvious. They may live between the leaves of the nest and feed upon the ant brood or pieces of insects brought by the ants.

CAMPONOTUS

CAMPONOTUS (DINOMYRMEX) LONGIPES (Gerst.)

This species was originally described from Mozambique but has since been recorded from East Africa generally, west to Sankisia, eastern Belgian Congo (lat. 26°), and south to Southern Rhodesia.

A few workers agreeing well with a damaged worker determined as this species in the Museum of Comparative Zoölogy were taken at elevations of about 3800 to 4000 ft. on the eastern slopes of the Imatongs. One was carrying what seemed to be a lump of starchy substance.

CAMPONOTUS (DINOMYRMEX) POMPEIUS subsp. CASSIUS Wheeler

This subspecies has been known only from the original collections at Yakuluku and Medje, Belgian Congo.

It was found on the western slopes of the Imatongs at elevations of about 4200 ft., 3300 ft., and 3500 ft. Both Dr. Myers and myself took this ant in high forest in and above the Lotti Forest (M. 10559, 10574, 10639) and I found a colony at the 4200 ft. elevation.

The colony had an oval entrance 20 x 11 mm. in diameter in red soil in a native pathway. From the entrance a trail of dropped soil particles extended in a straight line 37 mm. to the base of the crater which was of red clay. This crater was in the form of a semicircle

20 cm. in diameter and 12 cm. height at the crest. From the crest soil particles had tumbled down the outer slope for a distance of 32 cm. The nest was exposed to a depth of 45 cm. and extended still deeper. The nest consisted of simple irregular chambers and tunnels. Minima workers stood on guard in several exposed chambers but the maxima workers rushed out to attack. My Sudanese helper was bitten by one maxima on the forefinger which bled freely from a cut of 5.5 mm. length.

Under the slanting tunnel leading to the entrance and above the first chambers a colony of the rare genus *Calyptomyrmex* which proved to belong to a new species, *brevis,* was found. Also in the soil adjacent to the chambers was a tiny *Xiphomyrmex minusculus amen* and a small *Monomorium.*

CAMPONOTUS (MYRMOTURBA) MACULATUS ssp. MELANOCNEMIS Santschi

C. maculatus and its numerous forms have a remarkable distribution which includes the entire tropical world and in addition all Australia and much of the temperate part of Eurasia and the western United States. The typical form is African. The subspecies *melanocnemis* is recorded from French and Belgian Congo and Natal. Its varieties are described from an equatorial belt across the continent, one, *semispicatus* Santschi, being recorded from heights up to 2100 m. in Kenya. Because no one has worked out normal variation within this subspecies it seems futile at present to attempt to ascribe the Imatong form to one of the varieties, which itself may not be valid.

This subspecies seems the commonest *Camponotus* in the Imatongs and many specimens were taken from the surrounding plains to 6440 ft., well within the *Acacia abyssinica* zone. Both Dr. Myers and myself took it also on the Aloma Plateau close to the Sudan-Congo-Uganda junction at 3700 ft. (M. 10627) and he took it in the Azza Forest (M10734). I found this subspecies also 24 miles east of Jinja and at the Kawanda Experimental Station (4000 ft.) nesting in a sugar cane field, both localities in Uganda. At Kijabe, Kenya (6787 ft.) I found a worker of this subspecies under a piece of volcanic rock. On the southwest slopes of Mt. Garia at 6200 ft., in a grassy, rocky area with cycads and aloes, though within the *Acacia abyssinica* zone, a colony was found under a slab of rock 3.5 ft. in diameter. Many shallow chambers were exposed by overturning the slab and in these were many cocoons. The colony probably contained several thousand workers. The soldiers were very aggressive and could bite the skin effectively, though not drawing blood.

On the eastern lower montane slopes a colony was found nesting under a stone and its surrounding tuft of grass. Other colonies were observed nesting in the ground with a simple entrance hole.

A colony at about 4200 ft. on the western slopes nested in the carton hemispherical nest of a termite, *Amitermes (A.) evuncifer* Silvestri. A third insect inhabitant was a colony of the driver ant, *Aenictus mentu*, under which this association is more fully described in this paper.

A toad taken on the mud floor of the mud-walled and thatched rest house at Longoforok 8:30 a.m. July 30 had in its stomach parts of six soldiers of *melanocnemis* and in addition part of a spider and 56 soldier and worker heads of three termite species (*Macrotermes jeanneli, Odontotermes (O.) nilensis* Emersom MS and *Acanthotermes (Pseudacanthotermes) spiniger* (Sjostedt).

CAMPONOTUS (MYRMOTURBA) MACULATUS subsp. BRUTUS Forel

The large, red *brutus* was originally described from the Portuguese Congo and has since been found to be generally distributed in West Africa and the Belgian Congo.

A soldier of this striking subspecies was taken in the Lotti Forest and a large worker in high forest on the western slopes of the Imatongs at an elevation of about 4500 ft. Both ants were in the same type of high, luxuriant forest. Dr. Myers took this in similar forest above the Lotti Forest (No. 10559) one or two hundred feet.

CAMPONOTUS (MYRMOTURBA) MACULATUS ssp. AEGYPTIACUS Emery

This subspecies was originally described from Egypt and has since been recorded from Eritrea.

Though the form generally found on the plains of the eastern base of the Imatongs and in the mountains themselves is clearly the subspecies *melanocnemis*, the workers of one colony clearly are similar to workers from Egypt determined as *aegyptiacus* in the British Museum.

This colony was found on the plains at the foot of the eastern slopes of the Imatongs at the place known as Molongori. The ants were observed migrating during the bright moonlight of July 30 at 8:45 p.m. and later. The moon was nearly full, the temperature warm and there was a moderate breeze. Cumulus clouds were forming and lightning occurred intermittently. The ants were moving their brood from a nest entrance to a new entrance five meters away. Some of the brood was arranged in a semicircle around the old entrance but 8 to 15 cm. away from it. The ants moved in a steady column a few abreast and the soldiers were not observed to carry brood. The cause of this migration was not determined but I have observed migrations of ant colonies in the Neotropical Region caused by excessive parasitism, raiding doryline ants and excessive moisture in the nest.

CAMPONOTUS (MYRMOTURBA) MACULATUS (Fabr.), NUBIS subsp. nov. (cf. p. 385)

Plate 11

This new subspecies is particularly interesting because it seems the Imatong congener of *C. maculatus kersteni* Gerst., originally described from Mt. Kilimanjaro, Tanganyika, at 8,000 ft. and since recorded from the same peak at 2740–3000 m. by Santschi. *C. kersteni* is apparently a true mountain ant like the Imatong congener.

In climbing Mt. Kineti from the eastern side five colonies were found, all at elevations from 8500 to 8700 ft, and at widely separated localities. Every nest was in a meadow and consisted of irregular chambers and tunnels in the black humus under stones or among grass roots.

The first nest found was at 10 a.m. at 8500 ft. and though the temperature seemed warm in the open, the damp soil felt cool. The ants seemed as sluggish as any *Camponotus* I ever collected. Chambers extended to 18 cm. and the brood was found from 3–18 cm. below the surface. 40 cm. away was a nest of *Tetramorium simillimum isis* and workers of *Monomorium* (*M.*) *minutum* ssp. and *Ponera coarctata imatongica*.

Workers at 8700 ft. were found under a rock which contained a colony of the same *Tetramorium*.

Three nests were found anastomosing with nests of *Solenopsis punctaticeps juba*, the latter apparently living in cleptobiosis with them. The *Camponotus* were attacked by their tiny thieves who could grasp the far larger *Camponotus* only by a leg or antenna. The galleries of two of the *Solenopsis* were above the *Camponotus* galleries or in moss surrounding the entrace to the larger nest. The chambers of the *Camponotus* were 1.5 to 3 cm. high and horizontal.

CAMPONOTUS (MYRMOTURBA) MACULATUS (Fabr.), SUDANICUS subsp. nov. (cf. p. 385)

Most of the numerous forms of *maculatus* nest on or close to the ground in rotted wood, under stones, etc. This new subspecies is arboreal.

A single colony was found on the western slopes in luxuriant forest at an elevation of 6300 ft. The ants nested in the stub of a branch about 25 ft. up in a tree. Every effort was made to get the entire colony and probably not more than two or three escaped, among which must have been the queen. The queen in many ant species often rushes out the moment her nest is disturbed. There were 165 workers which were polymorphic though without a well-defined soldier caste. Brood consisted of eggs, larvae and worker pupae.

CAMPONOTUS (MYRMOTURBA) ACVAPIMENSIS Mayr

This species was originally described from the Gold Coast and has since been recorded from a large number of localities throughout the Ethiopian Region except in South Africa.

Stray workers were found on the eastern slopes of the Imatongs from the plains up to about 4000 ft. Mostly the ants were crawling over the rocky slopes in sparse grass-woodland and were one of the commonest ants in such localities.

Three colonies were found at an elevation of about 3700 ft. within 5.5 meters, two being 1.5 meters apart. Each was nesting under small rocks which were lying upon larger rocks except for thin layers of humus. Galleries honeycombed the humus and the brood was kept in the deeper chambers.

CAMPONOTUS (MYRMOSERICUS) RUFOGLAUCUS CINCTELLUS var. RUFIGENIS Forel

Camponotus rufoglaucus in its many forms is found over the entire Ethiopian Region except West Africa and over the continental Indo-Malayan Region to Southern China. The subspecies *cinctellus* is widespread. The variety *rufigenis* Forel has been recorded only from the Belgian Congo.

C. rufigenis was found on the grass-woodland plains 60 miles east of

Juba on the Nile and on the eastern lower montane slopes of the Imatongs to about 3850 ft. The ant nests in the soil and may form a crater entrance. One entrance was under a small rock.

CAMPONOTUS (MYRMOSERICUS) RUFOGLAUCUS subsp. FLAVOMARGINATUS (Mayr)

The subspecies was originally described from the Gold Coast and has since been recorded across Africa to Eritrea and south to Natal.

Workers taken on the eastern slopes at about 4000 ft. and the western slopes of the Imatongs at 4900, 5500, and 6200 ft. agree well with Belgian Congo specimens determined as *flavomarginatus* by Dr. W. M. Wheeler. There is not enough material for determining with certainty whether the Imatong may not be a variety of this subspecies. Those at 4900 ft. were taken on the ground in grass over ten feet high near a nest of *Meranoplus nanus* ssp. *soriculus*. Those at 5500 and 6200 ft. were taken in short grass areas and the latter extended into the *Acacia abyssinica* zone. A dealate female taken on the east slopes at between 5200 ft. and 6000 ft. appears to be this form. Another ant which I took at Er Renk (Lat. 11°45′N.) on the White Nile agrees well with these except for its more reddish head.

CAMPONOTUS (MYRMAMBLYS) CHAPINI Wheeler, GANZII subsp. nov. (cf. 386)

C. chapini is known only from the original collections in northeastern Belgian Congo. This new subspecies differs distinctly in its larger size and darker color.

The single colony upon which the subspecies is based was found above Molongori on the eastern slopes of the Imatongs at an elevation of about 4100 ft. A small hole beside a rock led down into irregular tunnels between and around stones to many small chambers in which was the brood. The ants were not aggressive and there were probably about two hundred workers. Stray workers were collected a week before above Longoforok, also on the eastern slopes, at an elevation of about 4000 ft.

CAMPONOTUS (MYRMAMBLYS) HAPI spec. nov. (cf. p. 386)

This new species, named for the Egyptian term for the deified Nile, is particularly interesting because, judging from Santschi's description and figure, it is closely related to his *C. orinobates* of Mt. Kenya and the Kikuyu Escarpment at Kijabe (6800 ft.), both in Kenya. The altitude on the slopes of Mt. Kenya is not specified. *C. orinobates* has five instead of six mandibular teeth and is in other ways different.

A single colony was found on the eastern slopes of the Imatongs at an elevation of 6700 ft. The ants were nesting in a dead twig 9 mm. in diameter and about 30 cm. long which had a central cavity of 3 mm. diameter. The twig was standing at the edge of the forest in a ravine of black humus. Fourteen workers and two alate females were recovered from the colony but many escaped. The brood recovered consisted only of elliptical, colorless young eggs 0.70 x 0.43 mm. and elongated-elliptical egg-like objects with a smooth membrane but opaque internally which were much larger, being 1.43 x 0.40 mm. These may have been eggs of another insect.

CAMPONOTUS (ORTHONOTOMYRMEX) SERICEUS (Fabr.)

C. sericeus like *C. rufoglaucus* is common to both the Indomalayan and Ethiopian Regions but the distribution is not exactly the same. *C. sericeus* is absent from South Africa but present in West Africa; the reverse is true of *rufoglaucus*. *C. sericeus* was originally described from Senegal.

Workers of this species were taken on the eastern slopes of the Imatongs at elevations of about 3800 ft. as well as on the plains below.

CAMPONOTUS (ORTHONOTOMYRMEX) VIVIDUS subsp. CATO Forel

C. vividus was originally described from Sierra Leone and has since been found to be generally distributed in West Africa, including the Belgian Congo, and there are records from Angola and Portuguese East Africa. The subspecies *cato* has been reported only from the Belgian Congo.

C. cato was found in the Lotti Forest and seemed not uncommon. Stray workers were picked up on the forest floor on fallen trunks and on leaves.

CAMPONOTUS (MYRMOTREMA) BAYERI Forel

This finely punctate black species with white hairs is recorded only from the Belgian Congo.

Single workers were picked up on the eastern slopes of the Imatongs at elevations from about 3900 ft. to 6000 ft., just below the very margin of the *Acacia abyssinica* zone. The ants were always found crawling over the rocky slopes where the grass and scattered trees were scanty.

CAMPONOTUS (MYRMOTREMA) sp. 1301–3

This black ant with finely punctate body and sparse, short, black bristles belongs to the group including *grandieri* For. and *olivieri* For.

It has the same distribution in the Imatongs as *C. bayeri*, the lower eastern slopes, but was not taken above 4100 ft. though doubtless it ascends to the *Acacia abyssinica* zone. The workers were found crawling over the rocky slopes amid sparse grass and trees.

CAMPONOTUS sp. 1447

This distinct species was taken in the Lotti Forest. It is characterized by its long, yellowish appressed pubescence and upright white bristles. These latter form a striking corona around the margin of the petiole.

CAMPONOTUS sp. 1442, 5

This species may be new but the material is insufficient for description. It is characterized chiefly by its high epinotum, very sparse white bristles, and the long, silvery pubescence appressed to the body.

Stray workers were taken in the Lotti Forest.

CAMPONOTUS (MYRMOPIROMIS) TRICOLOR spec. nov. (cf. p. 387)

This new species appears close to Santschi's recent (1935) *C. rotundinodes* of Belgian Congo, judging by his description and figure. He likens the latter to *C. conradti* Forel of Cameroon. The Imatong species however is clearly different in pilosity, sculpturing and probably head proportions. It is striking in appearance, being dark brown, almost black, with yellow antennae and leg joints, and has coarse white hairs on the body. The species was taken in the Lotti Forest.

POLYRHACHIS

POLYRHACHIS (MYRMA) SCHISTACEA var. DIVINA Forel

Plate 14

This variety, of a more widespread species, is recorded from East Africa and the Belgian Congo. The highest altitude reported is 1050 m. in Kenya.

This purple ant is more properly an ant of the lower montane slopes and the surrounding plains. Two large colonies, however, were seen just inside the lower level of the *Acacia abyssinica* zone at an altitude of 5900 ft. where the *Acacia* dipped down into a valley. On the same slope but at an elevation of 4100 ft. occurred a particularly large colony which had formed a mound 60 cm. long, 30 cm. wide and 20 cm. high. It probably contained at least 20,000 workers. Males and cocoons were present.

POLYRHACHIS (MYRMA) CUBAËNSIS Mayr, IMATONGICA subsp. nov. (cf. p. 388)

P. cubaënsis was described originally as from Cuba but the type locality was later determined as Port Natal, Natal. The genus *Polyrhachis* does not occur in Cuba or the New World. Several forms have since been described from Natal and East Africa.

Stray workers were taken on the east lower montane slopes at elevations of 3800 to 4000 ft. One was taken on a blade of grass, the others as they ran over the soil.

PSEUDOLASIUS

PSEUDOLASIUS MYERSI spec. nov. (cf. p. 389)

The genus *Pseudolasius* is represented by a number of species in the Indomalayan Region, at least one in Northern Australia, and four species in West Africa, Belgian Congo and Uganda.

This new species was found twice, once in the Lotti Forest and once in the gallery forest above it. One colony was under a log, the other under the bark of a fallen log on its under surface. The workers are strongly photophobic and remind one strongly of the northern *Lasius* (*Acanthomyops*).

PRENOLEPIS

PRENOLEPIS (NYLANDERIA) ALBIPES Emery, subsp.

This species has been known only from the original record of two workers taken in the Cameroons in 1899.

A worker taken in the Lotti Forest agrees in most respects with Emery's original description but is somewhat larger. It probably represents a new subspecies but the material is insufficient for description.

PRENOLEPIS (NYLANDERIA) sp.

Over a dozen species of *Nylanderia* have been recorded from Africa, including two common tropicopolitan species.

Several workers taken in the Lotti Forest probably represent a new species.

WORLD ANTS RECORDED FROM HIGH ALTITUDES

The scattered records of ants found at high elevations indicate that few species ascend above 10,000 ft. anywhere. Unfortunately specific records at the high elevations are not common and these are sometimes complicated by the failure to mention the ant caste involved. The winged castes, especially males, are likely to be carried to much higher altitudes by wind currents than are the colonies themselves and such records are of no particular significance.

An examination of Emery's parts of the *Genera Insectorum*, the world ant catalogue, revealed only 17 species of ants recorded from specified elevations of 2000 m. (6560 ft.) or more. These belonged to the genera *Myrmica*, *Aphaenogaster*, *Pheidole*, *Crematogaster*, *Dolichoderus*, *Brachymyrmex*, *Camponotus* and *Formica*. A search of other literature, however, revealed many more. In particular, Forel's study (1906) of ants of the Himalayas and Wheeler's work (1917) on the mountain ants of Western North America contained additional specific altitude records. These records of 2000 m. (6560 ft.) and some from lower altitudes from regions not otherwise represented are listed below. The North American records are those above 10,000 ft. in Wheeler (1917). Winged castes are omitted. It should be realized, of course, that such a list does not represent all of the species to be found at such elevations. It does represent, however, a large sample of the fauna. From personal observations in Western North America, for example, it is clear that more species occur here than are listed. No records are included for Eastern North America since the highest elevation east of the Rocky Mountains is only 7242 ft. (at Harney Peak, Black Hills, South Dakota). I found *Camponotus herculeanus whymperi* on the top of this peak and conditions were probably suitable for other species here. The peaks in North America east of the Mississippi River are 6,711 (6,684) ft. (Mt. Mitchell, North Carolina) or lower. Cole (1940) records only one species (*Stenamma brevicorne diecki impressum*) occurring at 6000 ft. in the Great Smoky Mountains and none above this altitude. On the summit of Mt. Washington (6293 or 6288 ft.), New Hampshire, Wheeler (1905) recorded no worker ants though nine species of the winged castes were found.

HIMALAYA MOUNTAINS

Leptogenys (Lobopelta) diminuta Smith	1000–2400 m.	(to 7870 ft.)
Platythyrea sagei Forel	1500–2000 m.	(to 6560 ft.)
Euponera (Brachyponera) luteipes Mayr	1500–2160 m.	(to 7080 ft.)
" " nigrita Emery	1000–2400 m.	(to 7870 ft.)
Aenictus ambiguus Shuckard	2160 m.	(7080 ft.)
" fergusoni montanus Forel	900–2400 m.	(to 7870 ft.)
" wroughtoni sagei Forel	1500–2000 m.	(to 6560 ft.)
Dorylus (Typhlopone) labiatus Shuckard	1500–2000 m.	(to 6560 ft.)
" (Alaopone) orientalis Westwood	2160 m.	(7080 ft.)
Tetramorium christiei Forel	1200 m., 2160 m.	(to 7080 ft.)
" elisabethae Forel	2590 m.	(8500 ft.)
" caespitum himalayanum Viehmeyer	2800 m.	(9190 ft.)
Crematogaster sagei Forel	600–2000 m.	(to 6560 ft.)
" himalayana Forel	1500–2100 m.	(to 6890 ft.)
Pheidole indica himalayana Forel	1500–2160 m.	(to 7080 ft.)
" jucunda fossulata Forel	2000 m.	(6560 ft.)
" javana dharmsalana Forel	1500–2000 m.	(to 6560 ft.)
" sagei Forel	1500–2000 m.	(to 6560 ft.)
" bhavanae Bingham	2500 m.	(8200 ft.)
Monomorium sagei Forel	1500–2000 m.	(to 6560 ft.)
Leptothorax inermis Forel	1500–2000 m.	(to 6560 ft.)
" fultoni Forel	1500–2000 m.	(to 6560 ft.)
" rothneyi Forel & var.	2160 m.	(to 7080 ft.)
" wroughtoni Forel	1981 m.	(6500 ft.)
Myrmica pachei Forel	3600 m.	(11,810 ft.)
" smythiesi Forel & forms	914–3600 m.	(to 11,810 ft.)
" rugosa Mayr & var.	1000–2600 m.	(to 8530 ft.)
Aphaenogaster sagei Forel & ssp.	2800–3600 m.	(to 11,810 ft.)
" rothneyi Forel	2100 m.	(6890 ft.)
" cristatum Forel	2000 m.	(6560 ft.)
" smythiesi Forel	2400–2700 m.	(to 8860 ft.)
Messor barbarum himalayanus Forel	2800 m.	(9190 ft.)
Tapinoma wroughtoni Forel	2000 m.	(6560 ft.)
Acantholepis frauenfeldi integra Forel	1500–2000 m.	(to 6560 ft.)
Prenolepis aseta Forel	2100 m.	(6890 ft.)
Lasius alieno-flavus Forel	2400 m.	(7870 ft.)
" niger alieno-brunneus Forel	1800–2700 m.	(to 8860 ft.)
" " alienus Först.	2700 m.	(8860 ft.)
" brunneus himalayanus Forel	1800–2700 m.	(to 8860 ft.)
Formica rufibarbis Forel	1600–3000 m.	(to 9840 ft.)
" " kashmirica Stärcke	3000–4125 m.	(to 13,530 ft.)
" picea lochmatteri Stärcke	2600–4800 m.	(to 15,740 ft.)
" " orientalis Ruzsky	3200–4500 m.	(to 14,760 ft.)
Polyrhachis menelas Forel	2160 m.	(7080 ft.)
Cataglyphis cursor senescens kuenlunensis Stärcke	1350–3700 m.	(to 12,140 ft.)
Camponotus barbatus albosparsus Forel	2160 m.	(7080 ft.)
" buddhae Forel	4000 m.	(13,120 ft.)
" fallax himalayanus Forel	2800 m.	(9190 ft.)
" wroughtoni Forel	2400–3600 m.	(to 11,810 ft.)
" maculatus kattensis Forel	1500–2000 m.	(to 6560 ft.)
" " aethiops cachmiriensis Forel	2438 m.	(8000 ft.)
" dolendus Forel	1000–2000 m.	(to 6560 ft.)
" truncorum Fabr.	1600–2900 m.	(to 9510 ft.)
" glebaria rubescens Forel	2000–2800 m.	(to 9190 ft.)

OTHER ASIATIC RECORDS

Messor barbarus meridionalis André	Turkestan	to 2438 m.	(to 8000 ft.)
Pheidole allani Bingham	Birmanie	500–2000 m.	(to 6560 ft.)
" pallida arenarum Ruzsky	Caucasus	to 1830 m.	(to 6000 ft.)
Crematogaster desecta Forel	Ceylon	2000 m.	(6560 ft.)
" sordidula Nyl.	Turkestan	to 2593 m.	(to 8500 ft.)
Myrmica rubra v. khamensis Ruzsky	Tibet	3477 m.	(11,400 ft.).
" tibetana v. furva Ruzsky	Tibet	3813 m.	(12,500 ft.)
" kozlovi Ruzsky	Tibet	3965 m.	(13,000 ft.)
Aphaenogaster obsidiana Mayr	Caucasus	to 3000 m.	(to 9840 ft.)
Tapinoma emeryanum M.	Turkestan	2400 m.	(7870 ft.)
" erraticum Latr.	Turkestan	to 2593 m.	(to 8500 ft)
Plagiolepis pygmaeus Latr.	Turkestan	to 2438 m.	(to 8000 ft.)
Myrmecocystus cursor aenescens Nyl.	Turkestan	to 2741 m.	(to 9000 ft.)
" " alpina N. K.	Turkestan	3050 m.	(10,000 ft.)
" bicolor setipes turkomanicus Em.	Turkestan	to 2745 m	(to 9000 ft.)
Formica fusca picae Ny.	Semiretshje	to 2500 m.	(to 8200 ft.)
" rufibarbis montana N. K.	Turkestan	to 2438 m.	(to 8000 ft.)
" (Proformica) nitida Kusnetzov	Turkestan	to 1980 m.	(to 6500 ft.)
Camponotus buddhae Forel	Pamir	2800 m.	(9190 ft.)
" herculeanus L.	Semiretshje	1700–2000 m.	(to 6560 ft.)

ALPS

Formica fusca L.	to 3000 m.	(to 9840 ft.)
Myrmica myrmecoxena Forel	2000 m.	(6560 ft.)
" lobicornis Nyl.	2000 m.	(6560 ft.)

MADAGASCAR

Camponotus (Myrmoturba) radamae becki altior Santschi	Highest point of island (9449 ft.?) (Mt. Adrigintra top)

NORTH AMERICA*

Myrmica brevinodis sulcinodoides Emery	New Mexico	3965 m.	(13,000 ft.)
" lobicornis fracticornis Emery	Arizona	3965 m.	(13,000 ft.)
Leptothorax acervorum canadensis Prov.	Colorado	4304 m.	(14,110 ft.)**
" " " convivialis Wheeler	New Mexico	3355 m.	(11,000 ft.)
Tapinoma sessile Say	Colorado	3202 m.	(10,500 ft.)
Lasius niger sitkaënsis Perg.	Colorado	3050 m.	(10,000 ft.)
" " alienus americanus Emery	Colorado	3050 m.	(10,000 ft.)
Formica sanguinea subnuda Emery	Colorado	3965 m.	(13,000 ft.)
" bradleyi Wheeler	Colorado	3660 m.	(12,000 ft.)
" truncicola integroides coloradensis Wheeler	Colorado	3965 m.	(13,000 ft.)
" ciliata Mayr	Colorado	3355 m.	(11,000 ft.)
" whymperi alpina Wheeler	Colorado	3355 m.	(11,000 ft.)
" fusca L.	Colorado	4270 m.	(14,000 ft.)
" fusca neoclara Emery	Colorado	3660 m.	(12,000 ft.)
" neogagates lasiodes vetula Wheeler	Colorado	3660 m.	(12,000 ft.)
Camponotus laevigates F. Smith	California	3355 m.	(11,000 ft.)
" herculeanus whymperi Forel	Colorado	3965 m.	(13,000 ft.)

* Ants from 10,000 ft. or more in Wheeler (1917) or from my *Myrmica* collection.
** Personal collecting.

CENTRAL AMERICA

Ponera gracilicornis Menozzi	Costa Rica	2000 m.	(6560 ft.)
Euponera (Trachymesopus) obsoleta Menozzi	Costa Rica	2000 m.	(6560 ft.)
Pheidole innupta Menozzi	Costa Rica	2000 m.	(6560 ft.)
Stenamma schmidti Menozzi	Costa Rica	2000 m.	(6560 ft.)

SOUTH AMERICA

Eciton (Labidus) coecum L., ssp.	Ecuador	3000 m.	(9840 ft.)
" " praedator F. Smith	Colombia	1830 m.	(6000 ft.)
Cheliomyrmex andicola Emery	Colombia	to 2588 m.	(8490 ft.)
Pseudomyrma sp.	Mt. Roraima top (Ven.-B.G.-Brazil)	2745 m.	(9000 ft.)
Pheidole riveti Santschi	Ecuador	3000 m.	(9840 ft.)
Solenopsis pylades Forel	Argentina	4000 m.	(13,120 ft.)
Dolichoderus tener Mayr	Chile	2000–3000 m.	(to 9840 ft.)
Brachymyrmex bruchi Forel	Argentina	4300 m.	(14,100 ft.)
" laevis andina Santschi	Argentina	4000 m.	(13,120 ft.)
Camponotus (Tanaemyrmex) bruchi Forel	Argentina	4300 m.	(14,100 ft.)
" " " lysistrata Santschi	Argentina	4500 m.	(14,760 ft.)
" " mus Roger	Argentina	4000 m.	(13,120 ft.)
" punctulatus termitaria heliades Santschi	Argentina	2500 m.	(8200 ft.)

AFRICA

Dorylus (Dorylus) brevipennis Emery	Mt. Elgon	2470 m.	(8100 ft.)
" " affinis Shuckard	Mau Escarp.	2100 m.	(6890 ft.)
" (Rhogmus) fimbriatus Shuckard	Mau Escarp.	2400 m.	(7870 ft.)
" " " laevipodex Santschi	Mt. Elgon	2470 m.	(8100 ft.)
" (Anomma) nigricans Ill.	Mt. Ruwenzori	2135 m.	(7000 ft.)
" " " burmeisteri (Shuck.)	Fernando Po	2400 m.	(7870 ft.)
" " " burmeisteri molestus (Gerst.)	Mt. Meru	3000 m.	(9840 ft.)
" " stanleyi Forel	Mau Escarp.	2420 m.	(7940 ft.)
Ponera ursa Santschi	Mt. Elgon	2300 m.	(7540 ft.)
" jeanneli Santschi	Mt. Elgon	2100 m.	(6890 ft.)
" coarctata imatongica Weber	Imatong Mts.	2593 m.	(8500 ft.)
" mesoëpinotalis Weber	Imatong Mts.	1962 m.	(6400 ft.)
" muscicola Weber	Imatong Mts.	2196 m.	(7200 ft.)
Bothroponera crassa Emery	Abyssinia	to 2438 m.	(7000–8000 ft.)
" " ilgi Forel	Kenya	1800–2000 m.	(6560 ft.)
Tetraponera scotti Donisthorpe	Abyssinia	to 2745 m.	(8000–9000 ft.)
Sima mocquerysi emacerata Santschi	Kenya	2100 m.	(6890 ft.)
Messor barbarus galla Emery	Abyssinia	2438 m.	(8000 ft.)
" " " rufula Forel	Imatong Mts.	1891 m.	(6200 ft.)
" sublaeviceps hoggarensis Santschi	Hoggar, Sahara	2310 m.	(7580 ft.)

Pheidole megacephala ilgi Forel	Abyssinia	2438 m.	(8000 ft.)
" " ssp. 1402, 1384	Imatong Mts.	2074 m.	(6800 ft.)
" " ssp. 1384	Imatong Mts.	2074 m.	(6800 ft.)
" " ssp. nr. punctulata	Imatong Mts.	2309 m.	(7570 ft.)
Melissotarsus emeryi pilipes Santschi	Mt. Kilimanjaro	2740 m.	(8990 ft.)
Myrmicaria eumenoides opaciventris congolensis For.	Imatong Mts.	2227 m.	(7300 ft.)
Crematogaster amabilis Santschi	Mt. Longonot	2450 m.	(8040 ft.)
" castanea ferruginea Forel	Mt. Elgon	2400 m.	(7870 ft.)
" " inversa flaviventris Sants.	Imatong Mts.	2105 m.	(6900 ft.)
" " inversa elgona Sant.	Mt. Elgon	2100 m.	(6890 ft.)
" foraminiceps Santschi	Mt. Kenya	2400 m.	(7870 ft.)
" mimosae Santschi	Mt. Kenya	2000 m.	(6560 ft.)
" vulcania Santschi	Longonot Neck	2140 m.	(7020 ft.)
" buchneri nasina Santschi	Kenya	2100 m.	(6890 ft.)
" gambiensis ssp.	Imatong Mts.	2071 m.	(6790 ft.)
" (Sphaerocrema) zonacaciae Weber	Imatong Mts.	2074 m.	(6800 ft.)
" auberti laestrygon striaticeps Forel	Hoggar, Sahara	2400 m.	(7870 ft.)
" neuvillei Forel	Abyssinia	to 2438 m.	(7000–8000 ft.)
Monomorium minutum kineti Weber	Imatong Mts.	3190 m.	(10,458 ft.)
" " arboreum Weber	Imatong Mts.	1891 m.	(6200 ft.)
" gracilimum Smith	Hoggar, Sahara	2700 m.	(8860 ft.)
" bicolor ssp. nr. nitidiventre Em.	Imatong Mts.	1830 m.	(6000 ft.)
" salomonis L.	Hoggar, Sahara	2050 m.	(6720 ft.)
" " areniphilum Santschi	Hoggar, Sahara	2800 m.	(9190 ft.)
" " obscuriceps Santschi	Hoggar, Sahara	2800 m.	(9190 ft.)
" crawleyi Santschi	Abyssinia	2438 m.	(8000 ft.)
Solenopsis punctaticeps juba Weber	Imatong Mts.	2806 m.	(9200 ft.)
" " erythraea Emery	Abyssinia	2438 m.	(8000 ft.)
Oligomyrmex alluaudi Santschi	Kenya	2100 m.	(6890 ft.)
Aneleus politus Santschi	Imatong Mts.	1962 m.	(6400 ft.)
Tetramorium simillimum F. Smith	Imatong Mts.	2013 m.	(6600 ft.)
" " isis Weber	Imatong Mts.	2644 m.	(8700 ft.)
" squaminode Santschi	Mt. Kilimanjaro	3800 m.	(12,470 ft.)
" " nubis Weber	Imatong Mts.	2806 m.	(9200 ft.)
" caespitum altivagans Santschi	Aberdare Mts.	3100 m.	(10,170 ft.)
" jeanae Weber	Imatong Mts.	1962 m.	(6400 ft.)
" semilaeve hoggarense Santschi	Hoggar, Sahara	2800 m.	(9180 ft.)
Xiphomyrmex zonacaciae Weber	Imatong Mts.	2166 m.	(7100 ft.)
Leptothorax nigrita saharensis Santschi	Hoggar, Sahara	2500 m.	(8200 ft.)
Engramma ilgi stygium Santschi	Mt. Kilimanjaro	2740 m.	(8990 ft.)
Technomyrmex albipes affinis Santschi	Mau Escarp.	2080 m.	(6820 ft.)
" " truncicolus Weber	Imatong Mts.	1891 m.	(6200 ft.)
Axinidris acholli Weber	Imatong Mts.	1891 m.	(6200 ft.)
Plagiolepis custodiens F. Smith	Kenya	2250 m.	(7380 ft.)
Plagiolepis sudanica Weber	Imatong Mts.	2074 m.	(6800 ft.)

Acantholepis capensis simplex Forel	Imatong Mts.	1891 m.	(6200 ft.)
" " incisa Forel	Kenya	2100 m.	(6890 ft.)
" " validiuscula Emery	Imatong Mts.	2309 m.	(7570 ft.)
" " issore Weber	Imatong Mts.	1891 m.	(6200 ft.)
" " acholli Weber	Imatong Mts.	1964 m.	(6440 ft.)
" " hirsuta Santschi	Mau Escarp.	2420 m.	(7940 ft.)
" " subspecies	Abyssinia	to 2438 m.	(6500–8000 ft.)
Camponotus maculatus erythraeus Emery	Mt. Elgon	2400 m.	(7870 ft.)
" " kersteni (Gerst.)	Mt. Kilimanjaro	2740–3000 m.	(to 9840 ft.)
" " pulvinatus Mary	Abyssinia	2438 m.	(8000 ft.)
" " mathildae Forel	Kenya	2000 m.	(6560 ft.)
" " melanocnemis Santschi	Imatong Mts.	1964 m.	(6440 ft.)
" " nubis Weber	Imatong Mts.	2644 m.	(8700 ft.)
" " sudanicus Weber	Imatong Mts.	1922 m.	(6300 ft)
" " semispicatus Santschi	Kenya	2100 m.	(6890 ft.)
" thraso assabensis Emery	Abyssinia	2745 m.	(9000 ft.)
" rufoglaucus flavomarginatus Mayr	Imatong Mts.	1891 m.	(6200 ft.)
" ligea Donisthorpe	Abyssinia	2745 m.	(9000 ft.)
" orinobates Santschi	Kenya	2100 m.	(6890 ft.)
" hāpi Weber	Imatong Mts.	2044 m.	(6700 ft.)
" cleobulus Santschi	Natal	3355 m.	(11,000 ft.)
" moderatus Santschi	Abyssinia	2438 m.	(8000 ft.)
" compressus thoracicus tahatensis Santschi	Tahat, Sahara	3000 m.	(9840 ft.)
" atlantis Forel	Hoggar, Sahara	2400 m.	(7870 ft.)
" seurati hoggarensis Santschi	Hoggar, Sahara	2000 m.	(6560 ft.)
Cataglyphis albicans targuia Santschi	Hoggar, Sahara	2700 m.	(8860 ft.)
" " livida arenaria Forel	Hoggar, Sahara	2000 m.	(6560 ft.)
Polyrhachis schistacea rugulosa Mayr	Mt. Kilimanjaro	1000–3000 m.	(to 9840 ft.)

SUMMARY

1. This study deals largely with the Imatong Mountains, Anglo-Egyptian Sudan. Records from other Central African mountains are also included. The Imatongs consist of an isolated igneous massif on the Central African plain rising to 10,458 ft. They are surrounded by mesophytic grass-woodland. The slopes may be divided into the following zones:

Lower Montane Slopes (2500–6000 ft., east side; 3000–5600 ft., west side). Climate tropical. Plants mesophytic to xerophytic on east, mesophytic to gallery or rain forest on west.

Acacia abyssinica Zone (6000–7200 ft., east side; 5600–7200 ft., west side). Climate temperate. Characterized by the conspicuous flat-topped tree, *Acacia abyssinica.*

Cloud Forest-Mountain Meadow Zone (7200–10,250 ft.). Climate cool temperate to subalpine. Forests of *Podocarpus,* etc. with heavy moss and lichen growth interspersed with meadows of grass and herbs.

Mt. Kineti Summit (10,250–10,458 ft.). Climate alpine. Summit with short grass and herbs; heavy lichen growth on rocks.

2. Of 125 species, subspecies or varieties of ants found in the Imatong Mountains, 113 are confined to single zones, as follows:

Lower Montane Slopes	89 species
Acacia abyssinica Zone	21 species
Cloud Forest-Mountain Meadow Zone	3 species
Mt. Kineti Top	0 species

The association of ants with plant zones is thus not fortuitous. Since, however, nearly all of the ants are carnivorous the ants and plants are probably best considered as members of a definite biocoenose with altitudinal limits. A more direct relationship between ants and plants is that between *Monomorium kineti* and *Tetramorium nubis* since they tend coccids (*"Ripersia"* n. sp.) on the roots of grasses found only in the two highest zones.

The east lower slopes have 39 species not found elsewhere, nearly all of which belong to the mesophytic grass-woodland. The west lower slopes have 45 species not found elsewhere, most of which belong to the closed rain forest.

3. No species of ant occurs in all zones. The army ant, *Dorylus* (*Anomma*) *molestus,* however, invades all zones but Mt. Kineti summit.

It is not only the dominant ant but one of the clearly dominant animals of the mountains because of its great numbers and predatory habits. The *Dorylus* and *Myrmicaria congolensis* are co-dominant ants of the *Acacia abyssinica* zone. A single ant, *Monomorium minutum kineti,* a new subspecies of a cosmopolitan species, is found on the summit of Mt. Kineti (10,458 ft.). The ant exists by pasturing coccids ("*Ripersia*" n. sp.) on the roots of short grasses.

4. Most of the characteristic African genera such as *Paltothyreus, Megaponera, Ocymyrmex, Macromischoides, Oecophylla, Camponotus* (*Dinomyrmex* and *Orthonotomyrmex*), *Polyrhachis* (*Myrma*) and *Pseudolasius* do not leave the tropical zone. The genera found in the temperate *Acacia abyssinica* Zone are

Dorylus (*Anomma*)
Ponera
Messor
Pheidole
Myrmicaria
Crematogaster
Monomorium
Solenopsis
Tetramorium
Xiphomyrmex
Axinidris
Technomyrmex
Plagiolepis
Acantholepis
Camponotus

which are mostly cosmopolitan or with many Holarctic species. Except for the widely ranging predator, *Dorylus* (*Anomma*), the only genera found in the cool temperate Cloud Forest-Mountain Meadow Zone are *Ponera, Pheidole, Monomorium, Solenopsis, Tetramorium, Acantholepis* and *Camponotus* which are important genera of temperate regions. The single genus, *Monomorium,* which occurs on the summit of Mt. Kineti is not only cosmopolitan but an ancient genus since it has many species in Australia and New Zealand, areas isolated since the Mesozoic.

The Imatong fauna must be derived from the lowlands from the very nature of the mountains. The ants of few genera are adaptable enough to leave the tropical lowlands. The species found in the temperate zones, however, may have reached their present stations at different times in the past when these stations were connected climatically with the lowlands, such as perhaps in the Tertiary or as recently as Pluvial II, a wet stage in Africa possibly thirty thousand years ago.

5. Fourteen species of the cosmopolitan genus *Crematogaster* occurred in the Imatongs of which eight were from the east lower montane slopes; the wealth of Africa in species of this genus is thus illustrated as also their great development in mesophytic regions. Nineteen

species of the cosmopolitan genus *Camponotus* occurred in the Imatongs; these were distributed through all zones but Mt. Kineti summit.

The occurrence of the cosmopolitan *Odontomachus haematoda, Pheidole megacephala, Monomorium minutum, Tetramorium guineense, T. simillimum* and *Camponotus maculatus* on the isolated Imatongs in Central Africa suggests that Africa may be the home of these species.

6. Four of the Imatong species were known only from South Africa. These are: *Aenictus merwei, Opthalmopone berthoudi, Acantholepis minuta,* and *Ocymyrmex weitzeckeri.* The last named species is known by a single record from Tanganyika. All were found only on the eastern slopes in mesophytic to xerophytic grass-woodland.

An additional four species were known only from East Africa. These are: *Dorylus* (*Anomma*) *molestus, Platythyrea cribrinodis, Camponotus* (*Dinomyrmex*) *longipes,* and *Aneleus politus.* The *Dorylus* occurs on all sides of the mountains as the dominant ant. The *Platythyrea* and the *Camponotus* were found only on the eastern slopes in grass-woodland. *Aneleus politus* was found in forest on the western slopes and is known only from the other and original record in Kenya.

Twenty species were known only from West Africa, including the Belgian Congo. The fourteen found only on the west slopes were all in rain forest; the six found only on the east lower slopes were from mesophytic grass-woodland and their West African congeners very likely were found in the same type of habitat.

7. Characteristically West African rain forest genera or subgenera found in the Imatongs are *Phrynoponera, Crematogaster* (*Atopogyne*), *Macromischoides, Paedalgus* and *Pseudolasius.* Characteristically East and South African is the genus *Ocymyrmex.* Two genera were new, *Hylidris* and *Axinidris,* the former found also on the Nile-Congo watershed south of Yei, Sudan.

8. 55 out of the 125 species are new and so far known only from the Imatongs. Other species are probably new but are not at present determinable with material available in the United States. At least 45% are thus endemic and this percentage is much higher than in mountains of the temperate regions such as the Rocky Mountains.

9. It is evident that the Imatongs are at the crossroads of ant migrations in Africa. The mountains contain West, East and South African elements of the ant fauna. Situated at the upper part of the Nile basin, the mountains also have connections with the Mediterranean

and at least one ant, *Anochetus sudanica,* is so close to *A. ghilianii* of the Mediterranean region, as to suggest direct relationships between the ant faunas.

10. Many of the species or subspecies of Imatong ants found in the cooler, damper and cloudier zones are distinctly darker than their closely related species or subspecies found on the tropical lower slopes.

11. Mound-building ants are rare in the Imatongs and include *Messor, Myrmicaria* and *Polyrhachis.* The last named does not occur in the temperate zones. *Messor* forms a mound in the lowlands but at 6200 ft. nested under a slab of rock. *Myrmicaria* forms merely a loose pile of soil. The predominantly cloudy and wet weather in temperate zones probably explains the scarcity of mound-building.

12. Though few ants are known from temperate zones of other Central African mountains, certain comparisons are significant. *Dorylus (Anomma) molestus* occurs at similar elevations on the Imatongs and on Mts. Meru, Kenya, Kilimanjaro, Ruwenzori and the Aberdare Mts. as well as on the connecting lowlands. *Tetramorium squaminode* occurs on Mt. Kilimanjaro and a closely related new subspecies, *nubis,* is found at a comparable elevation on the Imatongs. *Camponotus maculatus melanocnemis* is found up to 6440 ft. on the Imatongs and at 6787 ft. on the plateau at Kijabe, Kenya. *Camponotus maculatus kersteni* is confined to 8000 to 9840 ft. on Mt. Kilimanjaro and a closely related new subspecies, *nubis,* is found on the Imatongs from 8500 to 8700 ft.

When it is possible to examine more African species other significant similarities may be found among Central African mountain faunas. The fact that closely related forms of *Tetramorium* and *Camponotus* are found at comparable elevations on distinctly separated mountains may indicate that they were once part of a continuous population when the lowland climate was cool and moist. With a change to a hotter and dryer lowland climate the intermediate population may have become extinct (or developed into another form) and the new separated populations evolved into distinct subspecies. Migration is probably not possible for these species under present conditions because of the mesophytic country separating them, and migration by air of fecundated females is still less probable. The heavy-bodied females are comparatively feeble flyers (especially *Camponotus*) and lose their wings quickly after fecundation.

13. Though far fewer collections of other animals were made in the Imatongs than of ants, the following generalizations are suggested:

Species of terrestrial vertebrates, except perhaps birds, are comparatively as few in the higher zones as ant species. Two species found only in the Cloud Forest-Mountain Meadow Zone are the giant forest hog and the Colobus monkey. A new subspecies of chameleon was observed only on the summit of Mt. Kineti.

More genera of termites were found in the lower tropical zone than in the higher temperate zones. Two common termites (*Macrotermes natalensis* and *M. jeanneli*) are restricted to the lower slopes as is the ant *Megaponera foetens*, which preys upon them.

Spiders are distributed through all zones; the genera taken on Mt. Kineti summit were not taken at lower elevations. Spiders are much more common in the cold, wet and dark cloud forests than are ants.

14. Such information on the biology of the ants of the Imatongs as could be gathered on safari is given. Most of the species form irregular nests in the soil. Most of the species prey upon insects, including other ants; two tend coccids; *Messor* is probably a harvester. Many species harbor as guests Thysanurans and other insects; a small thief ant lives with two other species. The cyclic activities of the dominant ant (*Dorylus*) may depend ultimately on the moon, whose waxing light added to sunlight may build to a threshold value affecting the activity of the ants. An *Ocymyrmex* worker exhibited complicated reflex behavior simulating intelligence.

15. The first compilation of world ants found at elevations of 2000 m. (6560 ft.) or more shows that, while many species may be found at the 2000 m. level, the numbers decrease rapidly with increase in altitude. Few ants are found at 3000 m. (9840 ft.), and at 4000 m. (13,129 ft.) or more only nine species are known. The world altitudinal record is of *Formica picea lochmatteri* Stärcke at 4800 m. (15,740 ft.) in the Himalayas.

LITERATURE CITED

ARNOLD, G.

1915-1920. A monograph of the Formicidae of South Africa. *Ann. S. African Mus.*, **14**: 1–578, Pl. I-IX.

CARPENTER, G. D. H.

1935. The Rhopalocera of Abyssinia, a faunistic study. *Trans. Ent. Soc. London*, **83**: 313–447, 18 figs., Pl. VIII-XIII.

CHIPP, T. F.

1929. XXIX. The Imatong Mountains, Sudan. Bull. Misc. Inf. No. 6, R. Bot. Gardens, Kew: 177–197, Pl. VIII-XI, map.

COLE, A. C. JR.

1940. A guide to the ants of the Great Smoky Mountains National Park, Tennessee. *Amer. Midland Nat.* **24**: 1–88, 17 figs., 7 Pl.

EMERY, C.

1910–1925. Formicidae in Wytsman's Genera Insectorum, Bruxelles.

1916. Les *Pheidole* du groupe *megacephala* (Formicidae) *Rev. Zool. Africaine*, **4**: 223–250, 9 figs.

FOREL, A.

1899. Trois Notices Myrmécologiques. *Ann. Soc. Ent. Belgique*, **43**: 303–310.

1906. Les Fourmis de l'Himalaya. *Bull. Soc. Vaud. Sc. Nat.*, **42**: 79–94.

HARDY, F.

1940. A Provisional Classification of the Soils of Trinidad. *Trop. Agric.* (Imp. Coll. Trop. Agric.) Trinidad, B. W. I., **17**: 153–8, 1 Table.

HESSE, R., ALLEE, W. C. and SCHMIDT, K. P.

1937. Ecological Animal Geography. New York, xiv+1–597, 135 figs.

HUTCHINSON, G. E.

1930. Report on Notonectidae, Pleidae, and Corixidae (Hemiptera). Mr. Omer-Cooper's investigation of the Abyssinian waters. *Proc. Zool. Soc. London*, Pt. 2, pp. 437–466, 17 figs.

1933. The Zoo-geography of the African aquatic Hemiptera in relation to past climatic change. *Int. Rev. d. ges. Hydr. u. Hydr.*, **28**: 436–468, 7 figs.

KARAWAJEW, W.

1912. Ameisen aus dem paläarktischen Faunengebiete. *Rev. Russe Ent.* **12** (No. 3): 1–16, 3 figs.

KUSNEZOV, N. N.

1925. 2, Zur frage der vertikalen Verteilung der faunen elemente Turkestans. *Zool. Anz.* **62**: 107–117, 2 figs.

LESSERT, R. DE

1919. Resultats Scientifiques de la Mission Zoologique Suédoise au Kilimandjaro, au Mérou, etc. (1905–1906). Araignées. III Thomisidae. *Rev. Suisse Zool.*, **27**: 99–234, 28 figs., 2 pl.

MENOZZI, C.

1931. Qualche nuova Formica di Costa Rica. (Hym.) *Stettiner Ent. Zeit.*, **92**: 188–202, 7 figs.

MOREAU, R. E. and SCLATER, M. A.

1937. The Avifauna of the Mountains along the Rift Valley in North Central Tanganyika Territory (Mbulu District).—Part I. *The Ibis*, Ser. 14: 760–786, Pl. XVI-XIX.

SANTSCHI, F.

1910. Nouvelles fourmis d' Afrique. *Ann. Soc. Ent. France*, **79**: 351–369, 4 figs.

1914. Voyage Alluaud et Jeannel en Afrique Orientale, 1911–12, Hym. II. Formicidae: 41–148, 30 figs., Pl. II-III.

1923. Descriptions de nouveaux Formicides éthiopiens et notes diverses. -1. *Rev. Zool. Africaine*, **12**: 259–295, 6 figs.

1930. Description de Formicides éthiopiens nouveaux ou peu connus. V *Bull. Ann. Soc. Ent. Belgique*, **70**: 49–77, 46 figs.

1932. Formicides Sud-Africaines. *Soc. Ent. France Livre Cent.*: 381–392, 12 figs.

1934. Fourmis du Sahara Central. *Mem. Soc. Hist. Nat. Afrique Nord*: 165–177, 11 figs.

SCHNEIRLA, T. C.

1938. A Theory of Army-Ant Behavior based upon the Analysis of Activities in a Representative Species. *Jour. Comp. Psych.*, **25**: 51–90.

SCOTT, H.

1933. Entomological expedition to Abyssinia, 1926–7. Hymenoptera, III: Tenthredinidae, Formicidae, Mutillidae, Scoliidae, Masaridae, Vespidae. (with Benson, Bequaert and Schulthess). *Ann. Mag. Nat. Hist.*, Ser. 10, **12**: 97–120, Fig. a, b.

STÄRCKE, A.

1935. Wissenschaft Ergebnisse der Nederlandischen Expeditionen in den Karakorum und die angrenzenden Gebiete 1922, 1925 und 1929/30. Zool. (Formicidae). F. A. Brockhaus, Leipzig.

WEBER, N. A.

1940. Ants on a Nile River steamer. *Ecology*, **21**: 292–293.

1941a. Four new genera of Ethiopian and Neotropical Formicidae. *Ann. Ent. Soc. Amer.* **34**: 183–194, Pl. I.

1941b. An ecological study of the ant fauna of the Imatong Mountains, Anglo-Egyptian Sudan, with special reference to altitude and plant zones. Year Book of The American Philosophical Society, 1940, pp. 271–272. Philadelphia.

1942a. A biocoenose of papyrus heads (*Cyperus papyrus*). *Ecology*, **23**: 115–119, 3 figs.

1942b. New doryline, cerapachyine and ponerine ants from the Imatong Mountains, Anglo-Egyptian Sudan. *Proc. Ent. Soc. Washington.* **44**: 40–49, Pl. 5.

WHEELER, W. M.

1905. Ants from the summit of Mount Washington. *Psyche*, **12**: 111–114.

1917. The Mountain Ants of Western North America. *Proc. Amer. Acad. Arts. Sc.*, **52**: 457–569.

1921. Observations on army ants in British Guiana. *Proc. Amer. Acad. Arts Sc.*, **56**: 291–328, 10 figs.

WHEELER, W. M., with the collaboration of J. BEQUAERT, I. W. BAILEY, F. SANTSCHI, and W. M. MANN.

1922. Ants of the American Museum Congo Expedition. A contribution to the myrmecology of Africa. *Bull. Amer. Mus. Nat. Hist.*, **45**: xi + 1139, Pl. I-XLV, 47 maps, 103 text figs.

PART II—TAXONOMY[1], [2]

NEW MYRMICINAE

CREMATOGASTER

CREMATOGASTER (C.) LATUKA spec. nov.

Plate 15, Fig. 11

Worker. Length extended 3.5–3.9 mm. (of thorax, not including "neck," 0.77–1.0 mm.). Head in front view, excluding mandibles, broader than long in maxima, as long as broad in minima, occipital margin distinctly impressed, sides and anterior clypeal margin convex; frontal carinae short, feebly raised, antennal fossae well developed, eyes moderately convex, situated nearer posterior than anterior head margin; mandibles short, strongly curved and with 4 well-developed teeth; antennal scapes extending to occipital corners, club 3-jointed, 2nd funicular joint longer than broad and distinctly longer than 3rd. Thorax from above flattish on top, the sides marginate, the mesonotal carina reduced to a faint gibbosity almost absent on the minima. Epinotal spines short, conic, directed slightly backwards and downwards. Petiolar node from above broader than long in maxima, longer than broad in minima with dorsal surface flattened and depressed, the sides produced as rounded lobes. Post-petiole from above broader than long and divided by a deep furrow into two lobes. Gaster and legs of normal proportions.

Shining, microscopically reticulate basally, head feebly striate, mandibles rugose, thorax striate on margins, the striae running transversely on pronotum. Pilosity of sparse, fine appressed hairs most numerous and coarsest on appendages. Brownish ferruginous, the minima being darkest, posterior margin of gastric segments infuscated.

Cotypes: workers of one colony (No. 1379) which I took July 31 on the east slopes of the Imatong Mts., A.–E. Sudan at an elevation of about 4600 ft. The ants nested in a hollow twig a meter above ground.

---

[1] Holotypes of the new Imatong ants will be deposited in the Museum of Comparative Zoölogy, Harvard. Cotypes will be divided between this museum and my collection.

[2] For descriptions of other Imatong new species see Weber 1941 a and b.

CREMATOGASTER (C.) MENILEKI Forel, SUDDENSIS subsp. nov.

Worker. Length extended 3.5–4.1 mm. (of thorax, excluding "neck" 0.9–1.1 mm.). Head in front view, excluding mandibles, as broad as long to slightly broader than long, occipital margin feebly impressed, sides strongly convex, anterior clypeal margin convex; eyes moderately convex, situated closer to occipital than to clypeal margin; mandibles strongly convex and with 4 stout teeth; antennal scape distinctly exceeding occipital corners. Mesonotum with a feeble median gibbosity. Epinotal spines of variable shape but always conic, short, more or less acutely pointed. Petiolar node broader than long; postpetiole divided by a median furrow into two lobes.

Shining, basally microscopically reticulate, front of head and thorax striate, mandibles rugose. Pilosity of scanty, fine, appressed hairs and sparse, longer and upright hairs. Yellowish ferruginous, head and thorax variably infuscated.

Female. Length extended 8.2 mm. (of thorax 2.2 mm.). Head in front view broader than long, antennal scapes fail to reach occipital corners, mandibles 5-toothed. Epinotal declivity convex and without spines or tubercles. Sculpture and pilosity as in worker. Ferruginous, darker than in worker.

Workers similar to the ssp. *proserpina* Santschi but darker, more strongly sculptured and with stouter and shorter epinotal spines.

Cotype workers: several (No. 1243) taken 9.vii.39 on the Upper White Nile, A.-E. Sudan from papyrus (*Cyperus papyrus*) in the swamp known as the Sudd.

Holotype female: one female (No. 1245) taken 10.vii.39 in the above region.

CREMATOGASTER (DECACREMA) LANGO spec. nov.

Plate 15, Figs. 6–7

Worker. Length extended about 1.9 mm. (of thorax, excluding "neck," 0.47 mm.). Head in front view, excluding mandibles, barely longer than broad, occipital margin faintly impressed medially, sides and anterior clypeal margin convex; frontal carinae short, feeble, antennal fossae well developed; eyes 0.11 mm. in diameter, convex, situated closer to anterior than posterior head margin; mandibles strongly convex, with 4 distinct teeth; antennal scapes bowed, not reaching occipital corners, antennae 10-jointed, the terminal 2 forming a club, funicular joints 3–5 strongly transverse. Thorax proportions as in figures. Petiolar node from above broader than long, the dorsal surface concave, sides marginate and produced as convex lobes, ventral surface of petiole toothed. Postpetiolar node from above broader than long, divided into two lobes by a median furrow, anterior margin of gaster with angular corners. Femora incrassate.

Smooth and shining but for scattered, fine punctulations chiefly on thorax. Pilosity of sparse, fine appressed hairs and longer, coarser, nore numerous and more upright hairs on appendages. Bright brown, posterior margins of gastric segments infuscated, appendages yellow brown.

Holotype: one worker (No. 1301) which I took July 24 on the east slopes of the Imatong Mts., A–E. Sudan at an elevation of about 3800 ft.

CREMATOGASTER (ORTHOCREMA) SORDIDULA Nyl., MOLONGORI subsp. nov.

Worker. Length extended 2.4–2.8 mm. (of thorax, excluding "neck," 0.53-0.73 mm.). Differing from the typical form chiefly in smaller size, coarser sculpturing and much shorter and sparser pilosity. Compared with a cotype of the subspecies *natalensis* the present form is darker, is not smooth back of the antennal fossae and is more distinctly sculptured on the thorax. Middle section of clypeus and frons smooth and shining, elsewhere on head striate-punctate; thorax and pedicel striate-punctate, gaster finely reticulate. Pilosity on body of sparse, appressed fine hairs and scattered longer and more upright hairs. Color variably brown to dark brown, darkest on head and gaster.

Cotypes: several workers (No. 1375) which I took July 31 at an elevation of about 4000 ft. on the east slopes of the Imatong Mts., A.-E. Sudan.

CREMATOGASTER (ATOPOGYNE) AFRICANA Mayr, POLYMORPHICA subsp. nov.

Worker. Length extended 4–8 mm. (of thorax, excluding "neck," 1.1–2.14 mm.). Head of maxima, excluding mandibles, broader than long, head of minima about as long as broad; occipital margin broadly impressed, sides convex, anterior clypeal margin truncate. Pronotum of maxima rounded, of minima gibbous on each side. Epinotal spines of maxima short, acutely conic, of minima much longer and more slender. Postpetiole of maxima broader than long, bilobed posteriorly, more flattened above than in minima.

Close to the forms *fickendeyi* and *schumanni* in general habitus but differing from these and the other numerous forms of *africana* in larger size and extreme polymorphism. The only other *Crematogaster* of comparable polymorphism recorded by Arnold is *C. acaciae victoriosa* with a worker range in length of 3–5 mm.

Cotypes: Workers of one colony (No. 1408) which I took August 2 on the west slopes of the Imatong Mts., A.-E. Sudan at an elevation of about 4500 ft.

CREMATOGASTER (SPHAEROCREMA) LOTTI spec. nov.

Plate 15, Fig. 2

Worker. Length extended 3.3–3.7 mm. (of thorax, excluding "neck," 0.9–1.0 mm.). Head in front view, excluding mandibles, broader than long, occipital margin almost straight, faintly impressed, sides convex, anterior clypeal margin truncate, feebly convex; frontal carinae short, feebly raised, fossae distinct; eyes large, convex, situated almost entirely on posterior half of head; mandibles strongly convex, 4-toothed; antennal scapes exceeding occipital corners by about ¼ their length, club 3-jointed, all funicular joints except 3rd clearly longer than broad, the latter about as broad as long. Pro- and meso-notum sharply marginate to carinate dorso-laterally, dorsum slightly concave; epinotal spines diverging from above, longer than the interval between their bases, slender and acutely pointed. Petiolar node from above with expanded lateral lobes so as to be over 1½ times broader than long, dorsum feebly concave. Postpetiole with globose and entire node antero-posteriorly compressed. Gaster short, anterior margin truncate. Legs long and slender.

Shining, microscopically reticulate basally, the latter vestigial on head, front of head between eyes and mandibles striate, the striations concentric about antennal fossae, mandibles coarsely striate. Pilosity of sparse, fine, appressed hairs and the customary thicker, longer and reclinate hairs of appendages. Brown to dark brown, the appendages paler.

Cotypes: several workers (No. 1444) which I took August 5 in the Lotti Forest on the west slopes of the Imatong Mts., A.-E. Sudan.

Near *C. bequaerti* and *kneri* but smooth and shiny instead of densely punctate-striate and dull.

Crematogaster (Sphaerocrema) zonacaciae spec. nov.

Plate 15, Fig. 3

Worker. Length extended 4.0–4.2 mm. (of thorax, excluding "neck," 1.1 mm.). Head in front view, excluding mandibles, broader than long, occipital margin impressed, sides convex, anterior clypeal margin truncate; frontal carinae continued back to a level with the eyes; eyes situated closer to occipital than to anterior clypeal margin, moderately large and convex; mandibles strongly convex, 4-toothed, the basal tooth smallest; antennal scapes reaching or slightly exceeding occipital corners, funicular club 3-jointed. Pronotum from above marginate, pro-and meso-notum separated by a V-shaped suture directed forward and bisecting the pronotum, a feeble, rounded carina being present in the apex, mesonotum submarginate on sides, meso-epinotal suture deep and complete; epinotal spines long, narrow, acute, about as long as the interval between their bases. Petiolar node from above with convex lobate sides, over 1½ times broader than long. Postpetiolar node entire, antero-posteriorly compressed. Gaster short, anterior margin truncate. Legs moderately long and slender.

Sub-lucid, basally reticulate, front of head shining, rest striate-punctate, front divided by a median furrow extending from clypeus to occiput; mandibles rugose; thorax striate with shallow punctations. Pilosity of fine, moderately abundant, appressed hairs, appendages with longer and reclinate hairs. Castaneous, appendages brown.

Cotypes: workers from a colony of several hundred (No. 1420) which I took August 3 at an elevation of about 4700 ft. on the west slopes of the Imatong Mts., A.-E. Sudan.

Near *striatula* but with head less impressed occipitally and with a distinct median furrow, with epinotal spines less curved and with frons of head smoother.

Monomorium

Monomorium (M.) minutum Mayr, kineti, subsp. nov.

Plate 15, Figs. 10, 19

Worker. Length extended 2.4–2.6 mm. (of thorax 0.64 mm.). Funicular joints 3–8 as broad or broader than long. Pronotum from above broader than long, subglobose in outline to mesonotum; meso-epinotal suture distinct and laterally and dorsally; epinotal declivity faintly marginate on sides. Petiolar node from above sub-globose; postpetiole from above broader than long. Gaster from above truncate anteriorly.

Smooth and shining with piligerous punctations. Pilosity of scattered fine, long hairs reclinate to upright interspersed with shorter, sub-appressed hairs most numerous on head. Dark brown, appendages apically yellowish brown.

Female. Length extended 3.9 mm. (of thorax 1.1 mm.). Head in front view, excluding mandibles, broader than long, occipital margin convex, anterior clypeal margin emarginate medially, eyes situated at middle of sides of head, mandibles 4-toothed, antennal scapes exceeding occipital corners. Epinotal declivity marginate on each side. Petiolar node from above antero-posteriorly compressed, smaller and less broad than postpetiolar node. Gaster with anterior margin truncate. Legs long and slender.

Shining, smooth except for sparse punctations most numerous on pedicel. Pilosity of numerous long, fine, reclinate to upright hairs. Dark brown, head and gaster somewhat infuscated, appendages paler.

Male. Length extended 2.5 mm. (of thorax 0.75 mm.). Head in front view, excluding mandibles, longer than broad, occipital margin impressed, sides and anterior clypeal margin convex, eyes large, situated closer to mandibular insertions than their diameters; mandibles bent apically and prolonged into 3 acute teeth; all funicular joints distinctly longer than broad. Epinotum smooth and without tubercles. Petiole rising smoothly into a convex node which is more than ½ as high as the petiole and flattened dorsally. Legs long and slender. Wings with numerous hairs and pale, thick veins.

Shining, head punctate, thorax sparsely and irregularly punctate, gaster smooth. Pilosity of scattered long, fine, upright hairs which are most numerous on gaster. Dark brown, gaster infuscated, appendages paler brown.

Type colony: one colony (No. 1334) of all castes which I took July 27 on the summit of Mt. Kineti, 10,458 ft. Imatong Mts., A. E. Sudan. The ants nested in soil and tended coccids ("*Ripersia*" sp.) on the roots of grasses.

MONOMORIUM (M.) MINUTUM Mayr, ARBOREUM, subsp. nov.

Worker. Length extended 2.1–2.3 mm. (of thorax, excluding "neck," 0.54–0.58 mm.). Head in front view, excluding mandibles, 1¼ times longer than broad, occipital margin impressed, sides convex, anterior clypeal margin produced as a convex lobe; frontal carinae extending to a level with the eyes; eyes convex, situated slightly closer to anterior clypeal than to occipital margin; mandibles convex and with 4 large teeth; antennal scapes distinctly not reaching occipital corners; funicular joints 3–8 broader than long. Mesoëpinotal impression distinct laterally and dorsally. Petiolar node from above with convex sides, narrower than postpetiole; postpetiole transversely elliptical. Gaster narrowed anteriorly and truncate. Legs long and slender.

Shining; thorax on sides above middle and hind legs punctate. Pilosity of long, fine, scattered upright hairs. Brownish yellow, head and gaster infuscated.

Female. Length extended 3.7 mm. (of thorax, excluding "neck," 0.95 mm.). Head in front view, excluding mandibles, longer than broad occipital margin faintly impressed, sides convex, anterior clypeal margin produced as a convex lobe which is feebly emarginate medially; frontal carinae extending to a level with the eyes; eyes situated about midway between anterior clypeal and occipital margins; mandibles with 4 distinct teeth; antennal scapes reach occipital corners; epinotal declivity feebly marginate on each side. Petiolar node higher than postpetiole, with dorsal margin somewhat truncate and anteroposteriorly compressed. Postpetiole from above transversely elliptical. Gaster narrowed anteriorly and truncate. Legs long and slender.

Shining, smooth but for piligerous punctations, striate-punctate epinotum on sides and lower declivous surface, and punctate pedicel; clypeus feebly bicarinate. Pilosity of moderately abundant fine, reclinate hairs. Brownish yellow; head, thorax and gastric segments except anterior portion, infuscated.

Type colony: one colony (No. 1397) which I took August 2 on the west slopes of the Imatong Mts., A.-E. Sudan at an elevation of about 6200 ft. The ants nested at the base of large ferns growing from a tree at a height of 16 ft.

Easily separated from the subspecies *pallidipes* and *kineti* by pale color and sculpture; resembling somewhat *M. andrei fur* Forel but distinctly larger, head and scapes longer and the petiolar node is less compressed.

MONOMORIUM (M.) ESTHERAE spec. nov.

Plate 15, Fig. 18

Worker. Length extended 2.2–2.4 mm. (of thorax, excluding "neck". 0.56–0.58 mm.). Head in front view, excluding mandibles, rectangular, occipital corners rounded, occipital margin feebly impressed, sides subparallel, anterior clypeal margin produced as two distinct teeth; mandibles with 4 teeth of variable development. Thorax in profile with evenly convex pro-mesonotum, distinct mesoëpinotal impression and epinotum descending smoothly; thorax from above appears laterally in the form of two convexities, a stronger and broader promesonotum and a feebler and narrow epinotal. Petiole in profile with distinct peduncle and evenly rising node which is higher than the postpetiole; petiolar node antero-posteriorly compressed and with convex dorsum. Postpetiole from above transversely elliptical. Anterior margin of gaster concave and obtusely angulate laterally. Legs moderately long and slender.

Shining, smooth except for piligerous punctations. Pilosity of moderately abundant long, fine hairs and a shorter and thicker pilosity on appendages.

Cotypes: three workers (No. 1423) which I took August 4 on the west slopes of the Imatong Mts., A.-E. Sudan, at an elevation of about 5050 ft. The ants had formed a tiny crater in the soil.

This species is dedicated to the memory of the late Dr. Esther W. Wheeler, an admired friend and fellow myrmecologist. Her last studies were on the ants of North Dakota.

SOLENOPSIS

SOLENOPSIS PUNCTATICEPS Mayr, JUBA, subsp. nov.

Plate 15, Figs. 5, 8, 14

Worker. Length extended 2.0–2.8 mm. (of thorax, excluding "neck", 0.48–0.75 mm.). A subspecies which differs from the typical form and the forms *caffra* and *kibaliensis* in smaller size of minima as well as maxima workers and in darker color. The clypeal teeth are differently shaped than in typical *punctaticeps* and the middle pair of mandibular teeth better developed. Minima worker slightly darker and with larger eyes than the corresponding worker in *caffra* which has also the occiput less impressed. Differing from the forms *africana, cyclops, indocilis, maligna, cleptomana* and *erythraea* in clypeal and mandibular teeth proportions. The *erythraea* and *africana* maxima workers have the sides of head more strongly convex; the *cyclops* worker has the head much broader.

Shining, smooth except for piligerous punctations. Pilosity of moderately abundant fine yellowish hairs of short to moderate length which are mostly reclinate to subappressed; all parts of body bear the pilosity. Minima worker brownish yellow with the head and thorax variably darker. Maxima worker variably brown with infuscated dorsal surfaces of head and gaster and, to a less extent, the thorax.

Female. Length extended 5.2–5.5 mm. (of thorax 1.6 mm.). Head in front view, excluding mandibles and eyes, approximately as broad as long, occipital margin transverse, feebly impressed, sides convex, anterior clypeal margin prolonged into 2 acute and well-developed teeth; eyes large, convex, situated closer to the mandibular insertions than their diameters; antennal scapes failing to reach occipital corners by more than their distal diameters; mandibles with 4 well-developed teeth. Epinotal declivity concave between the smoothly marginate sides. Petiole pedunculate with smoothly rising node appearing conic in side view and with medially impressed dorsum when viewed from behind. Postpetiole lower than petiole, transversely elliptical when viewed from above. Anterior margin of gaster concave, not angulate. Legs moderately long and slender.

Shining, body generally smooth except for piligerous punctations; head with a smooth median groove running to occiput; punctate in front of eyes; striate between frontal carinae except for smooth posterior part of clypeus; sides of pedicel finely striate-punctate. Pilosity of abundant, fine, yellowish upright hairs. Dark brown, appendages paler.

Cotypes; workers and females of one colony (no. 1356) which I took July 28 at an elevation of 9200 ft. in the Imatong Mts., A.-E. Sudan. The ants nest in soil, often about other ant nests.

OLIGOMYRMEX

OLIGOMYRMEX SANTSCHII spec. nov.

Plate 15, Figs. 4, 16

Soldier. Length fully extended 1.7 mm. (of thorax 0.41 mm.). Head in front view with closed mandibles 0.66 mm. long by 0.40 mm. wide. Eyes minute, mandibles 5 toothed, antennae 9-jointed, a median ocellus in middle of head. Thorax from above with promesonotum globular in outline and 0.24 mm. broad; basal surface of epinotum 0.11 mm. broad, concave between lateral carinae. Petiole from above twice as thick through node as through peduncle. Postpetiole from above distinctly broader than petiole and transversely elliptical. Gaster small and ovate. Legs short, femora and tibiae inflated.

Head in front view densely punctate, closely striate except for the smooth bicarinate clypeus and frons and merely punctate occipital corners, the corners bearing also a transverse carina; occiput striate-punctate; sides of head posteriorly shining, sparsely punctate; mandibles smooth. Thorax and pedicel densely punctate, especially laterally and on epinotum, pro-mesonotum also striate above; dorsum of petiolar and postpetiolar nodes shining, sparsely punctate; gaster shining, with piligerous punctations. Pilosity of moderately abundant fine, yellowish short reclinate hairs covering body generally, and a few longer and coarser curved hairs chiefly on thorax. Light ferruginous, appendages paler.

Worker. Length fully extended 1.03–1.06 mm. (of thorax 0.30 mm.), length in straight line as they crawl 0.55–0.64 mm. Head in front view including closed mandibles 0.37 mm. long by 0.26 mm. wide. Eyes minute, mandibles 5-toothed, antennae 9-jointed. Mesoëpinotal suture faint, epinotal teeth distinct, acute, triangular. Postpetiole slightly less than twice as broad as petiole.

Head, thorax and pedicel densely and coarsely punctate; clypeus bicarinate, frons of head and mandibles smooth and shining, gaster with piligerous punctations. Pilosity of moderately abundant short, fine and reclinate hairs with a few scattered much longer, coarser and curved hairs chiefly on thorax and gaster. Pale ferruginous.

Cotype workers and holotype soldier: 17 workers and one soldier (No. 1475) which I took August 11 in the forest of Khor Aba on the Nile-Congo watershed south of Yei, A.-E. Sudan.

Near *O. jeanneli* Santschi and of comparable size in soldier and worker but *jeanneli* soldier has 10-jointed antennae, nothing is said in the description about pre-occipital carinae and the epinotum is unarmed. The worker *jeanneli* has mandibles 4-toothed, head finely striolate, epinotum unarmed and is in other ways different.

Dedicated to my late colleague, Dr. F. Santschi, in recognition of his studies on *Oligomyrmex* and African ants in general.

CAREBARA

CAREBARA BARTRUMI spec. nov.

Plate 15, Figs. 17, 20

Female. Length 14 mm. (of thorax from anterior extension of mesonotum to episternal angle in a straight line 4.7 mm.). Scutum of mesonotum with a sharply marginate furrow medially and anteriorly which disappears gradually posteriorly; epinotum carinate on each side, the carinae dorsally projecting as rounded lobes when viewed from the side. Petiole in side view with node rising smoothly to a dorsal thickness of 0.5 mm. and truncate above, posterior margin sharply descending to postpetiole, the latter feebly concave above and distinctly lower than the petiole.

Shining, finely punctate, the punctations separated by smooth areas, anterior part of head with punctations tending to be connected by striae. Pilosity of minute, scattered, yellowish hairs. Mahogany brown.

Male. Length 8 mm. (of thorax, as measured in female, 3.0 mm.). Scutum of mesonotum with an antero-median furrow as in female but less sharp. Dull, densely punctate, punctations coarsest on head. Pilosity a dense, backwardly directed reclinate pubescence. Dirty yellowish brown head and thorax infuscated, wings dirty pale brown, the veins margined in dark brown. Clypeus produced antero-medially as a distinct hump or gibbosity.

Holotype female and male: one pair (No. 1486) which I took *in copula* August 13 at 6 a. m. at Yei, Equatoria, A.-E. Sudan. The ants were crawling on the ground before sunrise.

Probably near *C. sudanica* Santschi, which is not figured, but the male is very different and the female smaller and with differently shaped epinotum. This species is much too small for *C. vidua* and its var. *dux;* The female is distinctly larger than that of *C. osborni*. The female is close to *langi* but this is paler and has the petiole evenly rounded above. *C. bartrumi* is dedicated to Mr. J. E. Bartrum, Assistant District Commissioner at Yei in memory of his cordial hospitality.

PAEDALGUS

PAEDALGUS SUDANENSIS spec. nov.

Plate 15, Figs. 12, 15

Female. Length extended 5.6 mm. (of thorax, from antero-dorsal margin in straight line to episternal angle, 1.76 mm.). Scutum of thorax with an antero-median furrow disappear in anterior third of scutum; declivous surface of epinotum marginate on each side and dorsally produced as an obtuse tooth. Petiole with a sharply rising node which is antero-posteriorly compressed and feebly convex above. Postpetiole in side view broader than petiolar node and from above distinctly broader than the former, as well as longer, somewhat transversely elliptical from above with straightened anterior margin and slightly angular sides. Anterior margin of gaster concave for the reception of the postpetiole and obtusely angulate on each side. Gaster elongate-ovate. Legs of moderate length, slender, 1st tarsal joint nearly 1½ times as long as the terminal 4, the latter longer than broad. Wings 4.2 mm. long.

Dull, densely punctate, head and, to a lesser extent, the thorax also vermiculate. Pilosity of a fine, dense, reclinate pubescence giving a gray cast to the ant when viewed under low magnification. Dark ferruginous, appendages paler. Wings pale with pale brown veins margined with dark brown.

Holotype: one winged female (No. 1293) which I took July 22 at the east base of the Imatong Mts., A.-E. Sudan.

CALYPTOMYRMEX

CALYPTOMYRMEX (C.) BREVIS spec. nov.

Plate 15, Fig. 1

Worker. Length extended 2.5–2.6 mm. (of thorax, excluding "neck," 0.6 mm.). Head in front view, excluding mandibles, slightly broader than long, broadest behind, occipital margin impressed, clypeus sharply depressed so that in front view the anterior head margin is divided into a convex lobe on each side by the lowered clypeus; lateral margins of clypeus produced anteriorly as a sharp pair of teeth; antennal scape extending back of eyes but falling far short of occipital corners; mandibles trigonal with 3 distinct apical teeth and about 3 denticles basally. Thorax from above trapezoidal, the anterior pronotal margin high and convex, humeri angulate, sides feebly convex and converging posteriorly to the epinotum. Epinotum with subparallel sides, about half as broad as pronotum, declivity slightly angulate. Petiolar node from above transversely elliptical. Postpetiole from above transversely elliptical with truncate anterior margin, broader than petiole. Anterior margin of gaster impressed for reception of postpetiole.

Sculpture, which is basally punctate, largely obscured by squamate hairs, head reticulate, the reticulations tending to become striae in front, mandibles striate; thorax vermiculate-reticulate, pedicel above reticulate, gaster finely but densely punctate. Body covered densely with a uniform pilosity of narrow-squamate hairs which extend to the femora, tibiae and, sparsely, to the scapes and 1st tarsal joint; appendages with a fine, dense, appressed to reclinate pilosity of short hairs. Pale ferruginous, hairs pale yellowish.

Cotypes: several workers of a small colony (No. 1441) which I collected August 5 in the Lotti Forest, west slopes of Imatong Mts., A.-E. Sudan. Two workers of this colony were left with my colleague, Mr. Donisthorpe, at the British Museum (Natural History) during my visit in October.

MACROMISCHOIDES

MACROMISCHOIDES VIRIDIS spec. nov.

Plate 15, Fig. 9

Worker. Length extended 3.4–4.1 mm. (of thorax, excluding "neck," 0.98–1.15 mm.). Thorax from above with a pronounced pronotal tubercle on each side which is obtuse and variably pointed; meso-epinotal suture pronounced above and for a short distance laterally; epinotal spines diverging, slender, acute, much longer than interval between their bases. Petiolar node from above appears thin and strongly antero-posteriorly compressed. Postpetiole from above slightly broader than petiole, broader than long. Gaster ovate. Legs long and slender.

Shining, head finely and shallowly punctate, with sparse rugae of irregular lengths which tend to become joined so as to be somewhat reticulate, especially posteriorly; thorax reticulate-vermiculate; thorax and pedicel finely and shallowly punctate; gaster and legs smooth. Pilosity of moderately abundant long, fine, upright hairs which are longest and most numerous on the head and thorax. Head and thorax dark brown, appendages paler, gaster metallic bluish-green, a color which is particularly distinct in the living ant.

Female. Length extended 4.9 mm. (of thorax, excluding "neck," 1.3 mm.). Similar to the worker except for the usual sexual differences. Pronotum laterally with distinct tubercles though blunter and lower; epinotal spines long, slender, acute, about twice as long as the interval between their bases. Petiolar node antero-ventrally compressed, postpetiole broader. Sculpture, pilosity and color as in worker.

Male. Length extended 4.6–4.8 mm. (of thorax, from antero-dorsal extension of scutum to episternal angles, 1.9–2.1 mm.). Mandibles with 6 teeth of which the apical 2 or 3 are most distinct, the others of irregular development; eyes hemispherical, closer to mandibular insertions than their diameters; 2nd funicular joint longer than antennal scape and as long as funicular joints 3–5 taken together. Epinotal declivity with a tiny tubercle on each side. Crest of petiolar node compressed antero-posteriorly and irregularly tuberculate; postpetiole broader. Sculpture much as in worker but feebler and more striate on thorax. Pilosity as in worker but hairs shorter and scantier. Color as in worker. Wings hyaline with pale brown veins.

Cotypes: workers, females and males of one colony (No. 1419) which I took August 3 at an elevation of about 4700 ft. on the west slopes of the Imatong Mts., A.-E. Sudan. The ants formed a carton nest on leaves of *Afromum*.

OCYMYRMEX

OCYMYRMEX WEITZECKERI Emery, CELER, subsp. nov.

Worker. Length extended 8–9 mm. (of thorax 2.3–2.6 mm.). Head, excluding mandibles, slightly longer than broad, occipital margin distinctly impressed, sides diverging to the mandibular insertions, anterior clypeal margin convex, notched medially with a distinct tooth on each side; frontal carinae raised, convex; eyes 0.35–0.37 mm. in diameter, moderately convex, situated slightly medial to lateral outline; antennal scapes exceeding occipital corners by their distal diameters; mandibles 5-toothed, the basal 2 small. Pro-mesonotal suture above marked by a tubercle or raised spiracle opening on either side. Petiole with a slender peduncle which at its insertion is about ⅓ the height of the node, the node in side view globose, from above longer than broad. Postpetiole from above longer than broad, broader than petiole and broader behind than in front. Gaster distinctly constricted anteriorly. Legs long and slender.

Shining; head striate, feebly and shallowly punctate, occiput somewhat smooth; thorax striate, feebly punctate, pronotum above partly smooth; petiolar peduncle transversely striate, the node feebly and sparsely striate-punctate; postpetiole above mostly smooth; gaster microscopically reticulate anteriorly, more feebly behind. Pilosity of moderately abundant stoutish hairs most numerous on head and thorax and a pilosity of shorter and finer hairs on gaster and legs; psammophore well developed. Reddish ferruginous, gaster infuscated.

Cotypes: several workers (No. 1462) which I took August 6 at Torit, north of the Imatong Mts., A.-E. Sudan.

This subspecies differs from the typical form and the vars. *hirsutus* and *arnoldi* especially in having less deeply punctate head and the pedicel more shallowly punctate.

TETRAMORIUM

TETRAMORIUM SQUAMINODE Santschi, NUBIS subsp. nov.

Plate 16, Fig. 24

Worker. Length 2.6 mm. (of thorax 0.95 mm.). Head in front view, excluding mandibles, slightly less than one-tenth longer than broad back of eyes, faintly impressed at occipital margin, occipital corners moderately rounded; sides convex, wider back of eyes than in front; eyes convex, situated distinctly in front of middle of sides; anterior clypeal border medially emarginate; frontal carinae distinct, sinuate, with a small convex lobe above antennal insertions; mandibles strong, trigonal, with a large apical tooth and about six irregular smaller teeth; scapes elongate-clavate, extending to occipital corners; funicule with a three-jointed club longer than remaining joints. Thorax without sharp humeri, in dorsal view with irregularly sinuate lateral margins and feeble mesoëpinotal impression; in side view evenly convex, epinotal spines acute, slender, longer than the intervening distance between them and the episternal lobes. Petiole pedunculate in side view with a squamate node which is about one-half higher than the length of the exposed peduncle; node viewed from behind with a transverse crest, feebly impressed medially, and convex sides. Postpetiole about eight-tenths as high as petiole, from above transversely elliptical, one-sixth wider than postpetiole, three-fourths wider than long. Gaster ovate, anterior margin feebly impressed at postpetiolar junction. Legs of moderate length, femora and tibiae swollen.

Shining; head moderately rugose, sparsely and shallowly punctate; thorax rugose, becoming vermiculate to reticulate at margins, sparsely and shallowly punctate; pedicel faintly punctate, gaster smooth. Pilosity of upright, coarse and truncate hairs; shorter, finer, pointed and reclinate hairs on the appendages and anterior and inferior portions of head. Dark brown, appendages a more yellowish brown.

Cotypes: two workers (No. 1355) which I took July 28, at an elevation of about 9200 ft. in the Mt. Kineti massif of the Imatong Mts. Additional workers from the same colony were collected. The ants were tending coccids on ("*Ripersia*" sp.) on roots of grass (Myers No. 11580) and nested in irregular chambers extending down 70 mm. into black humus.

The typical *squaminode* was collected on Mt. Kilimanjaro at elevations of 2850 to 3800 m. Comparing with Santschi's original description and his and Arnold's figures of the typical *squaminode*, *nubis* differs in having seven instead of six mandibular teeth, a greater space between the epinotal spines and episternal lobes, less acute apex of petiolar node, lower postpetiole and its anterior face more sloping. It differs from the race *do* Forel in that its clypeus is not tricarinate and the sides of the pronotum are not smooth.

TETRAMORIUM BREVIS spec. nov.

Worker. Length 1.4 mm. (of thorax 0.55 mm.). Head in front view, excluding mandibles, one-sixth longer than broad back of eyes; occipital margin distinctly impressed; sides slightly convex; anterior clypeal margin feebly convex; frontal carinae distinctly more feebly developed than in *simillimum*, subparallel; eyes moderately convex, situated on anterior half of head so that their posterior portion slightly extends past the middle; mandibles trigonal, with about five teeth of which only the two apical are well-developed; antennal scapes fail distinctly to reach the occipital corners; funicular club three-jointed, markedly longer than the preceding joints taken together. Thorax in side view evenly convex except for slight mesoepinotal impression; from above humeri angulate, mesoëpinotal region distinctly impressed; epinotal spines reduced to a pair of small, blunt teeth, much smaller than in *simillimum* or *pusillum*. Petiole pedunculate; node massive, in side view the anterior face rising in an even concavity, feebly convex dorsum forming slightly obtuse angles with anterior and posterior descending. Postpetiole lower than petiole, convex above; seen from above transversely elliptical, about one-quarter broader than petiole. Gaster ovate, anterior margin impressed at postpetiolar junction. Legs of moderate length, femora swollen.

Head with numerous shallow punctations, striate in front, reticulate on sides. Thorax and pedicel punctate, dorsally vermiculate-reticulate. Gaster smooth and shining. Pilosity sparse, of short, mostly thick, hairs. Dark brown, appendages light brownish-yellow.

Holotype: one worker (No. 1405) which I took Aug. 2 at an elevation of about 5600 ft. on the western slopes of the Imatong Mts. The ant was among grass more than six feet tall through which were scattered *Acacia abyssinica* trees.

This very small species is related to the *simillimum* group but is noticeably smaller, darker, and with greatly reduced epinotal spines. It must be one of the very smallest species in this large genus.

TETRAMORIUM JEANAE spec. nov.

Plate 16, Fig. 29

Worker. Length about 2.8 mm. (of thorax 0.91 mm.). Head in front view, excluding mandibles, one-sixth longer than broad; occiput distinctly impressed, angles rounded; sides feebly convex, widest back of eyes; anterior clypeal margin convex, not emarginate; frontal carinae distinct, sub-parallel, feebly divergent in middle, forming a feeble and elongate lobe over antennal insertions; eyes moderately convex, situated in front of middle; mandibles stout, trigonal with three distinct teeth apically and three shorter teeth basally; antennal scapes slightly enlarged distally and exceeding occipital angles by nearly their distal diameters; funicular club three-jointed and longer than remaining joints taken together. Thorax in side view slightly convex at pronotum and nearly plane behind; mesoëpinotal impression very faint in side view but from above the thorax is distinctly impressed laterally at this point; epinotal spines short, stout, acutely pointed and directed upwards about 50 degrees from the epinotal basal surface, distinctly shorter than the distance between them and the episternal lobes. Petiole pedunculate, in side view with a high node which is over a half longer than exposed peduncle, the node forming with peduncle a smoothly concave surface, the anterior and dorsal surfaces meeting in a right angle, the posterior angle more rounded, viewed from behind with truncate top and convex sides. Postpetiole transversely elliptical, one-third wider than long. Gaster ovate, feebly impressed anteriorly at postpetiolar junction. Legs of moderate proportions, femora slightly incrassate.

Shining: sparsely and shallowly punctate except on gaster; clypeus with only one distinct carina which is median and a faint carina on each side; frons with about five low and irregular carinae, sides of head with large, shallow reticulations; sides of thorax with sparse carinae, medially with numerous distinct punctations, thorax and pedicel dorsally mostly smooth, with sparse vermiculate or reticulate carinae, pilosity of moderately long, scattered, acutely pointed yellowish hairs and much finer and more appressed hairs chiefly on the appendages. Dark brown, appendages more yellowish brown.

Holotype: one worker (No. 1395) which I took Aug. 2, at an elevation of about 6400 ft. on the western side of the Imatong Mts. The ant was crawling over an open grassy margin of forest.

This species differs distinctly from any in American museums. It resembles somewhat *T. setigerum* ssp. *quaerens* Forel but is smaller, darker, much shinier since with less punctation, the epinotal spines are much shorter and it is in other ways different. In Arnold's key to African *Tetramorium* it runs to *T. frenchi* but this species has a longer head which is parallel-sided and with a straight occipital margin; the clypeus with three carinae, petiolar peduncle as long or longer than the node with a vertical anterior and oblique posterior face, etc.

T. jeanae is dedicated to my wife in recognition of her assistance during the taxonomic investigations on these African ants in American museums.

TETRAMORIUM VITICOLA spec. nov.

Plate 16, Fig. 31

Worker. Length 3.1–3.3 mm. (of thorax 1.1 mm.). Head in front view, excluding mandibles, one fifth longer than broad back of eyes; occipital margin shallowly impressed, sides sub-parallel, anterior clypeal margin convex, faintly emarginate in middle, frontal carinae very feeble, eyes convex, situated in front of middle, mandibles trigonal, with three strong apical teeth and three feebly developed basal teeth; antennal scapes not quite reaching occipital corners, funicular club three-jointed, the club a little shorter than remainder of funiculus. Thorax in side view evenly convex, the mesoëpinotal impression feebly indicated but from above distinct as a lateral impression; basal epinotal surface in side view forming with declivity a sloping, feebly convex surface, spinotal spines short, acutely conic, curved upward, a trifle longer than the stout, acutely pointed episternal angles. Petiole with very short peduncle and massive node, the node rising as an even convexity to the posterior face which is vertical and feebly concave, peduncle ventrally with a minute tooth, in front above a trifle broader than long, elliptical. Postpetiole distinctly higher than the petiole, in side view rising as an even convexity to the abruptly descending posterior face, from above, three-tenths broader than petiole, transversely elliptical. Gaster ovate. Legs moderately short, femora incrassate.

Head reticulate-vermiculate, densely but shallowly punctate, clypeus with a strong median and one or two lateral carinae on each side; thorax and pedicel coarsely reticulate with fine, shallow punctations between; gaster densely punctate, with a few setigerous, large, carinate punctations anteriorly which become confluent at the anterior margin. Pilosity of moderately abundant upright yellow hairs which are shortest on head. Pale ferruginous.

Cotypes: one colony (No. 1409) which I took Aug. 3 at an elevation of 4900 ft. on the west slopes of the Imatong Mts. The ants were 30 ft. up in a dead, hollow liana on a tree in a rain forest khor.

TETRAMORIUM SIMILLIMUM (F. Smith), ISIS, subsp. nov.

Worker. Length extended 2.7–2.8 mm. (of thorax 0.7 mm.). Head in front view, excluding mandibles, longer than broad, antennal scapes distinctly not reaching occipital corners, mandible with 6 teeth of which the basal 4 are variable and indistinct. Thorax in profile evenly convex, epinotal spines in form of short, acute, triangular teeth. Petiolar node large, its anterior margin in profile being a sharp right angle and from above appearing truncate. Postpetiole, from above transversely elliptical, broader than petiole. Anterior gastric margin truncate.

Differing from the typical tropicopolitan form largely in color and sculpture. Head, thorax, pedicel gaster dark brown, almost black, only the margins of the segments being brown; mandibles, antennal and legs yellowish brown so that they contrast distinctly with the body; all parts of the body are much darker than the corresponding parts in the typical form, such as is found in Cuba, Australia, Java, Philippine Is., etc. Head, thorax and pedicel distinctly more sparsely and shallowly punctate above, head less regularly striate.

Cotypes: workers of one colony (No. 1350) which I took July 28 at an elevation of 8700 ft. in the Imatong Mts., A.-E. Sudan.

XIPHOMYRMEX

XIPHOMYRMEX SUDANENSIS spec. nov.

Plate 15, Fig. 40

Worker. Length extended 2.3 mm. (of thorax 0.64 mm.). Head in front view, excluding mandibles, slightly larger than broad, occipital margin broadly and feebly impressed, sides feebly convex; anterior clypeal margin convex, lateral margins carinate, not reduced to a mere ridge, feebly emarginate medially; frontal lobes shallowly convex, carinae distinct and extending posterior to antennal scapes; eyes situated on the sides, moderately convex, closer to occipital than to clypeal margin; mandibles strongly convex, with 3 distinct apical teeth and 2–3 indistinct and irregular teeth basally; antennal scapes fail to reach occipital corners by a distance equal to about twice their distal diameters, funicular club 3-jointed. Thorax from above with angular humeri, feebly convex anterior margin and sides converging to epinotum with two emarginations on each side, mesoëpinotal suture not impressed, epinotal spines straight, diverging, as long as the interval between their bases; thorax in side view evenly convex above and with long, acute, straight spinotal spines. Petiole with massive and squarish node, which, seen from the side, forms a sharp angle anteriorly; node from above rectangular, longer than broad, corners rounded. Postpetiole convex dorsally, from above transversely elliptical, broader than petiole. Gaster short, ovate. Legs short, femora thick.

Shining; head and thorax above with numerous longitudinal striae between which are sparse, shallow punctations; sides of head and thorax reticulate-striate and punctate as above; pedicel reticulate-punctate, dorsum of postpetiole with a smooth median area. Pilosity of short, fine, curved hairs which are abundant on the gaster and much sparser on the head and thorax. Ferruginous, dorsum of head and gaster infuscated.

Holotype: one worker (No. 1291) which I took near Torit, north of the Imatong Mts., A.-E. Sudan July 22. This and *papyri*, described from the female caste, are closely related.

XIPHOMYRMEX PAPYRI spec. nov.

Plate 16, Fig. 36

Female (*alate*). Length extended 3.2–3.3 mm. (of thorax 0.90–0.96 mm.). Head in front view, excluding mandibles, slightly longer than broad, occipital margin broadly impressed, sides feebly convex, anterior clypeal margin convex, emarginate medially; frontal lobes low and convex, carinae distinct and bordering a distinct scrobe long enough to accommodate the antennae; eyes convex, 0.20 mm. in diameter, situated closer to mandibular insertions than their diameters; mandibles convex, 7-toothed, the apical 3 teeth strong, the basal 4 weak and of variable development, antennal scapes failing to reach occipital corners by a distance greater than their distal diameters, club 3-jointed. Humeri of pronotum angulate, scutum flat dorsally, epinotal spines long, stout, acutely pointed; episternal angles in form of acutely pointed triangular teeth directed upwards. Petiole with short peduncle and massive node which in side view is squarish and from above is transversely rectangular. Postpetiole from above about twice as broad as long, sides convex. Gaster short, ovate, truncate in front. Legs of moderate length, femora swollen.

Shining; head striate-punctate above, reticulate-punctate on sides. Pronotum and pedicel coarsely reticulate-punctate; scutum striate-punctate; gaster smooth but for piligerous punctations. Pilosity of moderately dense short, fine upright hairs. Ferruginous, dorsum of head infuscated, gaster dark brown. Wings hyaline, iridescent, with pale, yellowish-gray stigma and veins.

Cotypes: Four females (No. 1242) which flew to the S.S. Gedid July 8 on the Upper White Nile, A.-E. Sudan while we were passing through the Sudd. These closely resemble the worker of *X. sudanensis* but for the proportions of the petiole, except for the usual sexual differences.

XIPHOMYRMEX WEITZECKERI Emery, EDITHAE, subsp. nov.

Worker. Length extended 3.5 mm. (of thorax, excluding "neck," 1.0 mm.). Head in front view, excluding mandibles, longer than broad back of eyes, occipital margin broadly impressed, sides convex, anterior clypeal margin convex, notched medially; eyes situated in the middle of head, antennal scapes extending to or slightly beyond occipital corners, mandibles with 3 distinct apical teeth and 4 irregular denticles. Mesoëpinotal suture impressed, bordered posteriorly above by a carina. Petiolar node antero-posteriorly compressed strongly, viewed from behind broader than high, sides subparallel, dorsal border truncate, feebly convex. Postpetiole from above strongly compressed anteroposteriorly. Head above striate-punctate, reticulate-punctate at sides. Thorax punctate, above anteriorly vermiculate transversely, longitudinally vermiculate posteriorly, the vermiculations diverging behind, sides vermiculate; rest of body smooth and shining. Pilosity of sparse fine, moderately short, upright hairs. Dark brown, gaster brownish black, appendages lighter brown.

Holotype: one worker (No. 1405) which I took August 2 at an elevation of 6000 ft. in the Imatong Mts., A.-E. Sudan. Another worker taken the next day at an elevation of 4800 ft. belongs to this form. This ant is dedicated to Mrs. Edith B. Christianson in token of her long, friendly interest in these studies.

This subspecies differs from the typical *weitzeckeri* in being much darker in all parts of body, in having the hairs distinctly longer, the antennal scapes longer, sides of petiolar node less convex and the postpetiolar node thicker.

XIPHOMYRMEX MINUSCULUS Santschi, AMEN, subsp. nov.

Worker. Length extended 2.3 mm. (of thorax 0.64 mm.). Head in front view, excluding mandibles, slightly longer than broad, broadest back of eyes, occipital margin convex, sides convex, anterior clypeal margin convex, notched medially; antennal scapes extending about half ways from eyes to occiput, club 3-jointed; eyes convex, situated closer to clypeal than occipital margin; mandibles strongly convex, with 3 distinct teeth apically and about 3 indistinct denticles. Thorax from above with feebly convex anterior margin, straight sides converging posteriorly except for two emarginations, stout, acutely pointed, straight epinotal spines which are about as long as the interval between their bases; thorax in side view with feebly convex dorsum, epinotal spines curved slightly and large episternal angles. Petiole in side view with short peduncle and high, squarish node with rounded posterior face, from above node longitudinally rectangular. Postpetiole from above angularly and transversely elliptical. Gaster sub-globular, anterior margin truncate. Legs of moderate proportions.

Shining; head and thorax above sparsely and shallowly striate-punctate, sides of head, thorax and pedicel mostly smooth, striate- to reticulate-punctate, gaster with piligerous punctations. Pilosity of moderately abundant short, fine, upright hairs. Body black, the margins of segments dark brown, appendages dark brown.

Holotype: one worker (No. 1430) which I took August 4 at an elevation of about 4200 ft. in the Imatong Mts., A.-E. Sudan. It is dedicated to the Egyptian god Åmen.

XIPHOMYRMEX ZONACACIAE spec. nov.

Plate 16, Fig. 34

Worker. Length extended 3.5–3.7 mm. (of thorax, excluding "neck", 0.98–1.0 mm.). Head in front view, excluding mandibles, slightly longer than broad back of eyes, occipital margin feebly impressed, sides and anterior clypeal margin feebly convex, the latter feebly notched medially; eyes convex, situated closer to occipital than clypeal margin; mandibles convex, with 3 distinct apical and 3 or 4 indistinct more basal denticles; antennal scapes barely or not quite reaching occipital corners, club 3-jointed. Thorax from above with rounded humeri, anterior margin slightly convex, mesoëpinotal suture marked by a distinct depression and bordered laterally by a raised, transverse carina appearing in side view as a tubercle; epinotal spines straight, acute, about as long as the interval between their bases. Petiole in side view with a short peduncle and high node narrowed dorsally and descending posteriorly in a convexity; node from above and behind with sides convex and narrowing dorsally. Postpetiole from above transversely elliptical, broader than petiole. Gaster short, ovate, truncate anteriorly. Legs moderately long and slender.

Shining; head striate-punctate above; remainder of head, thorax and pedicel reticulate-punctate, gaster smooth except for piligerous punctations. Pilosity of reclinate, short hairs which are most numerous on gaster. Brownish black appendages dark brown.,

Cotypes: workers of one colony (No. 1315) which I took July 25 at an elevation of 7100 ft. in the Imatong Mts., A.-E. Sudan.

Triglyphothrix

Triglyphothrix cinereus spec. nov.

Plate 16, Fig. 25

Worker. Length extended 2.7–2.9 mm. (of thorax 0.73–0.75 mm.). Head in front view, excluding mandibles, slightly longer than broad, occipital margin approximately straight medially, convex at corners, sides convex, narrowed anteriorly slightly; eyes large, convex, situated as far from the mandibular insertions as their diameters; antennal scapes failing to reach occipital angles by a distance about equal to their distal diameters, club 3-jointed; mandibles trigonal with 3 distinct apical teeth and 3–4 denticles basally of irregular development. Thorax from above, excluding epinotum, as broad through pronotum as long, sides and anterior margin feebly convex; in side view convex above, flattened at basal surface of epinotum, epinotal teeth sharp, triangular, directed backwards and upwards. Petiole from above with node 1½ times broader than long, anterior margin angularly convex, sides narrowed; in side view with short peduncle and high, squarish node. Postpetiole from above as long as petiolar node but distinctly broader and with sides produced more as convex lobes, in side view with convex dorsal margin. Gaster short, ovate. Legs moderately short and slender.

Coarsely, deeply and densely reticulate on head, thorax and pedicel. Pilosity of dense, multifid whitish hairs of which many are quadrifid, others quinquifid. Dark brown, appendages yellowish brown.

Cotypes: workers (No. 1304) which I took July 24 at an elevation of about 4000 ft. on the east slopes, Imatong Mts., A.-E. Sudan.

Runs to *hepburni* in Arnold key but *hepburni* with postpetiole almost 2 times wider than long and hairs trifid.

CATAULACUS

CATAULACUS PYGMAEUS E. André, SUDDENSIS, subsp. nov.

Worker. Length extended 3–4 mm. (of thorax 0.9–1.1 mm.). Thorax from above with pronotum transversely rectangular bordered with irregular setigerous tubercles and with mesonotal sides converging to the epinotum, these segments similarly setigerous. Epinotal spines from above stout, straight, bluntly pointed, in side view high and deflected forward, from above slightly broader than long with convex sides and anterior and posterior margins straight. Postpetiole from above wider than petiole, sides constricted posteriorly, anterior margin irregularly convex. Gaster emarginate anteriorly.

Sculpture basally a dense punctation which is overlain on head by loose reticulations, on thorax and pedicel by coarser reticulate-vermiculations and on gaster by fine vermiculations which are most distinct and convergent anteriorly. Pilosity of moderately abundant short, whitish setae, finest on gaster. Black, appendages dark brown.

Male. Length extended 4.1 mm. (of thorax 1.2 mm.). General habitus, except in thorax, as in worker. Mandibles trigonal, stout, with 2 distinct apical teeth; antennae 11-jointed; eyes not markedly longer than in worker but distinctly wider; epinotal spines shorter than in worker. Body finely and densely punctate as in worker but more reduced on gaster, overlying reticulations much less prominent. Color similar. Wings hyaline with pale yellowish-brown stigma and veins.

Similar in color to *C. pymaeus lujae* Forel but distinctly smaller and with the epinotal spines deflected sharply near the base.

Cotypes: several workers and one male (No. 1244) which I took July 10 in the Sudd above Adok on the Upper White Nile, A.-E. Sudan.

STRUMIGENYS

STRUMIGENYS (CEPHALOXYS) ESCHERICHI Forel, LOTTI, subsp. nov.

Plate 15, Fig. 13

Worker. Extended length 2.2–2.3 mm. (of thorax 0.6 mm.). Thorax in side view raised in uneven convex hump through the pro-mesonotum and lowered through the epinotum; epinotum in side view with feebly convex basal surface and strong, acute and straight epinotal spines which are directed upwards and backwards. Petiole with a long peduncle and node which in side view appears high and convex, antero-posteriorly compressed, and from above appears transversely elliptical. Postpetiole from above transversely elliptical, about 1½ times broader than petiole.

Densely and deeply punctate except on gaster which is finely shagreened at base, smooth distally; pro-mesonotum with a distinct longitudinal carina and superficial, feeble vermiculations, gaster with a few striae at the base. Pilosity of a few scattered long, coarse, upright, truncate to clavate hairs, moderately abundant narrow-squamate hairs on head and scape, and an appressed pubescence on appendages. Pale yellowish ferruginous.

Female. Extended length 2.5 mm. (of thorax 0.7 mm.). Similar to the worker except for the usual sexual differences. Antennal scapes failing distinctly to reach occipital corners; humeri of pronotum angulate. Sculpture as in worker except for smoother gaster with more striae at base. Color darker, being ferruginous with dark brown gaster.

Cotypes: workers and female of one colony (No. 1451) which I took August 5 in the Lotti Forest, west slopes of Imatong Mts., A.-E. Sudan.

Runs in Arnold key to *escherichi boerorum* but this 2.2 mm., mandibles half as long as head and sculpture quite different. Compared with a cotype of *escherichi* the new subspecies has the petiolar node less squarish from above, the pronotal carina more distinct, longer antennal scapes and darker color.

NEW DOLICHODERINAE

TAPINOMA

TAPINOMA CARININOTUM spec. nov.

Plate 16, Fig. 32

Worker. Length extended 2 mm. (of thorax 0.6 mm.). Head in front view distinctly longer than broad, occipital margin and sides convex, anterior clypeal margin broadly and distinctly impressed medially, eyes 0.14 mm. in diameter, moderately convex, situated less than 0.14 mm. from the mandibular insertions; mandibles large, trigonal, with 2 distinct apical teeth, a denticle, a 3rd tooth, then 3–4 indistinct denticles completing the biting margin, all teeth of variable development so that there may be merely a distinct apical tooth and 8–9 denticles; antennal scapes exceeding occipital angles by a distance about equal to 2 times their distal diameters; all funicular joints longer than broad. Thorax from above convex anteriorly and at sides of pronotum, sides converging to epinotum; basal and declivous surfaces of epinotum separated by a complete, sharp, transverse carina. Gaster short. Legs long and slender.

Finely and shallowly reticulate. Pilosity a fine, whitish, appressed pubescence. Grayish brown, appendages paler.

Cotypes: several workers (No. 1293) which I took July 22 at the east base of the Imatong Mts., A.-E. Sudan.

TECHNOMYRMEX

TECHNOMYRMEX ALBIPES (F. Smith), TRUNCICOLUS, subsp. nov.

Worker. Length extended 2.4–2.6 mm. (of thorax 0.69–0.75 mm.). Head in front view ovate, narrowed anteriorly; excluding mandibles distinctly longer than broad; occipital margin distinctly impressed in larger workers, less distinctly in smaller workers; anterior clypeal margin broadly impressed; eyes 0.15–0.16 mm. in diameter, feebly convex; antennal scapes exceeding occipital corners by about twice their distal diameters; funicular joints 2–3 as broad as long. Thorax in side view with feeble pro-mesonotal suture and deep mesoëpinotal impression; basal surface of epinotum convex, obtusely angulate.

Pilosity a fine, yellowish white appressed pubescence, and a few, scattered, long, upright hairs. Dark brown, appendages paler.

Cotypes: workers of one colony (No. 1382) which I took nesting in a twig of a gnarled tree at an elevation of 6200 ft. in the Imatong Mts., A.-E. Sudan, August 1.

Differing from workers placed under the typical form (Br. Solomon Is., Mann) in finer sculpture and paler appendages, differing from the var. *brunneipes* of India especially in paler color, differing from ssp. *foreli* of Natal in having shorter scapes and darker color, especially of antennae, differing from var. *affinis* of Kenya in paler color, clypeus more distinctly impressed and scapes longer.

TECHNOMYRMEX INCISUS spec. nov.

Plate 16, Fig. 37

Worker. Length extended 2.8 mm. (of thorax 0.79 mm.). Head in front view ovate, excluding mandibles distinctly longer than broad, occipital margin feebly impressed, anterior clypeal margin broadly impressed; eyes 0.14 mm. in diameter, feebly convex, situated closer to the mandibular insertions than their diameters; mandibles trigonal with a series of fine denticles and an apical tooth; antennal scape exceeding occipital corners by over twice their distal diameters, funicular joints 2–6 clearly longer than broad. Thorax from above 1½ times longer to mesoëpinotal impression than broad through pronotum. Gaster elongate-ovate. Legs of moderate proportions.

Finely and densely punctate. Pilosity of a fine yellowish-white appressed pubescence and a few, scattered, upright and coarse hairs most numerous on the gaster distally. Dark brown, appendages paler, coxae and trochanters of middle and hind legs and trochanter of fore leg ivory white.

Holotype: one worker (No. 1445 a) which I took August 5 in the Lotti Forest, west slopes of Imatong Mts., A.-E. Sudan. Easily distinguished by the deep incision between the mesonotum and epinotum.

TECHNOMYRMEX LONGISCAPUS spec. nov.

Plate 16, Fig. 41

Worker. Length extended 2.5 mm. (of thorax 0.88 mm.). Funicular joints 2–6 longer than broad. Thorax from above distinctly constricted laterally at pro-mesonotal and mesoëpinotal sutures; in side view convex except for feeble impression at pro-mesonotal suture, mesoëpinotal impression deep and obtuse, epinotum convex above. Gaster ovate. Legs of moderate proportions.

Finely and densely punctate. Pilosity a fine, yellowish-white appressed pubescence, and coarse, upright grayish hairs which are scanty on head and thorax, much more numerous on gaster. Blackish brown, appendages dark brown, tarsi paler.

Holotype: one worker (No. 1446) which I took August 5 in the Lotti Forest, west slopes of Imatong Mts., A.-E. Sudan. Easily distinguished by the long antennal scapes.

NEW FORMICINAE

PLAGIOLEPIS

PLAGIOLEPIS (P.) SUDANICA spec. nov.

Plate 16, Fig. 38

Worker. Length extended 1.4–1.5 (of thorax 0.41–0.44 mm.). Clypeus produced medially as a gibbosity partly covering mandibles:

mandibles small, trigonal, with 4 fine teeth. Thorax in side view flattened on top, convex anteriorly and at epinotum, pro-mesonotum raised as a feeble convexity. Meso-epinotal impression distinct and continuous laterally and dorsally, bordered posteriorly by a spiracular tubercle on either side dorso-laterally; epinotum feebly marginate on each side and intercepted by a slightly protuberant spiracle laterally. Petiole from behind with subparallel sides and convex dorsum. Gaster from above short, ovate. Legs moderately slender.

Shining, smooth but for setigerous punctations. Pilosity a fine, sparse, appressed pubescence most abundant on head, and a few scattered, coarse, upright hairs chiefly on thorax. Medium brown, appendages yellowish brown.

Cotypes: four workers (No. 1402) of one colony which I took August 2 at an elevation of 68000 ft. in the Imatong Mts., A.-E. Sudan. Near *P. mediorufa* of B. Congo but head larger and more impressed at occiput, appressed pubescence more abundant but gastric hairs less numerous, color of thorax and appendages darker.

ACANTHOLEPIS

ACANTHOLEPIS CAPENSIS Mayr, ACHOLLI, subsp. nov.

Plate 16, Fig. 26

Worker. Extended length 2.2–2.4 mm. (of thorax 0.79–0.81 mm.). Head in front view, excluding mandibles, slightly longer than broad, occipital margin feebly impressed, sides and anterior clypeal margin convex; antennal scapes exceeding occiput by over ⅓ their length. Epinotum bluntly bi-tuberculate. Petiolar scale with feeble though distinct teeth. Shining, meso-epinotal region and sides of epinotum sparsely rugose, epinotum above and behind punctate. Pilosity of a sparse, white, appressed pubescence and moderately abundant long, yellowish-white hairs most numerous on gaster. Black, appendages blackish brown.

Female (*deälate*). Length extended 4.0–4.3 mm. (of thorax 1.4–1.5 mm.). Head in front view triangular, excluding mandibles approximately as broad as long, antennal scapes exceeding occiput by over ⅓ their length. Petiolar scale feebly bituberculate above. Finely and densely punctate. Pilosity of an abundant fine, yellowish-white pubescence and longer but fine hairs which are most numerous on gaster where they border the margins of the segments. Blackish brown, appendages dark brown.

Cotypes: workers and females of one colony (No. 1309) which I took July 24 at an elevation of 6400 ft. in the Imatong Mts., A.-E. Sudan.

Resembling *simplex* and *issore* but differing from both chiefly in having distinct teeth on the petiolar scale; smaller than *issore*.

ACANTHOLEPIS CAPENSIS Mayr, ISSORE, subsp. nov.

Plate 16, Fig. 27

Worker. Length extended 2.4 mm. (of thorax 0.84–0.86). Resembling the subspecies *simplex* Forel (comparing with a cotype in the Museum of Comparative Zoölogy). The size, however, is distinctly larger, the head is less rectangular, the long hairs more numerous, and the appendages darker. Head broadest through the posterior margin of eyes, sides convex, occipital margin feebly impressed; antennal scapes surpassing head by about ⅓ their length. Sides of epinotum prolonged as blunt tubercles. Node of petiole expanded latterly, dorsally emarginate. Shining, microscopically reticulate, sides of epinotum mostly smooth, sparsely and shallowly sculptured. Black, appendages dark brown, funiculi and tarsi yellowish brown.

Cotypes: workers of one colony (No. 1404) nesting August 2 in a dead stub of a branch of an *Acacia abyssinica* tree at an elevation of 6200 ft., west slope of Imatong Mts., A.-E. Sudan, near the locality known as Issore.

Syntypes: workers (No. 1423) taken Aug. 4 near the above locality at an elevation of 5050 ft.

According to Arnold all South African species of *Acantholepis* nest in the ground; the present form is thus aberrant in its ecology.

ACANTHOLEPIS CAPENSIS Mayr, THOTH, subsp. nov.

Plate 16, Figs. 28, 39

Worker. Length extended 2.1–2.4 mm. (of thorax 0.70–0.73 mm.). Head in front view, excluding mandibles, clearly longer than broad, occipital margin medially straight; sides broadest through eyes, convex, anterior clypeal margin somewhat truncate medially; eyes moderately convex, situated closer to occipital than to clypeal margin; antennal scapes exceeding occiput by between ⅓ and ½ their length; mandibles with 5 acute teeth. Epinotum bluntly bituberculate; dorsal margin of petiole entire, truncate dorsally.

Shining, sides of mesonotum and to a slight extent the epinotum, shallowly rugose. Pilosity of minute, scattered appressed hairs and moderately abundant, long, whitish hairs most numerous on gaster. Dark brown, appendages slightly paler.

Female (*deälate*). Length extended 5 mm. (of thorax 1.9 mm.). Head, excluding mandibles, approximately as long as broad back of eyes; eyes closer to occipital than clypeal margin; antennal scapes exceeding occipital corners by nearly ½ their length; mandibles 5-toothed. Petiolar scale entire, feebly convex above. Densely and finely punctate Pilosity of an abundant, long, fine, yellowish-white appressed pubescence and a few long, fine, upright hairs chiefly on gaster. Blackish-brown, appendages paler.

Cotypes: workers and female (No. 1297) of one colony which I took July 23 at an elevation of 2900 ft. at the east base of the Imatong Mts., A.-E. Sudan.

This form, dedicated to the Egyptian god, Thoth, is noteworthy in having long antennal scapes.

ACANTHOLEPIS MEGACEPHALA spec. nov.

Plate 16, Fig. 23

Worker or *Soldier*. Length extended 4.3 mm. (of thorax 1.2 mm.). Head in front view, including closed mandibles, 1.54 mm. long x 1.45 mm. wide, occipital margin strongly impressed as in some *Camponotus* soldiers, sides convex, anterior clypeal margin truncate; eyes 0.26 mm. in diameter, situated closer to mandibular than to occipital margin, frons with 3 distinct ocelli; antennal scapes extending about ⅔ the distance of the occipital angles, all funicular joints longer than broad; mandibles stout, strongly convex, with 4 stout teeth showing when mandibles are closed. Pronotum from above about as broad as long, the sides strongly convex, 1.6 times broader than broad through meso-epinotal region; epinotum bluntly bituberculate. Petiolar scale prolonged into a pair of acute spines about as long as the interval between them. Gaster short, ovate. Legs long and slender.

Head densely and finely punctate, thorax more sparsely and shallowly punctate; mesonotum rugose laterally and posteriorly above; epinotum rugose-punctate; gaster smooth but for setigerous punctations. Pilosity of a fine, appressed pubescence most numerous on head, and numerous long, whitish, upright hairs chiefly on the thorax and gaster. Head mahogany red, infuscated about mandibles and occiput; thorax, petiole and gaster black, legs and antennae dark brown.

Holotype: one worker taken by Dr. J. G. Myers (No. 10662) 15.iii.39 in the Azza Forest, Equatoria, A.-E. Sudan. In the vial with this unique were ordinary looking *Acantholepis capensis* ssp. workers.

A soldier caste seems not recorded before in this genus but the present worker has every characteristic of this caste.

CAMPONOTUS

CAMPONOTUS (MYRMOTURBA) MACULATUS (Fabr.), NUBIS, subsp. nov.

Plate 16, Fig. 30

Worker major. Length extended 9.7 mm. (of thorax 3.3 mm.). Thorax in side view with convexity interrupted by anterior raised mesonotal margin and by mesoëpinotal impression; petiolar scale cuneate, convex in front, flat behind except converging at apex. Finely and densely punctate, slightly vermiculate. Pilosity of numerous fine, yellowish, upright hairs on clypeus and scattered, minute, appressed hairs on head and rest of body; head, thorax and petiole with a few long, brownish hairs; posterior margin of gastric segments each with a row of upright, brownish yellow hairs. Brownish black, appendages dark brown.

Worker minima. Length extended 6.4 mm. (of thorax 2.5 mm.). Punctation feebler than in maxima, hence vermiculations more distinct and body shinier. Pilosity and color as in maxima.

Cotypes: workers of one colony (No. 1351) which I took July 28 at an elevation of 8700 ft. in the Imatong Mts., A.-E. Sudan.

Smaller, less polymorphic and with darker legs, thorax and petiole than *melanocnemis;* with less extreme maxima caste; minima caste much darker. Maxima caste smaller and darker than *solon*, *ballioni boera*, *brutus*, *guttatus*, *hannae* or *aegyptiacus*. Both castes much darker and larger than *miserabilis pessimus*. Shinier, thorax less deeply punctate and somewhat darker than *congolensis*.

CAMPONOTUS (MYRMOTURBA) MACULATUS (Fabr.), SUDANICUS, subsp. nov.

Worker maxima. Length extended 9.1 mm. (of thorax 3.3 mm.). Head in front view, excluding mandibles, longer than broad, occiput feebly and broadly impressed; antennal scape exceeding occiput by about 3/10 its length; anterior clypeal margin truncate. Shining, finely and shallowly vermiculate-punctate. Pilosity of sparse, fine, minute, appressed hairs; numerous upright short to moderate length, yellowish hairs on anterior portion of head; a few long, fine, yellowish hairs on thorax and petiole; long, fine, yellowish hairs bordering margins of gastric segments. Body dark brown to almost black; legs and funiculi brownish yellow becoming brown distally.

Worker minima. Length extended 6.4 mm. (of thorax 2.6 mm.). Head and thorax dark brown, thorax and petiole brown, legs brownish yellow; shining.

Cotypes: workers of one colony (No. 1396) which I took August 2 at an elevation of 6300 ft. in the Imatong Mts., A.-E. Sudan. Nesting in branch of tree at a height of about 25 ft.

Smaller than *melanocnemis*, especially in maxima and the latter caste without soldier head, also paler; darker than *aegyptiacus* and without spots, maxima much smaller; paler and smaller than *congolensis* and *solon;* unusual because of arboreal nest.

CAMPONOTUS (MYRMAMBLYS) CHAPINI Wheeler, GANZII, subsp. nov.

Worker maxima. Length extended 7.5 mm. (of thorax 2.5 mm.). Distinctly larger than typical *chapini;* thoracic sutures less impressed, epinotum less angulate; frontal carinae more evenly convex.

Worker minima. Length extended 4.2 mm. (of thorax 1.4 mm.). Frontal carinae more convex and body slightly darker than two cotypes of *chapini* but otherwise closely similar.

Cotypes: workers of one colony (No. 1378) which I took July 31 at an elevation of about 4100 ft., east slopes of Imatong Mts., A.-E. Sudan. Dedicated to Ganzi, ex-soldier and faithful Sudanese servant.

CAMPONOTUS (MYRMAMBLYS) HĀPI spec. nov.

Plate 16, Fig. 21

Worker maxima. Length extended 7.4 mm. (of thorax 2.05 mm.) Head in front view, excluding mandibles, quadrangular, broadest back of eyes, occipital margin convex, anterior clypeal margin convex, feebly notched medially; frontal carinae convex, terminating before midlevel of eyes; eyes large, feebly convex, situated much closer to occiput than to clypeal margin; mandibles stout, strongly convex, 6-toothed; antennal scapes distinctly exceeding occipital corners, all funiculi longer than broad. Thorax from above like an elongate triangle with convex base at the anterior pronotal margin; feebly impressed laterally at mesoëpinotal suture. Petiolar scale from above less than 3 times broader than long, sides acutely convex; dorsal crest from behind transverse, faintly impressed medially. Gaster elongate-ovate. Legs slender, moderately short.

Shining; finely and shallowly vermiculate-punctate. Pilosity of a few reclinate to upright yellowish hairs of moderate height of which there are several each on the frons, mesonotum, epinotal angle, petiolar scale and a few on the gaster, especially on the margins; and scattered, minute, fine appressed hairs. Head black, rest of body dark brown except for the appendages which are paler.

Worker. Length extended 5.8 mm. (of thorax 1.8 mm.). Similar to the maxima worker except for smaller size; clypeal margin and petiolar scales not impressed.

Female (*alate*). Length extended 7.3 mm. (of thorax 2.3 mm.). Similar to the worker but for the usual sexual differences. Head in front view, excluding mandibles, clearly longer than broad, occipital margin evenly convex to the eyes, sides sub-parallel, a trifle widest back of eyes; eyes closer to the occipital angles than their diameters; anterior clypeal margin convex; antennal scapes exceeding occiput by their distal diameters; ocelli very small; mandibles 6-toothed. Epinotal declivity sub-vertical as in worker. Petiolar scale from behind with broad impression dorsally and corners rounded angles. Wings 6.5 mm. long, hyaline, veins and stigma brownish yellow.

Cotypes: workers and alate females of one colony (No. 1310) which I took July 24 at an elevation of 6700 ft. in the Imatong Mts., A.-E. Sudan. This species is near *C. orinobates* Santschi and is dedicated to the Egyptian god, Hāpi, the deified Nile.

CAMPONOTUS (MYRMOPIROMIS) TRICOLOR spec. nov.

Plate 16, Fig. 33

Worker. Length extended 5.7 mm. (of thorax 2.1 mm.). Head in front view, excluding mandibles, clearly longer than broad, occipital margin sharply and broadly concave; sides convex, broadest back of eyes; anterior clypeal margin produced as a crenulate, convex lobe; eyes large, feebly convex, closer to occipital than clypeal margins; mandibles strongly convex, when closed 5 teeth are visible; antennal scapes slender, nearly straight, exceeding occipital corners by about ¼ their length; all funicular joints clearly longer than broad, the terminal joint distinctly shorter than the next 2 taken together. Thorax from above appearing as a narrow triangle with the convex base at the anterior pronotal margin; pro-mesonotal and mesoëpinotal impressions faint at the sides, the former a distinct suture. Petiolar scale from above thick, hemispherical, the plane margin being posterior. Gaster from above elongate-ovate. Legs moderately long and slender.

Shining; finely and densely vermiculate-reticulate. Body black, appendages yellowish brown, darker proximally. Pilosity of a few long, fine, yellowish hairs on the head, thorax and gaster where most numerous at the margins; of 4 long, white setae on the epinotal declivity, 5 on the posterior margin of the petiolar scale and 6 or 7 partly yellow setae on the first gastric segment; of a fine, moderately abundant, long pubescence.

Holotype: one worker (No. 1445) which I took in the Lotti Forest, west slopes of Imatong Mts., A.-E. Sudan August 5. This striking species, colored in black, yellowish brown and with white setae, is probably near *rotundinodis* Santschi.

POLYRHACHIS

POLYRHACHIS (MYRMA) CUBAËNSIS Mayr, IMATONGICA, subsp. nov.

Plate 16, Fig. 22

Worker. Length extended 6.2–6.9 mm. (of thorax 2.1–2.5 mm.). Near a cotype worker of the ssp. *gallicola* Forel in the American Museum of Natural History. *Imatongica*, however, is more robust and the middle pair of petiolar spines is much shorter. Antennal scapes suddenly clavate distally; funicular joints 1–5 clearly longer than broad, joints 6–9 about as broad as long, terminal joint and the preceding 2 taken together subequal. Thorax from above trapezoidal, the sides converging and scalloped at the pro-mesonotal and meso-epinotal sutures, anterior corners (humeri) spinose, posterior corners (epinotal) in the form of low, rounded teeth. Dull, densely and finely punctate, superficially vermiculate on head and thorax. Fine, whitish, appressed pubescence on appendages. Black.

Cotypes: 4 workers (Nos. 1301–3) which I took at elevations of 3800–4000 ft. on the east slopes of the Imatong Mts., A.-E. Sudan, July 24.

PSEUDOLASIUS

PSEUDOLASIUS MYERSI spec. nov.

Plate 16, Fig. 35

Worker. Extended length 2.9–3.2 mm. (of thorax 0.70–0.92 mm.). Head in front view, excluding mandibles, distinctly longer than broad, occipital margin concave, sides convex, anterior clypeal margin produced as a feebly sinuate convex lobe; eyes minute, variably pigmented situated slightly posterior to a level with the posterior extension of the frontal carinae; mandibles trigonal with 6 stout teeth; antennal scapes extending to occipital corners in maxima workers and exceeding them slightly in minima workers; funicular joints 2–6 about as broad as long, remainder longer than broad. Petiolar scale feebly bituberculate above. Gaster short, ovate. Legs moderately long and slender, femora compressed.

Feebly shining; faintly punctate. Pilosity of a dense, whitish, appressed pubescence and much coarser and longer, upright, yellowish hairs most numerous on clypeus and gaster, scattered on head and thorax. Minima workers yellow with a brownish tinge, mandibular teeth dark brown; maxima workers brownish yellow.

Cotypes: several workers (No. 1441) which I took August 5 in the Lotti Forest, west slopes of Imatong Mts., A.-E. Sudan. Dedicated to my host on this safari, Dr. J. G. Myers.

Larger than *gowdeyi* cotypes and with longer scapes, etc.; paler than *bufonum* cotypes which have 5 mandibular teeth, etc.; with shorter scapes than *weissi sordidus* which have 5 mandibular teeth, etc.

PLATES

PLATE 1

PLATE 1

Outline map of Africa showing position of Imatong Mountains, Anglo-Egyptian Sudan, by an X.

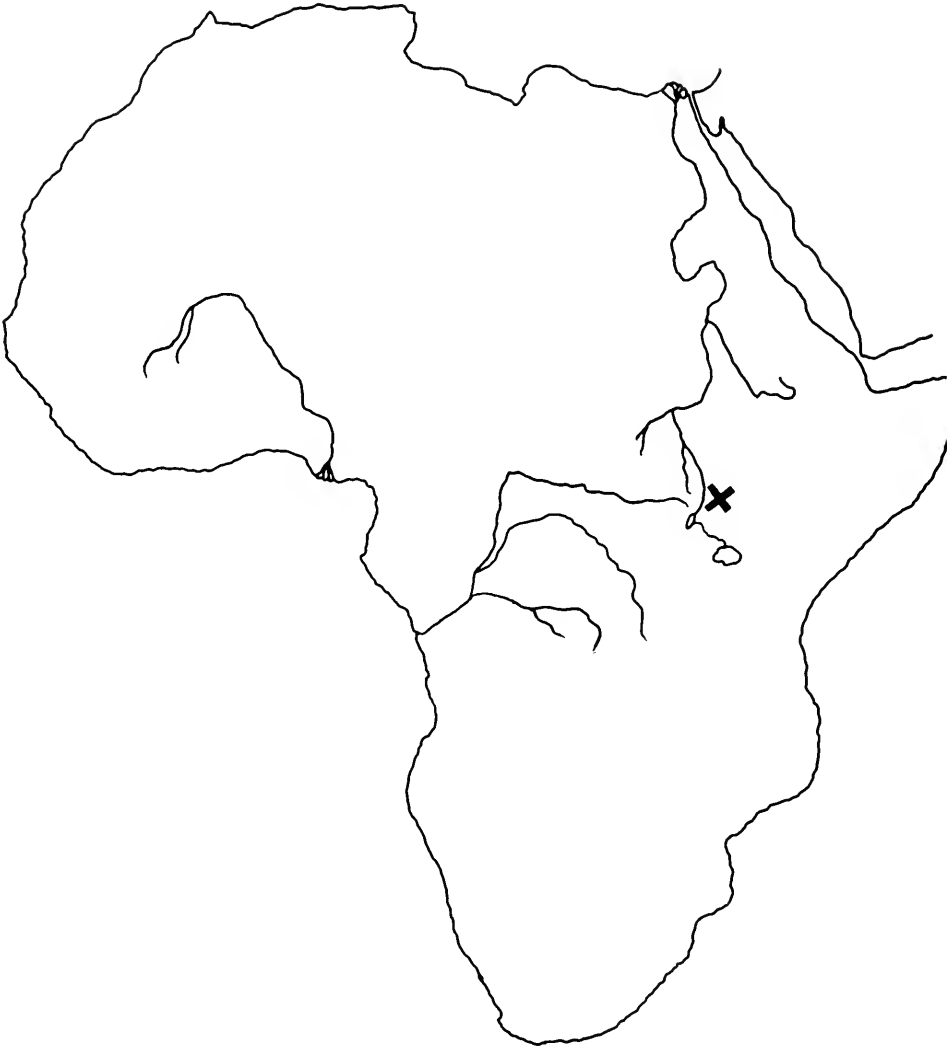


PLATE **2**

PLATE 2

Map of Imatong Mountains in thousand foot contours beginning with 4000 ft. contour. Route of the expedition in dotted lines.

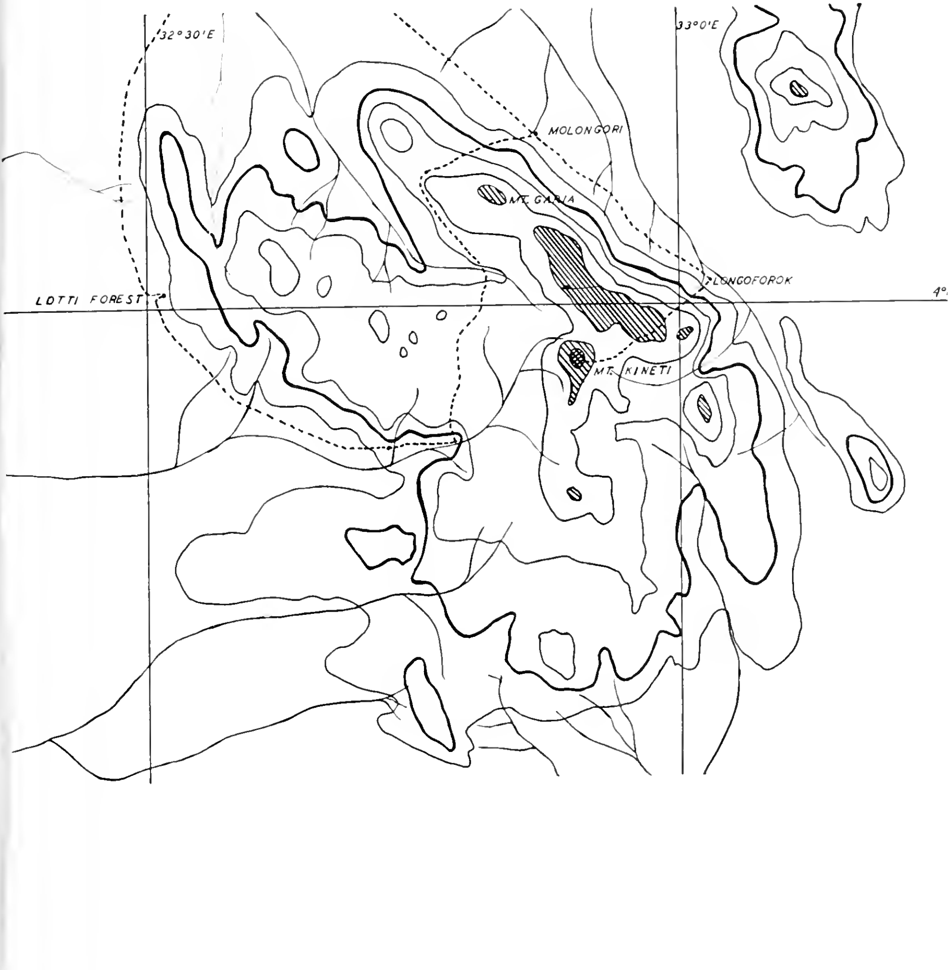

32° 30' E
33° 0' E
MOLONGORI
MT. GARIA
LONGOFOROK
LOTTI FOREST
MT. KINETI
4°

PLATE **3**

PLATE **3**

Lotti Forest, west lower slopes of Imatong Mountains, showing high forest allied to the West African rain forest. El. about 3300 ft.

PLATE 4

PLATE 4

Acacia abyssinica Zone of Imatong Mountains. El. 6800 ft. Characteristic tree is the flat-topped *Acacia.*

PLATE 5

PLATE 5

Cloud Forest-Mountain Meadow Zone of Imatong Mountains. El. 8700 ft. Aloe in flower in foreground.

PLATE 6

PLATE 6

Mt. Kineti summit, Imatong Mountains. El. 10,548 ft. Cairn marks the highest spot.

PLATE 7

PLATE **7**

Dracaena fragrans forest of west lower slopes, Imatong Mountains. El. about 6000 ft.

PLATE 8

PLATE 8

Trench and craters made by the dominant ant and one of the dominant animals of the Imatong Mountains, *Dorylus (Anomma) nigricans burmeisteri molestus.* Ruler 15 cm. long. El. 6000 ft.

PLATE 9

PLATE 9

Excavated nest of *Myrmicaria eumenoides congolensis*. Ruler 15 cm. long. El. 7300 ft.

PLATE **10**

PLATE 10

Nest of *Monomorium minutum kineti* as revealed when the rock beside it was overturned. White objects are coccids (*Ripersia* n.sp.) tended by the ants. Ruler 15 cm. long. Summit of Mr. Kineti, 10,458 ft.

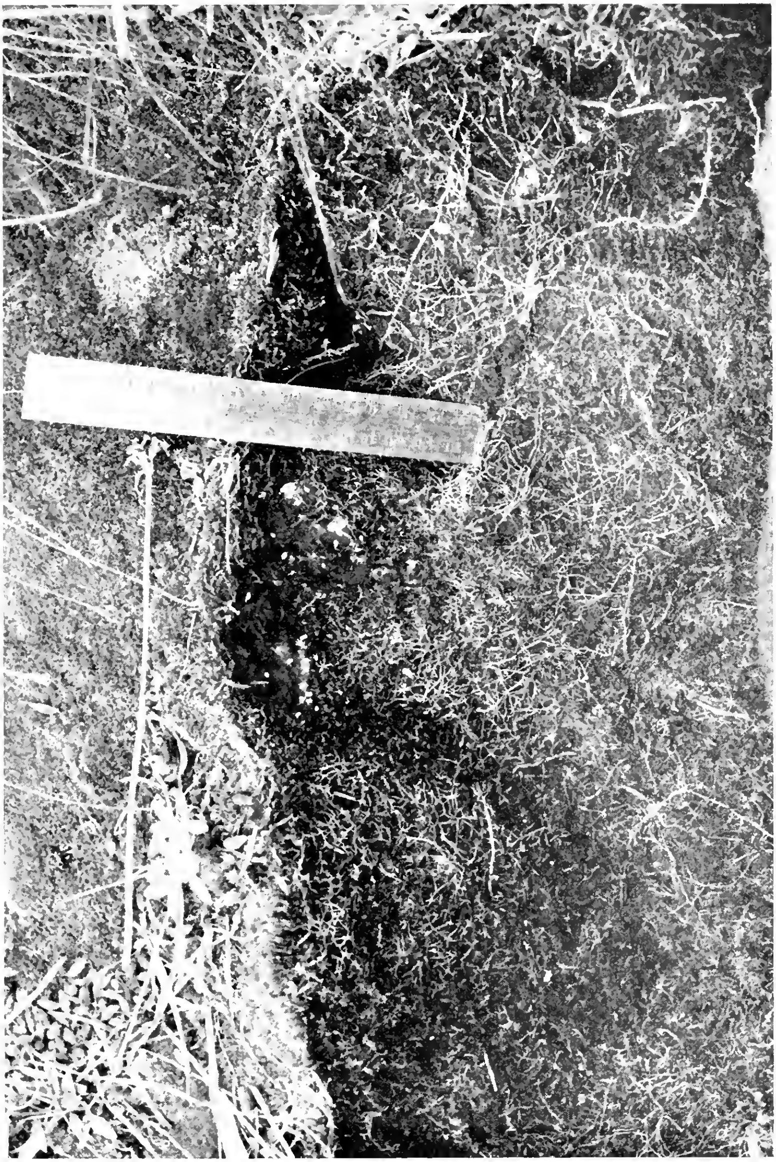


PLATE **11**

PLATE **11**

Nest of *Camponotus maculatus nubis* as revealed when the rock beside it was removed. Tiny chambers of the thief ant, *Solenopsis punctaticeps juba*, anastomosed with the *Camponotus* nest. Ruler 15 cm. long. El. 8700 ft.

PLATE **12**

PLATE 12

Site of enormous polydomous colony of *Acantholepis capensis acholli*. The ants nested under loose slabs of scaling rock. El. 6440 ft.

PLATE **13**

PLATE **13**

One of the nests of plate 12 exposed when the overlying rock was overturned and showing the carton used in construction of the chambers. Ruler 15 cm. long.

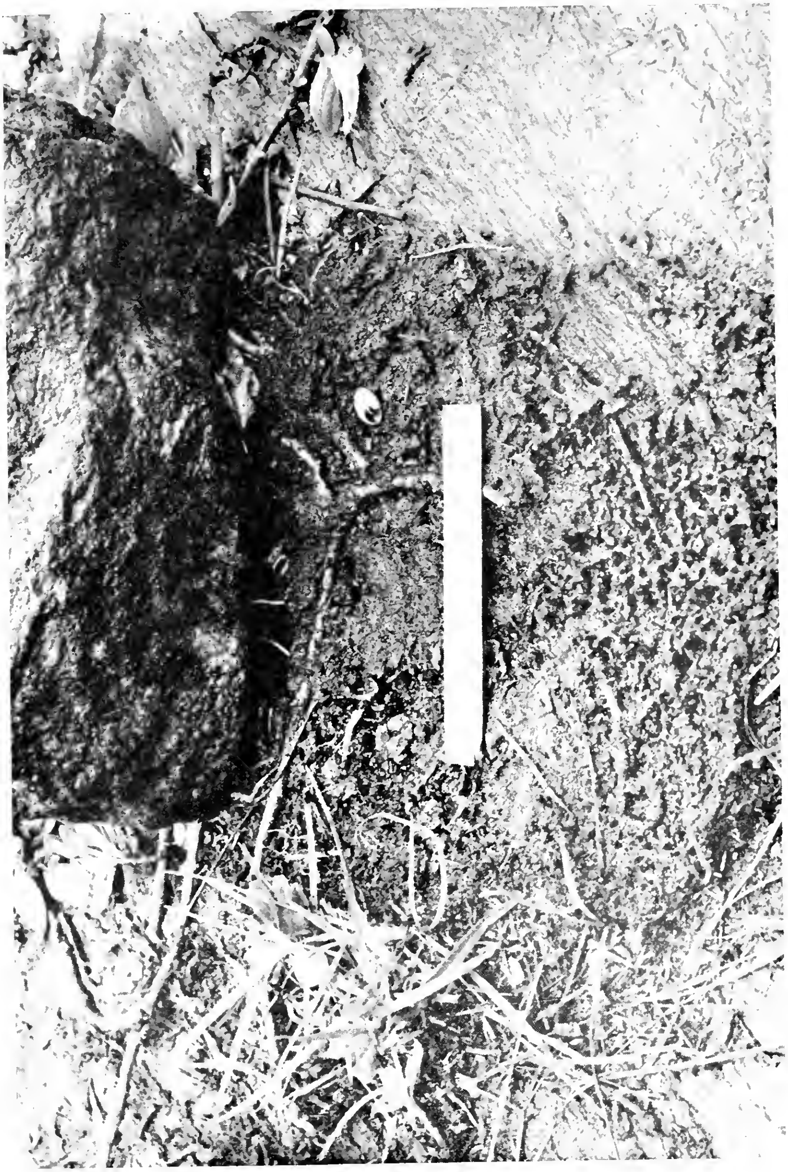


PLATE **14**

PLATE 14

Nest of *Polyrhachis* (*Myrma*) *schistacea divina* partly excavated and showing workers crawling on the 15 cm. ruler. El. 4100 ft.

PLATE 15

PLATE 15

Fig. 1 *Calyptomyrmex (C.) brevis* Weber. Lateral view of worker showing antennal scrobe.

Fig. 2 *Crematogaster (Sphaerocrema) lotti* Weber. Lateral view of worker thorax and pedicel.

Fig. 3 *Crematogaster (Sphaerocrema) zonacaciae* Weber. Lateral view of worker thorax and pedicel.

Fig. 4 *Oligomyrmex santschii* Weber. Frontal view of soldier head.

Fig. 5 *Solenopsis punctaticeps* Mayr, *juba* Weber. Frontal view of maxima worker head.

Fig. 6 *Crematogaster (Decacrema) lango* Weber. Dorsal view of worker thorax.

Fig. 7 *Crematogaster (Decacrema) lango* Weber. Lateral view of worker thorax.

Fig. 8 *Solenopsis punctaticeps* Mayr, *juba* Weber. Frontal view of minima worker head.

Fig. 9 *Macromischoides viridis* Weber. Lateral view of worker thorax and pedicel.

Fig. 10 *Monomorium (M.) minutum* Mayr, *kineti* Weber. Frontal view of worker head.

Fig. 11 *Crematogaster (C.) latuka* Weber. Lateral view of worker thorax.

Fig. 12 *Paedalgus sudanensis* Weber. Wing of female.

Fig. 13 *Strumigenys (Cephaloxys) escherichi* Forel, *lotti* Weber Frontal view of worker head.

Fig. 14 *Solenopsis punctaticeps* Mayr, *juba* Weber Lateral view of female epinotum and pedicel.

Fig. 15 *Paedalgus sudanensis* Weber. Lateral view of female epinotum and pedicel.

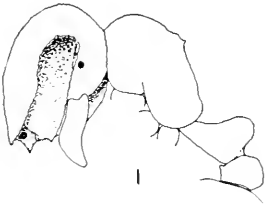
Fig. 16 *Oligomyrmex santschii* Weber. Lateral view of worker thorax and pedicel.

Fig. 17 *Carebara bartrumi* Weber. Frontal view of male head.

Fig. 18 *Monomorium (M.) estherae* Weber. Frontal view of worker head.

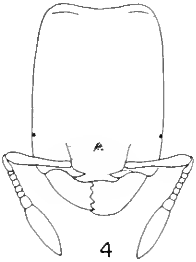
Fig. 19 *Monomorium (M.) minutum* Mayr, *kineti* Weber. Lateral view of worker thorax.

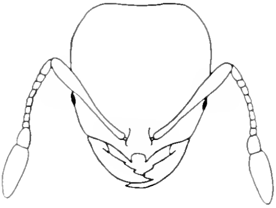
Fig. 20 *Carebara bartrumi* Weber. Frontal view of female head.

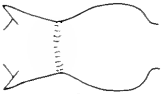

1


2

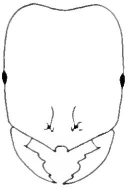

3


4

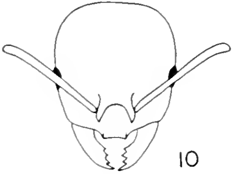

5


6


7

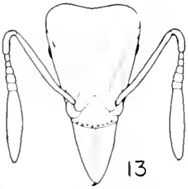

8

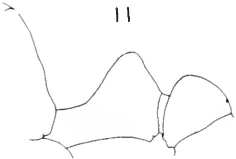

9

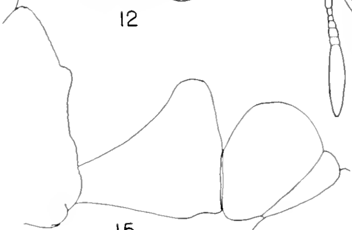

10


11

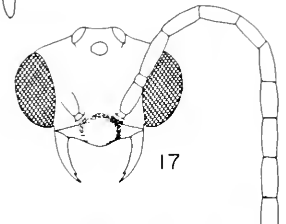

12

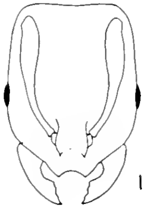

13

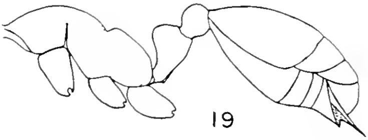

14


15


16


17


18


19

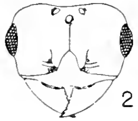

20

PLATE 16

PLATE 16

Fig. 21 *Camponotus (Myrmamblys) hāpi* Weber. Lateral view of maxima worker.

Fig. 22 *Polyrhachis (Myrma) cubaënsis* Mayr. *imatongica* Weber. Anterior view of worker petiolar scale.

Fig. 23 *Acantholepis megacephala* Weber. Lateral view of soldier.

Fig. 24 *Tetramorium squaminode* Santschi, *nubis* Weber. Lateral view of worker thorax and abdomen.

Fig. 25 *Triglyphothrix cinereus* Weber. Dorsal view of worker pedicel nodes.

Fig. 26 *Acantholepis capensis* Mayr, *acholli* Weber. Dorsal outline of worker thorax and pedicel.

Fig. 27 *Acantholepis capensis* Mayr, *issore* Weber. Dorsal outline of worker thorax and pedicel.

Fig. 28 *Acantholepis capensis* Mayr, *thoth* Weber. Dorsal outline of worker thorax and pedicel.

Fig. 29 *Tetramorium jeanae* Weber. Lateral view of worker thorax and pedicel.

Fig. 30 *Camponotus (Myrmoturba) maculatus* (Fabr.), *nubis* Weber. Lateral view of maxima worker thorax.

Fig. 31 *Tetramorium viticola* Weber. Lateral view of worker thorax and pedicel.

Fig. 32 *Tapinoma carininotum* Weber. Lateral view of worker thorax.

Fig. 33 *Camponotus (Myrmopiromis) tricolor* Weber. Lateral view of worker thorax and pedicel.

Fig. 34 *Xiphomyrmex zonacaciae* Weber. Lateral view of worker thorax and pedicel.

Fig. 35 *Pseudolasius myersi* Weber. Lateral view of worker thorax and petiole.

Fig. 36 *Xiphomyrmex papyri* Weber. Lateral view of female epinotum and pedicel.

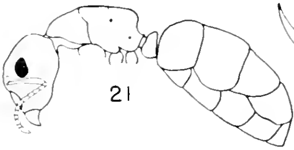
Fig. 37 *Technomyrmex incisus* Weber. Lateral view of worker thorax.

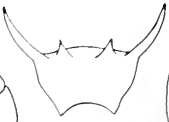
Fig. 38 *Plagiolepis (P.) sudanica* Weber. Frontal view of worker head.

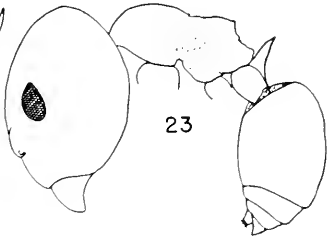
Fig. 39 *Acantholepis capensis* Mayr, *thoth* Weber. Frontal view of female head.

Fig. 40 *Xiphomyrmex sudanensis* Weber. Dorsal view of worker pedicel nodes.

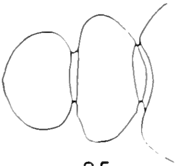
Fig. 41 *Technomyrmex longiscapus* Weber. Frontal view of worker head.

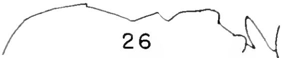

21

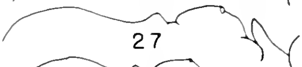

22


23

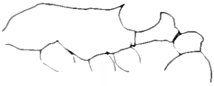

24


25


26

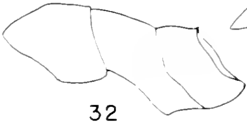

27

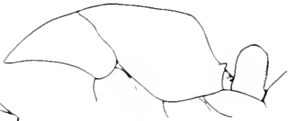

28


29

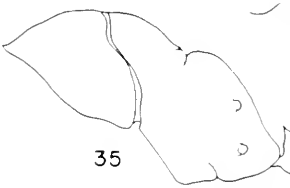

30

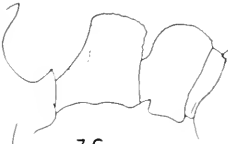

31

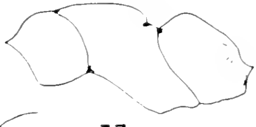

32

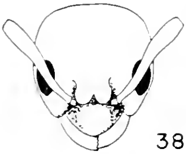

33

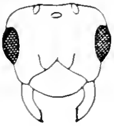

34

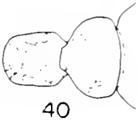

35

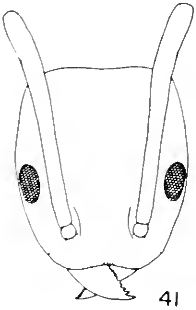

36


37


38


39


40


41

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
Vol. XCIII, No. 3

CONTROL OF COAT COLOR IN THE VARYING HARE *LEPUS AMERICANUS* ERXLEBEN

By Charles Peirson Lyman

With Eleven Plates

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
December, 1943

No. 3—*Control of Coat Color in the Varying Hare,* Lepus americanus *Erxleben*

By Charles Peirson Lyman[1]

ACKNOWLEDGEMENTS

I take this opportunity to record my grateful and sincere thanks to the late Dr. Glover M. Allen. Without his profound knowledge and ever-helpful advice this paper could not have been completed. Memory of his generous kindness will remain with me always.

I would also like to express my thanks to Dr. H. B. Bigelow and Dr. F. L. Hisaw who have given me invaluable aid and advice during the preparation of this paper. Dr. A. A. Abramowitz and Dr. L. H. Kleinholz have helped me in many ways, and I am greatly indebted to them for their assistance.

TABLE OF CONTENTS

---

[1] Submitted in March, 1942, as a thesis for the degree of Doctor of Philosophy at Harvard University. The author has been absent ever since in the military service. A preliminary note on these experiments and the results obtained appeared in Proc. New England Zool. Club, **19**, May 15, 1942, pp. 75–78. (Editor).

INTRODUCTION

For many years naturalists have been interested in the seasonal color change of certain northern mammals and birds from brown in summer to white in winter. The transformation is at once so complete and so spectacular that it can not fail to arouse the interest of the curious. The present study was undertaken to find, if possible, the means by which one of these variable animals, the varying hare (*Lepus americanus* Erxleben) effected this coat color change. It was hoped that the mechanism which timed the change, the physiological processes which brought about the change, and some clues to the solution of the puzzling problem of pigmentation would result from this work. *Lepus americanus* was chosen for study because it was the most available of a series of rather unavailable mammals and birds.

Lepus americanus, with its closely related species, *Lepus bairdi* and *Lepus washingtoni,* occupies a greater area than any other group of North American hares or rabbits. These hares range across the continent from the Atlantic to the Pacific, from the northern borders of the United States to the tree line in northern Canada, in the East southward along the heights of the Alleghany mountains to Virginia, in the West southward along the Cascades and Sierra Nevada to Donner Mountain and along the Rocky Mountains to central New Mexico. All but *Lepus washingtoni,* and its subspecies, *klamathensis,* change from a more or less pure white in winter to a buffy brown in summer. The latter species changes very little, while its subspecies, *klamathensis,* sometimes changes and sometimes does not (Nelson, 1909).

MATERIAL AND METHODS

One hundred and twenty-five live hares were used in this study of which about seventy-seven lived long enough to produce some experimental results. The rest died so soon after arrival that they were of no more use than a sick animal killed in the field. Fifteen of the hares came from Wolfville, Nova Scotia, and were supplied through the kindness of Mr. R. W. Tufts, the Chief Federal Migratory Bird Officer there. The rest came from the neighborhood of McAdam, New Brunswick, and were obtained through professional dealers who trap them during the winter for restocking in the United States. I would like to express my gratitude to Mr. Tufts, and to Mr. W. H. Williams of St. Croix, N. B., for the trouble and pains they took in capturing and shipping me rabbits during the fall, a time when trapping is extremely difficult. Also I am greatly indebted to Mr. F. Pirie, Minister of Lands and Mines in New Brunswick, and Mr. G. Stobie, the Commissioner of Inland Fisheries and Game in Maine, for granting me special licenses to trap hares during the time when the regular season was closed.

All the hares were of the race *struthopus.* It should be mentioned here that the hares from Nova Scotia varied in their winter pelage from a pure white to a grizzled grey. Apparently this was not a condition brought about by captivity, since a personal communication from Mr. Tufts informs me of just such a variation in hares shot by him during the winter. Incidentally, it is suggested that the distinctions between the races *struthopus* and the more southern *virginianus* must be rapidly disappearing in New England due to the large scale restocking of *struthopus* in the natural range of *virginianus*.

In this work all animals were kept in cages of sizes varying from five by ten feet, to two and one-half by three feet. They were fed Purina 'rabbit chow', greens or oak twigs and given plenty of water. A great deal of difficulty was experienced in keeping them alive and healthy. One of the causes of death was broken hind legs in young rabbits, brought about by a sudden violent leap of the animal. The break usually occurred at the proximal epiphysis of the tibia. Another cause of death was a mange-like disease, which caused the epidermis to crack and the hair to be shed in great patches. The eyes of the affected animal were crusted and half closed. If the trouble became chronic, the animal wasted away and generally died within a week, but several recovered completely, except for a slight cloudiness in the cornea of the eye. Yet another malady was an infection in the body, causing large pustules, particularly in the neck region. These pustules were often severe enough to kill the infected hare, especially if they occurred in the body cavity. Lastly, a good deal of difficulty was experienced in regulating the green feed. If too much was given, the animals died of acute diarrhoea; if too little, they died of avitaminosis.

All animals were examined by hand about every two weeks, or more often if in some critical phase in the moulting or sexual cycles. With a little practice a caged hare can be caught in a strong butterfly net and thoroughly examined without use of anaesthesia, so that a large number of hares can be examined and their condition annotated over a relatively short period of time.

Animals were weighed periodically and at the time of death in order to determine the general body condition. No animal which was atypical because of sickness was used in experimental conclusions.

All tissues, with the exception of some skins, were fixed in Bouin's solution. The whole skins that were kept were either dried flat or preserved in 10 per cent formaldehyde.

NORMAL PELAGE CHANGES

Exposition

Any one familiar with northern mammals knows of the change of coat color in *Lepus americanus*, and this same subject has been discussed and studied by a large number of naturalists. The fact that the summer coat is brown and relatively short, while the winter one is longer and white has never been disputed, but the means by which this change takes place has been the subject of much debate. As early as 1784, Pennant (p. 96) stated that, "these animals, at the approach of winter, receive a new coat, which consists of a multitude of long white hairs twice as long as the summer fur . . ." Richardson (1829, p. 218), however, disagreed with him and said, "the change to the winter dress takes place by a lengthening and blanching of the summer fur."

The argument whether the winter coat is a new one, or the old one bleached and lengthened, has been going on intermittently ever since. Welch (1869), in the first paper devoted exclusively to this subject, decided that the winter coat has partially new white hair, and partially the bleached summer coat. Apart from him, authors have thrown all their forces into one camp or the other. Thus Merriam (1884, p. 209) and Poulton (1890, p. 95) believed that the winter coat was a lengthened and bleached summer coat, while the summer coat consisted of winter hairs which darkened nearly to the tips, and then lost these white tips by the hair becoming brittle and breaking off.

Metchnikoff (1901; 1903, p. 316; 1906) took it as fact that hair which turned to white in winter did so by a bleaching of the summer coat. In both *Lepus variabilis* and in the ptarmigans *Lagopus albus* and *Lagopus alpinus* he demonstrated certain dendritic cells or "chromophages" which contained melanin. He believed that these cells had phagocytized the pigment from the shaft of fur or feather and that they carried it either to the outside of the shaft where it was released, or else back into the skin. Trouessart (1906, p. 271) concurred with the findings of Metchnihoff. Their belief that the grown, keratinized shaft was capable of maintaining living amoeboid elements is no longer accepted among histologists. In all probability the "chromophages" which they saw were actually pigment-forming cells which were caught during the growth of the follicle and incorporated in the completed shaft.

Hadwen (1929, 1934), using live varying hares for study, wrote two papers presenting evidence which he felt proved that the hairs turned white by bleaching rather than by new growth. Gunn (1932) concurred with Hadwen in believing that a hair could bleach from its tip toward its base.

Against the hair-bleaching theory, several writers expressed the opinion that the change of color was due to a new growth of white hairs. In 1894, Allen carefully described the moults in the varying hare as worked out from study skins. He saw no evidence of bleaching of the summer hairs and placed all the emphasis on a new growth of white hair. Seton (1909, p. 624), Nelson (1909, p. 86), Anthony (1928, p. 483), Morgan (1939, p. 476–77) and Orr (1940, p. 30) in their descriptions of the varying hare, all agree that the winter moult consists of growth of new white hair and shedding of the brown hair. Finally, Grange (1932) published an article in refutation of Hadwen's 1929 paper. Grange, like Hadwen, used captive live animals, but his results are in complete disagreement with the latter's and agree exactly with the earlier work of Allen.

Before any progress could be made on the problem as a whole, it was necessary to determine once and for all whether it was bleaching or white hair growth that changed the pelage color. Studies by the author on both study skins and live animals convinced him that the theory of bleaching had no foundation in fact. Except for one correction to be mentioned below, the writer can offer few additions to the descriptions of Allen and Grange; and to give a clear picture of what takes place in the moults of the varying hare one can do no better than to quote these two men. A discussion of Hadwen's two papers, which champion the bleaching theory, will be taken up after the description of coat-color change.

Normal Pelages and Moults

A detailed description of the pelage of *Lepus americanus* is not necessary here. Except for the white patch on the right shoulder of the adult, Fig. No. 1 gives a good general idea of the coat color and markings of an adult and a young one in the summer coat. The general color of the upper parts is brown, and the white blaze on the forehead of some adult animals is the exception rather than the rule, though it is present in all young. The under parts, from the anterior portion of the chest to the base of the tail, are white; the white extends down the inside of the hind legs to the foot. The under portion of the chin is whitish and sometimes individuals retain throughout the summer some winter hair on the hind feet, giving them a whitish tinge. The ears are brown, darker toward the edges, and trimmed with a dull white.

To quote Allen (1894, p. 108–109): "This pelage, considered in detail, consists of two distinct parts — a thick woolly underfur and a heavy coat of long overhair. The underfur is plumbeous basally generally for about two thirds of its length, with the apical third fulvous or tawny. . . . The overhair is of two kinds as regards both pattern and structure. It consists chiefly of particolored hairs which are plumbeous basally, generally about as far as the plumbeous zone of the underfur, then blackish for about half their total length, then passing abruptly into a broad band of fulvous and then again abruptly into black at the extreme tip. These hairs are extremely attenuated at the base, gradually thicken as they become black, attaining their greatest diameter at and throughout the subapical fulvous zone, and then rapidly taper to a fine pointed tip. Mingled with these particolored hairs is a greater or less profusion of wholly black, rather longer hairs, of coarser and firmer texture. . . . They taper slightly toward the base and tip but are of a much more uniform diameter than the particolored hairs." Allen fails to point out that some of the "particolored hairs" are not attenuated, but have the same shape as the long, black hairs, though they are slightly shorter.

Actually Allen's description of hair types is considerably oversimplified, since gradations between the fundamental types of hair do occur. Grange found 23 types classified on color arrangement alone. Here three types only need be recognized: the long, almost uniformly diametered "guard" hairs; the "pile" hairs with the tip as thick as those of the guard hairs but with a thin, fine basal portion; and the "fur" which is fine along its whole length and is shorter than the two other types. The terms *guard, pile* and *fur* will be used throughout this paper to signify these three respective types.

In both the summer and the winter coat it is the guard and pile hairs alone which give the general pelage color, since the fur lies beneath and can not be seen. Therefore, in this study, all emphasis will be put on these two types of hair.

Fig. No. 2 shows a typical winter hare with an uninjured coat. Only the edges of the ears are black, though in some animals there is a black or brown blaze on the forehead. As with the summer coat, there are the same three general types of hair. The apical portion of both the pile and the guard hairs is pure white, but the thin basal part of the pile hair is plumbeous, while the guard hair is only a little greyer at the base than at the tip. The fur is very similar in color to the summer fur, though longer and more luxuriant, with the very tips of the longest hairs shading to white. The whole coat is heavier and longer than the summer coat.

In changing from summer brown to winter white, the first parts to change are the feet, the ears, and the tip of the nose. After these have completely changed, white hairs appear on the lower portions of the hips, and soon after on the shoulders. The white growth creeps up the back until, within ten days, there is a heavy growth of all three types of hair over back and sides. Apparently it is this new growth which the adherents of the bleaching school of winter change failed to note, yet the white tips of the fresh growth can be plainly seen if the brown hair is parted. Skins Nos. 118, 4245 and 5814 in the Museum of Comparative Zoölogy show this new white growth plainly, and at the U. S. National Museum in Washington a small series of *Lepus americanus virginianus*, Nos. 125513, 125519, 125516, 125518 and 125515 shows progressive growth of the white hair in the order given. The last places to start white hair growth are part of the cheeks below the eye, and a patch covering the forehead and reaching nearly to the tip of the nose.

Not until the white growth has attained nearly its full length are the brown summer hairs shed. At this time, large numbers of brown hairs, but no white ones, may be removed by passing one's hand over the back of the animal. The result of the moulting is that, within a little more than two weeks after the appearance of white above the brown on the lower hips, the animal has changed from a pelage which appeared to be brown to one which is virtually entirely white. The shedding of brown hair is soon over, the white hair reaches its full length, and growth of hair ceases until spring.

The sequence of events in the spring moult is the exact opposite of the autumn color change. The first sign of spring moult is the shedding of white guard and pile hairs from the mid-dorsal line. This takes place before any new hair growth appears and occurs in such large amounts that the shed white hair can be seen about the cages. The shedding quickly becomes generalized over the whole body, while a sparse growth of black-tipped summer guard and pile hair starts at the mid-dorsal line of the body and on the cheeks and forehead. This shedding and new growth continues along the sides and down the legs in the opposite direction of the autumn moult. The thickness of the new growth depends to some extent on the individual. A few caged animals possessed a rather rough, woolly coat during the whole summer, consisting partly of summer pile and guard hair, partly of unshed fur, with an occasional winter guard hair still in evidence. Undoubtedly such a coat would lose all relics of the winter hair if the animal were in the woods, where these hairs would be subject to harder wear. All animals pass through a stage of mottled white and brown coat, lasting until the new hair has completed its growth.

The one essential addition to the papers of both Allen and Grange is that during late August or early September the varying hare undergoes a third, or "preliminary autumn" moult. Unlike the spring or final autumn moults, the sequence of moulting areas is not precisely followed. Among the animals recorded, one began hair growth on the sides before growth started on the back. This was also the case in four study skins in the Museum of Comparative Zoölogy. Four animals had an even hair growth over back and sides, while in four other cases the hair growth on the sides appeared later than on the back.

The moult resembles the spring moult in consisting of summer colored guard, pile and fur hair; and resembles the late autumn moult in that the old coat is not shed until the new one is very nearly completely grown. To date, no author has mentioned this moult, though Grange (1932, p. 108) noted that on September 25th an animal which had last been examined 25 days earlier "*appears sleek, full coated and not scraggly* in the least (italics his). A decided and rather startling change from August 31." He concluded that the dorsal summer fur had grown and improved in quality but did not ascribe this to a true and complete moult. The growth of new hair varies as much in abundance as does the spring moult, but is always present and gives the fall coat a more luxuriant appearance.

It is easy to see how previous authors overlooked this moult, for, in studying a moult to white which takes place in October and November they would naturally not examine animals in August. When the moult begins, the tips of the new hairs may be easily seen on parting the summer coat, but, once the start of this moult is missed, it is almost impossible to detect it, as the new hairs are exactly the same in color as the old ones. Skins Nos. 4158, 4163 and 4164 in the M. C. Z. show this moult just starting on the sides of three animals taken in August. Further evidence of this moult will not be mentioned here, but will be taken up in the section on skin histology. It is interesting to note, however, that in the Ptarmigan, Salmonsen (1939) and others have described a preliminary autumn moult, making a total of three moults a year in this bird.

At the conclusion of the preliminary autumn moult in the hare, white hairs begin to appear on the upper surface of the hind feet. New "snow shoes" are grown on the lower surface and the ears begin to turn white. When the change is complete in these areas, white hairs start on the lower hips and the moult to winter pelage has really begun.

This brief summary of moults is necessarily incomplete. It is not the author's intention to give an extremely detailed account of the hair sequences, but rather to familiarize the reader with the general, normal conditions to be found at various times of the year. Since a more detailed external study offered no clues to the present problem, there was no real point in pursuing it further. It was hoped, however, that the activity of the skin itself might shed some light on the subject. Therefore, a histological study of the skin during the various moults was undertaken. Though the results were in the main rather disappointing, a few interesting facts were brought to light. If for no other reason, the histological study is important because it gives visual evidence of the inacceptability of the theory that the white winter hair is nothing but bleached summer hair.

Histology of the Inactive Skin

The patches of skin used in this study were obtained from both dead and live animals. A sample of skin about one centimeter square may safely be cut with a scissors from an etherized hare, for the wound heals quickly without bandage or stitching. By this method a complete histological picture of a moult may be obtained from a single specimen. The patches were taken on either side of the mid-dorsal line, high on the shoulders.

Ten per cent formalin was employed as a fixative during the early part of the study, but later Bouin's solution was used exclusively. After fixation, the hair was clipped or shaved from the skin. It was found that dehydration with dioxane kept the tissue softer than did the usual alcoholxylol technique. Nearly all tissues were infiltrated with paraffin but, because the skin is very tough, it was found that Peterfi's method (see Lee, 1937, p. 65) of infiltration with a one per cent solution of celloidin in methyl benzoate resulted in less distortion and tearing by the microtome knife. A part of each sample of skin was cleared and mounted entire. These whole mounts were very useful in determining the exact condition of the moult and in reconstructing as a unit the picture seen in sections.

Both the midsummer and the midwinter skin of the varying hare is "prime" in the sense that there is no growth of hair, and to describe the histology of one is to describe the other, except for the number of hair elements involved. The hair roots are not scattered evenly throughout the pelt, but lie in small groups which are themselves evenly spaced. Each group of hairs consists of one large-based guard hair, surrounded by usually five or six bunches of thin-based fur and pile hairs. The term "bunch" is used advisedly, for although each fur and pile hair is firmly imbedded in its own sheath of epidermal cells, each bunch of hairs goes through a common opening to the exterior, with only an occasional cell separating one hair in the bunch from its fellows. The bases of all three types of hair consist of solid keratin, without the ladder-like medulla found higher in the hair shaft. On the surface of the fur- and pile-hair roots are very fine striae which serve to hold the hairs firmly in the skin. This condition is greatly exaggerated in the guard hairs, which actually have little slivers of keratin embedded between the epidermal cells. The epidermal tissue surrounding a guard-hair base consists of two layers of columnar cells which are not closely associated with the epidermal cells of the pile- and fur-hair bunches. In each pile- and fur-hair bunch the epidermal cells are not precisely arranged, but are closely packed together in a mass. Each guard hair has an *arrector pili* muscle but this is not present in the fur- and pile-hair bunches.

The skin in midsummer or midwinter is, therefore, a tissue one function of which is to hold the dead hair firmly in place. There are no distinguishable layers of differentiation either in the hair root, or in the cells surrounding it. (See Figs. 3 and 4.)

It was mentioned that the summer pelt is much less fully haired than a winter one. However, the number of guard hairs and groups of fur and pile hair, and the number of bunches of fur and pile hair is not reduced. The sole reduction occurs in the number of fur and pile hairs in each bunch. In the summer each bunch contains less than half the number of roots that it contained in the winter. Since the bases of a pile and of a fur hair are indistinguishable, the proportion of fur and pile hairs per bunch in a winter compared to a summer skin could not be determined histologically.

Histology of Moulting

In the spring, preliminary autumn and final autumn moults, the general situation is similar. The first indication of the start of the moult is the appearance in longitudinal sections of small, basophilic buds at the bases of the epidermal cells of both guard hairs, and fur- and pile-hair bunches. These buds are the primordia of the new hair follicles. Fig. 5 shows such a bud although its attachment to the epidermal cells cannot be seen in this section. The epidermal buds push down into the connective tissue until it is a mass of hair follicles. Each follicle forms a single hair, that grows up the follicle shaft which has just been developed and pushes beyond the old, anchored hair. The guard-hair follicle is not closely associated with that of the pile- and fur-hair bunches, but each bunch is a compact unit of individual pile and fur follicles. As can be seen by Figs. 6 and 7, the skin of a moulting animal consists chiefly of active, deeply embedded hair follicles. Mitotic figures are common in the cells of the growing follicles, and occur chiefly in the bulb of the follicle at the base of shaft.

Morphologically, there is no difference between the apical half of a growing pile hair and that of a guard hair. Both follicles are larger than the fur follicles, and both form hairs with a medulla consisting of several cells side by side. As the pile hair grows, the size of the follicle is reduced, and the diameter of the developing hair decreases until it contains only one row of cells in the medulla arranged in the ladder-like manner of a fur hair. When any type of hair has attained its growth, the follicle forms a solid base, which has the striations in the keratin mentioned previously. The whole follicle then moves toward the surface of the skin.

In the preliminary and final autumn moults, but not in the spring moult, it has been shown that the new hair grows to nearly its full length before the old hair is shed. Histologically (see Fig. 6), it can be seen that the new hairs actually grow past the old, anchored hairs without removing them. It is not until the new hair has formed its anchoring root and the follicle begins to move toward the surface that the old hair loosens in its socket. Often, indeed, the large anchoring base of the new hair moving up against the old anchored hair is what actually dislodges the latter and causes it to fall out. Fig. 7 shows a typical preliminary fall moult, with fur and pile hairs still actively growing, while a new guard hair moves toward the surface. The old guard hair has already been displaced.

In the spring moult, the emphasis on shedding rather than new growth also may be demonstrated histologically. At the initiation of the spring moult, the epidermal cells which hold the guard hairs in place atrophy, so that most of the hairs are no longer firmly fastened in their sockets. Before the basophilic buds which are to form the new hairs have extended one-half their final length into the connective tissue, the old guard hair is loose enough to be removed by any slight mechanical force. Fig. 5 shows such a guard hair just before shedding. As may be seen, the new hair primordium has just begun to grow, the connective tissue is still thin, and no growing follicles are present, yet the hair is held by only the most delicate connections to the epidermal cells. Apparently the pile hairs undergo a similar fate, since in the pile- and fur-hair bunches many hair bases appear very loose. Because pile and guard hairs are shed at the same time it is reasonable to assume that these loose hair bases are those of pile rather than fur hairs. The shedding is not caused by the breaking of the old hairs as was claimed by Merriam, and by Hadwen in his 1929 paper, for it may be seen that the shed hairs still possess their solid, striated base.

The advantage of the two different methods of moulting seems obvious when considered in the light of the animals' bodily requirements. The preliminary fall moult replaces the worn summer coat with a fresh, brown coat. At the time this is taking place, though the days are still warm, the nights are chilly. If the animal shed most of its summer coat before growing the fall pelage, it would certainly suffer from the cold. This is of even greater importance in the moult to the winter coat, when really cold weather has set in. If at this time only part of the fall coat were present the animal would surely freeze to death.

In the spring the opposite situation exists. The temperature rises quickly until a heavy winter coat must be extremely uncomfortable. The animal then sheds the bulk of its winter coat before the spring coat has grown. If protective coloration is the main reason for the brown summer coat, the animal loses nothing by shedding the white hairs before the new brown ones come in, since shedding exposes the brown apical portion of the winter fur hairs, and the coat varies little in color from the true summer coat. The importance of coat thickness is not a trivial matter to these animals. Two animals which were artificially held in their preliminary fall pelage after the onset of cold weather died in December apparently from the effects of the cold. Another, which was induced to moult into a full winter coat in June, plucked a large amount of the fur from its chest with its teeth.

No evidence could be found to support Hadwen's (1929 and 1934) theory of the whitening of the winter coat after it has grown as a colored coat. If the papers of Allen and Grange and the writer's own observations fail to disperse a feeling of skepticism, it is believed that a brief examination of the series in the U. S. National Museum already mentioned, or those in the Museum of Comparative Zoölogy will dispel all doubts.

Histology of Pigment Formation

A histological study of growing guard and pile hair offers no morphological explanation for the presence of pigment in a summer hair and the absence of pigment in a winter hair. The matrix of the growing hair forms all the pigment *in situ* in the bulb of the hair follicle. No migration of formed pigment from the outside into the papilla of the hair can be seen, Fig. 8. After the pigment is formed, the melanoblasts are incorporated in the cortex and medulla of the growing hair.

Each melanoblast in the medulla forms a single medullary space in the hair. As keratinization proceeds, the diffused pigment granules of the medullary melanoblasts concentrate to form a cap over the nucleus of each cell. The pigment granules are then keratinized in this position, Fig. 8. It is this cappping of the nucleus which gives the ladder-like arrangement of melanin in a pigmented hair, for the apical portion of each medullary compartment contains a mass of pigment granules which formed over the nucleus of the pigment-forming cell. Peck (1931) states that in the grey domestic rabbit the nucleus of the pigment cell had lost its staining power and hence was not seen in the fully keratinized hair. In the hair of *Lepus americanus,* however, the nucleus flattens against the cap of pigment formed over it, and slowly shrivels in this position as the hair grows nearer to the surface. The pigment in the melanoblasts of the cortex remains diffuse and is keratinized in this condition.

The follicle of a pigmented spring guard or pile hair and that of a white autumn hair differ only in the presence of pigment. Often a hair which to the naked eye appears white, actually contains some pigment. In such a case the pigment formation occurs in the outermost melanoblasts in the hair-root bulb — the locus of the most active pigment building in a colored hair. The process of keratinization of the melanoblasts is exactly like that in a spring hair. If a hair is completely unpigmented, the melanoblast, which contains no pigment, is nevertheless incorporated in a medullary compartment and its nucleus flattens against the apical portion of the compartment exactly as if pigment were present. The problem therefore resolves itself into the reason for the presence of pigment in the cells in one case and the absence of pigment from apparently similar cells in another. To make any progress in such a study it was necessary to devote some time to the chemistry of animal pigments and pigment formation.

HAIR PIGMENTATION

Summary

Among the pigments present in the mammalian body, only melanin and lipochrome have been reported in the hair shaft. Lipochrome is known to be present in the feathers of some birds (Fox, 1936) and is suspected in the hair of mammals (Cowdry, 1932, p. 45). Tests by the author mentioned below (p. 447) show, however, that there is no lipochrome in the hair of *Lepus americanus.* The coloration of the hair of this animal is therefore due to melanin alone, and it is this pigment which must be examined further.

Nearly every phase of the problem of melanin pigmentation has been the object of much debate, so that a summary of the subject could at best be only a survey of the work of others flavored with the author's own opinions. For a detailed account of the subject the author suggests two reviews in English, one by Percival *et al* (1930), the other by Jacobsen (1934). Since that time no comprehensive survey of the subject has been published, and the work on melanin formation has lagged. Bloch's book (1927), though a trifle out of date, contains all that was known about melanin at that time.

Probably, melanin is chemically a rather inert organic pigment which is formed in certain definite cells in the animal body by a series of biological oxidations and polymerizations the exact steps of which are, for the most part, unknown. The degree of oxidation of the melanin apparently is the factor which determines its color. In 1917, Bruno Block (1929) isolated from a vetch the chemical 3, 4 dihydroxyphenylalanine, which he mercifully abbreviated to "dopa". Exhaustive tests showed that wherever melanin formation was taking place or should be expected to take place (e.g. in sunburned skin) the dopa, which is itself colorless, turned brown or black when brought into contact under proper conditions with the tissue. Bloch claimed that dopa was either one of a series of colorless chromogens, or else a substance which took the place of a chromogen. Dopa appeared to be a specific test for an enzyme-like substance which was involved in melanin formation. No other chemical could demonstrate the presence of this substance, though dopa could be oxidized by such enzymes as the polyphenoloxidase found in the myelogenous leucocytes of the mammalian skin (Laidlow, 1932, A). It was found that not only did the substance act like an enzyme in its oxidation of dopa, but also it reacted in a manner wholly characteristic of enzymes in various tests. Its activity could be killed by boiling or by alcohol, and it could be poisoned by typical enzyme poisons such as cyanide. Because tyrosinase was not demonstrated in mammalian tissue, Bloch postulated a new enzyme which he called "dopa-oxidase". This enzyme was conidered necessary in the chain of reactions which finally resulted in melanin. Dopa, when introduced into a tissue under the proper conditions, shows a remarkable parallel with the expected potentialities for pigment formation by turning into a substance indistinguishable from melanin. The dopa reaction is, therefore, a test for an enzyme or enzyme-like substance which, in the presence of the proper substrate, is capable of forming melanin. Whether dopa is actually involved in the formation of melanin *in vivo* is perhaps open to question, though Raper's work on this has had wide acceptance.

Pigmentation in the Hair of Lepus americanus

In this study, hair from museum specimens was used exclusively as there was no reason to suppose that this differed from the hair of the living animal. Chemical tests were carried out on the whole hair and also on short pieces of hair which were split in order to allow easier penetration of the chemicals used. The hairs were split by mounting them in Duco[1] cement on a stick and then cutting them with a razor blade under a dissecting microscope. Identical results were obtained using the intact hair and the split hair. The hairs were treated with the chemicals in depression microscope slides or other small containers and then mounted on flat slides for microscopic examination. Hairs which were to be compared were marked and mounted side by side in order that the comparison might be more accurate.

The technique employed for the dopa reaction was that described by Laidlow (1932B). Using this method, sections of tissue are cut on the freezing microtome and then immersed in a buffered solution of dopa until the solution turns a sepia brown, which marks the conclusion of the reaction. In preliminary tests, recently excised human skin was used in order to check the method against a known control. After this test proved successful, the same technique was used throughout, without further use of controls. All experiments with the dopa reaction were repeated in order that the results might be verified.

As was stated previously, the summer coat of the varying hare consists of: (1) guard hair, which may be black throughout its length or have a band of brown near the tip; (2) pile hair, which is grey along its attenuated portion, and black where the hair becomes thicker, with a brown band similar to that found in some of the guard hairs; (3) under-fur which is grey basally and brown along the apical third of the shaft. The shade of the brown color found in all three types of hair varies macroscopically with the individual animal.

In the winter pelage, both guard and pile hair is white, though the attenuated basal portion of the pile hair has a greyish tinge. The fur is like that found in the summer coat, except that the tips of the longest fibers are white.

Microscopically, the pigment consists of two distinct types. In the

---

[1] "Duco" is a commercial cement manufactured by Dupont De Nemours & Co.

brown bands of the summer guard and pile hairs, there is a yellow, diffuse pigment that seems to be incorporated into keratin of the cortex and medulla. In the region of the brown band the walls of the medullary spaces are not smooth, but have minute lumps or bubbles of keratin which appear like yellow droplets clinging to the walls or even loose in the spaces (Fig. 9). In the apical, brown portion of both summer and winter fur a similar though redder substance is found between each medulary space, but is not demonstrable in the cortical walls of the fiber, which are colorless.

The grey and black portions of summer guard and pile hair are pigmented with ovate granules which appear brownish in color under the microscope. These are found throughout the cortex and in ladder-like arrangement in the medulla (Fig. 10). The grey part of the fur of all seasons also has a ladder-like arrangement of pigment granules in the medulla, but has no pigment in the cortex. The thin base of the summer pile hair is like that of the basal part of the fur.

The white hairs of winter lack pigment, although a few groups of ovate brown pigment granules may be found here and there in the shaft. The greyish tinge in the basal part of the winter pile hair is apparently due to the thinness of the fiber and its numerous reflecting surfaces, for there are too few pigment granules present to influence the color. The apical third of the white hair also exhibits the peculiar bubble-like formations of keratin found in the upper portion of the summer hair, though basally both types have clean-cut medullary walls.

In areas of transition between brown and black, there are very small pigment granules and also the yellow diffuse pigment found in a truly brown section of hair. It is entirely possible that a complete series could be found from relatively large, well formed brownish granules, through smaller and lighter granules until the pigment no longer appeared formed, but as a yellow, shapeless mass. The object here, however, is not classification of the various gradations of pigment types, but rather a recognition of the two principal types, in order that their formation and composition may be more closely studied.

CHEMICAL TESTS

It was found that if the black tips of the summer hair, or the grey portion of the fur was exposed to 3 per cent hydrogen peroxide for forty-eight hours the pigment granules disappeared and the only pigment to be seen was a substance indistinguishable microscopically from the yellow diffuse pigment found in the brown portions of the summer hair, or the apical part of the fur (Fig. 11). Further exposure to hydrogen peroxide produced only a very slight bleaching over a long period of time (ten days). If the brown portion of the summer hair or the fur was exposed to hydrogen peroxide, the bleaching was similarly a very slow process.

Because it was considered possible that the yellow, diffuse pigment was a lipochrome, a series of tests were undertaken following Connor's (1928) suggested techniques for the detection of lipochromes. Every test without exception was negative. The fact that the pigments involved are completely insoluble in fat solvents is in itself sufficient proof that they are not lipochromes, and the other tests confirmed this view beyond question of doubt.

It was found that the yellow pigment in normal, brown summer hair was easily soluble in a ten per cent solution of sulphuric acid. (Solubility tests with alkalis were unsatisfactory because they destroyed the keratin of the hair.) The dark, granular pigment found in black hair was insoluble in this strength of acid. However, when the dark pigment was bleached to yellow, it became easily soluble in the acid. Apparently then, oxidation converts the dark granular pigment into a substance similar to the light-colored diffuse pigment. These reactions are strikingly similar to those reported by Gornitz and Rensch in their "eumelanin" and "phaeomelanin" of the feathers of birds.

On the other hand, Bogart and Ibsen (1937) upon obtaining similar results in bleaching cattle hair, concluded that the hydrogen peroxide had bleached the easily oxidizable granular melanin to a completely colorless substance, thus revealing a more stable reddish pigment, which had been hidden by masses of the granular pigment. This explanation was shown to be untenable, at least in the case of the hair of *Lepus americanus*, since when an intact black hair, full of brown pigment granules, was exposed to a weak solution of hydrogen peroxide and examined periodically, the actual dissolution of the granules, from dark, ovate bodies, through lighter brown, less formed masses, to yellow diffuse pigment could be observed. A second test by extraction confirmed this view. Brown and black summer hair was macerated in hot 20 per cent sulphuric acid. After filtering through coarse filter paper, the solution was centrifuged, driving the insoluble, granular pigment to the bottom and leaving above a brown colored liquid. The granular pigment was washed several times to remove all acid, then dried and exposed to three per cent hydrogen peroxide. The bleaching was examined periodically under the microscope, and was found to parallel exactly the bleaching of granular pigment in the intact hair. This dispelled any possibility that the theory of Bogart and Ibsen was applicable in the pigmentation of the hair of *Lepus americanus*.

Evidently, then, the pigments found in the coat of the varying hare are similar to the dark eumelanin and the light phaeomelanin described by Gornitz and Rensch in the plumage of birds. The phaeomelanin would appear to be the most oxidized form of the two melanin pigments. This is opposed to the view of Bloch, who believed that the darker melanins were the more oxidized forms. Frank has criticized the use of 3 per cent hydrogen peroxide by stating that its action is not comparable to a biological oxidation. However, it is firmly established (Dakin, 1922, p. 10–11) that the action of hydrogen peroxide is identical to that found in certain biological oxidations. The bleaching of brown granular pigment in rabbit hair will take place slowly in a solution of .1 per cent hydrogen peroxide, which is a concentration approaching the magnitude to be expected in a living cell. There is therefore a very reasonable basis for believing the phaeomelanin to be more heavily oxidized than the eumelanin.

The Dopa Reaction

It was found that a piece of skin could be removed from a brown animal during the precise time that the hair follicles were forming the brown band in the guard and pile hairs. By plucking a patch of skin, and making periodic histological examination of small areas of this patch as new hair grew in, the period during which this pigment was layed down could be accurately determined. By this method it was possible to examine follicles which were all in the same phase of pigment formation, since the growth of new hair was stimulated simultaneously in each new follicle by plucking the old hair.

When the dopa reaction was carried out on skin in this condition, it was found that the reaction was strongly positive in the hair follicles, so positive in fact, that it often masked the brown pigment already present (Fig. 13). Control sections of skin showed only the diffuse brown pigment which was being formed in a normal manner (Fig. 12).

When the dopa reaction was used on follicles forming the black portion of summer hair, the reaction was also positive in them. The strength of the reaction, however, was difficult to determine, because the follicles were already full of black pigment. A smoky tinge of grey around the site of pigment formation which was never present in control sections, plus an increased difficulty in making out individual pigment granules, showed that the dopa had reacted with the dopa-oxidase.

If, however, the dopa reaction was applied to sections of skin which were growing entirely unpigmented winter hair the reaction in the follicles where this hair was growing was in all cases negative (Fig. 14). No positive melanoblasts were ever found outside the follicles of the hairs.

We can conclude, therefore, that the brown band in the summer hair is formed in the presence of an excess of melanin forming enzyme, and a deficiency of melanin-precursor substance. It is also apparent that black hair is formed in the presence of sufficient melanin forming enzyme. In the white winter hair, however, there is not sufficient enzyme to permit the formation of appreciable quantities of melanin. The occasional melanin granules found in the white winter hair might be caused by a trace of melanin forming enzyme which was present in such small quantities that it was undetectable in the test used, or they might be caused by slow formation of melanin in the absence of the melanin enzyme. However, some white hairs with occasional groups of pigment granules show single, dopa positive, melanoblasts in the follicle, therefore the most logical explanation for these granules is that an occasional melanoblast retains the dopa-oxidase enzyme (Fig. 15). There is no known way of discovering the presence of melanin precursor in the absence of the melanin forming enzyme, so that it is possible that a white hair may contain the melanin precursor or mother substance in relatively large amounts.

The experiments indicate, in short, that the brown band in the summer hair is in no way comparable to the white hairs of winter. In the former case the limiting factor is a lack of sufficient substrate on which the enzyme could work. In the latter case it is evidently the lack of enzyme itself which acts as a limiting factor, and, whether there is sufficient substrate or not, the formation of melanin is checked by the absence of this vital factor.

From a genetic point of view (Onslow, 1915; Koller, 1930) it has been shown that in the skin of the dominant white domestic rabbit there is a substance which actually inhibits the melanin-forming enzymes. When extracted from the skin and applied with dopa to tissue which is ordinarily dopa positive, no reaction takes place. In recessive white rabbits the dopa reaction is negative, but no inhibitor can be extracted from the skin of the animal. It is therefore believed that a dominant white rabbit is white because the action of the enzyme is checked by the inhibitor, while a recessive white rabbit lacks the melanin-forming enzyme. The case of the varying hare appears similar to that of the recessive white domestic rabbit, since the presence of an occasional dopa positive cell in some of the white hairs precludes any possibility of an enzyme inhibitor.

In theorizing from the results recorded above, it is reasonable to suppose that each melanoblast has only a limited time during which it may manufacture pigment. This period must last from the time the cell is formed in the hair follicle until it is carried upward and keratinized in the growing hair shaft. Apparently the brown, granular pigment is made under conditions in which there is sufficient substrate and at least detectable amounts of melanin enzyme. Under these circumstances, during the limited period of pigment formation for a given group of cells, the least oxidized form of melanin is made in large amounts, but the reaction has not time to proceed far enough to completely oxidize all of the pigment to the yellow, diffuse type, before all biological oxidations are stopped by the death of the melanoblasts by keratinization. On the other hand, the yellow pigment is formed in an excess of enzyme (or lack of substrate). It is therefore probable that the step in melanin formation in which the dopa-oxidase takes part is quickly over, thus allowing more time for later oxidation reactions which would turn the granular pigment into the diffuse, yellow form.

Admittedly, this brings the problem of hair pigmentation not much nearer to a solution. The whole structure rests on the work of the biochemists, and until a clear cut picture of melanin formation has been worked out, the basic factors controlling coat color can never be solved

CONTROL OF COAT COLOR

Exposition

There has been much speculation about the external factors which influence or control the color change of seasonally variable mammals and birds, but very little experimentation on the problem. For example, Merriam (1882) believed that the pelage of a weasel, "*Putorius erminea*", did not change until the first snow, and that it was the presence of snow which controlled the color change. On the other hand, Barrett-Hamilton (1903) thought that the shock of the increasing cold caused a centripetal distribution of fat, which, in turn, produced a whitening of the hair. These two cases are quoted here, not in criticism of the authors, but in order to show how divergent conclusions may be which are drawn from observations in the field. The commonly accepted theory has been that temperature was the most important factor in the control of coat color, and that the white coat of winter was an adaptation to the snowy background of northern countries.

At the outset there are three obvious factors which vary regularly with the seasons — the temperature, the number of daylight hours, and the intensity of the daily illumination. It is an unfortunate fact that in the field these three factors can not be strictly separated and controlled since they are mutually correlated with each other. Observations under natural conditions are interesting in that they may offer clues to the causes of color change, but the actual separation of the environmental influences must of necessity be undertaken by the experimental biologist.

The first experiment to be recorded on this subject was that of the explorer Ross (1835, from Poulton, 1890, p. 94), who found that a Hudson's Bay lemming remained in its summer coat during the winter when kept in the warmth of the cabin. As soon as it was moved to the cold deck, the animal underwent a rapid change to the white winter pelage. This interesting reference certainly suggests that temperature has a definite effect on coat color in the lemming, though the number of hours of daily illumination in the cabin and on the deck were not considered. It is possible that artificial illumination of the cabin lasted for a longer daily period than did the natural illumination of an arctic winter day.

Hadwen (1929) kept some of his experimental varying hares indoors during the winter months. Because the temperature did not alter the seasonal change of coat color, he assumed that the rhythm of color change was an inherent one, which could not be influenced by the environment. He did not take into account the amount or intensity of daily illumination.

Salmonsen (1939), working with the ptarmigan *Lagopus mutus,* after a very careful description of the plumage changes based on the examination of study skins, developed a theory to show that the control of the plumage was under the influence of the mean temperature of the environment. He says himself, however, (p. 8) ". . . this attempt certainly is imperfect and unsatisfactory, and the results perhaps will appear to the reader to be too uncertain or vague", and goes on to say that he realizes that his book is not the final word on the matter. His theory is based on painstaking correlation of the temperature of the locality with the time in which the birds moulted. The whole is worked out from study skins taken in the wild, so that under no circumstances can the effect of light be ruled out. His theory may well be correct, but he produces no evidence which shows the effect of temperature change on a given series of birds while excluding the influence of light.

Finally, the unpublished paper of Wright (1940) on two species of North American weasel, *Mustela cicognani* and *Mustela frenata*, offers the most valuable information on this subject. Hampered as he was by a lack of animals, he nevertheless was able to show that the moult of these weasels from brown to white could be inhibited by moving the animals to a warm environment. He was also able to correlate the function of the thyroid with the change of coat color. As the thyroid is known to be very important in thermoregulation and body metabolism, his work is very suggestive of a solution of the problem in the weasel. He is continuing his work with this animal and one may expect interesting results from it. As he has not yet published on this subject, it is assumed that the problem has not yet been completely unravelled.

This completes the list of actual experiments on the influence of external factors, and it may be safely said that no positive evidence has yet been put forward to demonstrate without question of doubt the factor which controls the pelage color of *Lepus americanus*.

"Physiological Color": Explanation of Term

It was J. A. Allen (1894) who first noted that the coat color of the varying hare was not necessarily the same as the potential color of the animal. He says (p. 121), "In the case of wounds . . . resulting in the violent removal of large bunches of fur, it is interesting to note that in the autumn the new hair comes out white, often weeks in advance of the general change, and that in spring, under similar circumstances, the hair comes out brown, like the summer coat, much in advance of the general change from winter to summer pelage." In the study undertaken here the color of the replacement hair produced by the follicles after the old hair has been plucked is used as a means of determining the potential or latent color of the animal. The color of the regenerating hair is the color which the animal would be if it underwent a complete moult and regrowth of hair at the time of plucking, instead of growth in a specific small area. There has been no exception to this rule in this work. Moreover, the method has been used in the study of the effect of hormones on the plumage of birds for many years, so that it may be considered a well established technique. (Lillie and Juhn, 1932).

The color of the regenerating guard and pile hair is called here the "physiological color" of the animal, and refers specifically to the hair which regenerates after plucking areas high on, or just posterior to, the shoulders of the subject. The term must not be regarded as indicating that this is the only type of hair which the animal is capable of regenerating at the time when the test is applied. It is obvious, for example, that a physiologically brown hare would remain physiologically white on the belly. The expression will therefore be used in the strict sense defined here unless otherwise stated.

The color of uniform objects can be determined by means of a spectrophotometer, but it is extremely difficult to define the color of a small mass of particolored hair. Various methods of measuring the color of hair samples were examined, including spinning a measured amount of hair and comparing it to a color wheel, but no satisfactory system could be found. The determination of the physiological color of an animal was therefore simply comparative. With typical winter and summer hair as standards, samples of hair were examined in daylight without reference to the life history of the animal in question. In this way a fairly accurate determination of the physiological color of the pure winter white or typical summer brown condition could be made, but gradations between the two types of pelage were difficult to establish with accuracy.

In a normal animal which had not moulted recently, the growth of replacement hair is quite rapidand it is possible to determine the physiological color within three weeks after the patch has been plucked. Immediately after a moult, however, particularly the heavy final autumn moult, the hair follicles become refractory to any stimulus caused by removal of the developed hair, so that several more weeks may elapse before the color can be determined.

All animals used in these experiments were fed on the same diet. This eliminates the possibility of a lack of vitamins being the direct causitive factor for a physiological color change, such as has been found in black rats (Gyorgy and Poling, 1940).

Times of Normal Moults and Physiological Color Changes

Varying hares kept in outdoor pens so that they were exposed to the climate of eastern Massachusetts showed the following moults and changes of physiological color.

At the start of the preliminary autumn moult the animals were physiologically brown. The first appearance of new brown hair occurred in the last two weeks of August or the first week in September, and the whole pelage change was complete in a month or five weeks.

Although the animals were now brown, tests of the type described above showed that they were *physiologically white* at the conclusion of the preliminary autumn moult. (Data on artificially induced autumn moults indicates (p. 422) that the animals actually turned physiologically white before the preliminary autumn moult was complete.)

Shortly thereafter, new white hairs showed on the ears, and the hind feet grew new "snow-shoes". During the last two weeks in October, growth of white hair started at the lower hips, reaching the mid-dorsal line not more than ten days later. As might be expected, the animals remained physiologically white during this process. Between five and six weeks after the first appearance of the white hair tips on the lower hips, the last brown hairs were shed and the animals were in their complete winter coat. The longer time involved in the completion of the final autumn moult in comparison to the preliminary moult is due, at least in part, to the greater length of the new winter hairs. Between the last week in November and the second week in December all normal animals had completed the change to winter pelage. As soon thereafter as the hair follicles would react again to the stimulus of plucking, the animals were found to be still physiologically white.

Between the last three weeks of January and the first two weeks of February, the replacement hair began to take on the brown summer hue. The first sign of this change was a blackening of the tips of the new-grown hair and the appearance of brown pigment more basally, as a result of which the upper half of the hair was black at the tip, with a collar of white below followed by a light brown band. After a later plucking, the black tip was found to be wider, the white collar relatively more narrow, and the brown band darker in its lower part. Some totally black replacement hairs also made their appearance at about this time. Still later, the freshly grown replacement hair had no white collar and the dark, basal pigment appeared higher on the shaft, thus making the brown band shorter. This process continued until hair which grew in to replace the plucked white hair of winter had the black tip, the narrow brown band, and the black base of typical summer hair. When this stage was reached, the animals were considered to be physiologically brown. The change from the physiologically white condition took place in about six weeks. In most animals this change was completed in the month of March, and within one to three weeks thereafter the spring moult began. The earliest normal spring moult recorded here started in the beginning of March; the latest in the middle of April. The shedding of the winter hair and a growth of scattered summer hair often continued until late May or early June.

Thereafter, the animals remained physiologically brown until the preliminary autumn moult was complete.

The fact that living conditions were identical shows that variations in the time of moulting and of physiological color change were due to differences in the individual animals, and hence are probably of no great significance. In the autumn, the timing of the moults apparently bears some relation to age, as the younger animals were the last to begin and finish both pelage changes. At that time of year, young hares can be distinguished from adults by their less developed appearance, which can be checked later when autopsy reveals the unfused epiphyses of the long bones of the hind legs. No accurate correlation between age and the time of the spring moult and of physiological color change could be made because of the difficulty of determing the age of fully developed animals. It is interesting to note that there is a greater variation between the times of moults and of physiogical color changes in the spring, when all animals may be considered adults or at least sexually mature, than in the autumn, when some animals have not yet approached maturity.

In order to clarify the rather complicated series of moults and color changes, the complete picture is presented diagrammatically in Fig. 18. This chart is made from a compendium of data from more than thirty animals, and refers to no specific individual.

EXPERIMENTAL MODIFICATION OF PELAGE WITH LIGHT

Because Hadwen (1929) reported that varying hares kept indoors underwent a normal moult to winter pelage in the autumn, and because Bissonnette was able to modify the moulting cycles in ferrets (1935A) and mink (1939) by manipulation of the total light received daily by these animals, it appeared possible that light, and not temperature, was the important factor in the regulation of coat color in *Lepus americanus*.

To increase the amount of light per day, electric lights operated by a time switch were employed. The animals which were "night-lighted", to use Bissonnette's phrase, received a minimum of 5 foot candles in the darkest parts of their cages.

The gradual increase or decrease of light was used in the experiments of late 1939 and early 1940 because Bissonnette (1935B) had shown that this method was more effective in bringing male ferrets into an early breeding season than was a sudden increase. Later, this was abandoned for the more convenient method described (p. 420) below.

EXPERIMENT 1. — INHIBITION OF FINAL AUTUMN MOULT

Four hares recently obtained from Nova Scotia were exposed to 12.5 hours of illumination per day in outdoor pens, starting October 5, 1939. The "night lighting" was increased about one hour weekly until, on November 9, they received a total of 18 hours of illumination per day. One of the four animals showed white "snow shoes" and the tips of white hair on the lower hips at the start of the experiment, but the other three were still completely brown. On November 15, another animal, which had been so slow in its final normal autumn moult that the growth of white hair had not yet reached the mid-dorsal line, was added to the experimental group.

In spite of a cold December, all three totally brown animals remained in the brown autumn pelage. One died on December 7, and another on December 27, apparently from effects of the low temperature. The animal which had begun the final moult grew typical winter hair and displaced the autumn hair to the level of the top of the hips, and well up along the sides, but remained brown over the back and on the face, except for the tip of the nose (Fig. 16). The animal which was exposed to light later than the others retained a brown streak down the mid-dorsal line, but otherwise developed a modified winter pelage which was slightly flecked with brown hairs over the whole dorsal region.

Not only did the night lighting completely arrest the moult to the white pelage in three cases, but it also turned all the animals, which were physiologically white at the beginning of the experiment, back to the physiologically brown condition. One totally brown animal was plucked on October 26th and, instead of growing white hair as it did on October 5th, grew typical brown, summer hair. Two other animals tested in the same manner on November 14th also grew brown replacement hair. Five controls, exposed to normal daylight, underwent normal final autumn moults to the white winter pelage.

EXPERIMENT 2. — ARTIFICIAL PRODUCTION OF AUTUMN MOULTS

On January 7th, the three remaining hares were moved into a heated building where the temperature was never lower than 50°. The daily illumination was reduced to 16.75 hours at this time. From February

22 to March 20, the lighting was diminished about forty minutes per week, so that the final length of day was 13.0 hours. On April 16th, the total light per day was cut to 10.0 hours. The intensity of illumination was approximately the same as in the "night lighting" experiments.

The hare which was brown dorsally and white elsewhere was found to be physiologically white on March 3. It underwent no moult and died on May 2, having been in bad health for at least two months. The other two animals showed a heavy growth of brown hair, which resembled a preliminary autumn moult, on March 14. This was full grown by April 2. Both then underwent a moult to the winter pelage. This began on April 10th, with the animal which had been originally completely brown, and fifty days later with the animal which had nearly completed its final autumn moult. Neither change to white produced a typical winter pelage, for the "snow shoes" of the hind feet were not well developed and the coat had a brown or greyish tinge, but the results left no question that the normal cyclic changes of pelage had been reversed (Fig. 17).

Because the hares had been kept brown in spite of winter temperatures, and because they turned white in temperatures which were always above 50° F., it was considered that heat and cold were not primary factors in the control of coat color in *Lepus americanus*.

Thereafter, with two exceptions, experiments were carried out in two rooms, both thermostatically controlled so that the temperature varied between 65° and 70° during the cold weather. In the warm days of summer, it was not possible to reduce the heat, and the temperature in the rooms was the same as outside. One room, which will be referred to as the "9 hour light room", was illuminated for 9 hours daily — which is about the amount of daylight on the shortest winter day. The "18 hour light room", on the other hand, was illuminated with the same intensity for eighteen hours daily — or longer than on a long summer day. Animals were moved from one room to the other without any intermediate increase or decrease of daily illumination.

Repetition of Experiments #1 and #2 with Added Observations

Since the preliminary experiments described above, fifteen additional hares have been exposed to "night lighting" during the months when they would normally change to the winter pelage. It was found in all cases where the growth to the winter coat had not yet begun, that this growth was completely suppressed and the animal was physiologically brown when tested later. A total of nine cases reacted in this manner. If, however, the hares were exposed to "night lighting" after the final moult had started, the hair follicles which were active at the time the added illumination was applied continued to grow and form typical white winter hair, even though the animal had been changed to the physiologically brown condition.

The late application of light resulted in various types of pelage, from animals which were totally white except for a brown mask on the face, to animals which were completely brown except for white "snow shoes". In the former case, the added illumination did not shift the physiological color back to brown as quickly as in the case of an animal in which the final autumn moult had been completely arrested. In three cases out of four, the replacement hair of animals with a nearly complete winter pelage was a grey brown, which, though much darker than winter hair, yet had not reached the typical summer color. Replacement hair did not become true summer brown until several months later in these animals.

When kept in the 18 hour light room for long periods of time, hares underwent moults from one brown coat to another of the same color from time to time. As far as can be determined, these moults occurred with no reference to any external stimulus, as animals under identical conditions underwent moults at different times and of varying intensity. One hare, which was held in the 18 hour light room for a year, had four such moults during this time. Two others underwent two moults to brown in six months, and several others had one moult each. These moults resembled the preliminary autumn moult in that the outer hair was displaced by the new, growing hair rather than being shed as the new hair started its growth, and the hair growth began on the back and sides, rather than starting at the extremities. In all cases, animals kept in the 18 hour light room remained physiologically brown with the exception of one animal (#64) which replaced some brown hair rubbed from the lower back with pure white hair. This exceptional case will be discussed later (p. 440) but it is worth mentioning here that the animal was physiologically brown ten days later so the white condition must have been extremely short.

Repetition of the second part of the preliminary experiments bore out the original observations with some interesting additions. Six animals were moved to the 9 hour light room at various times of year after a conditioning period in the 18 hour light room of from four to eight months. Controls consisted of animals kept in the 18 hour light room. In two cases, the experimental animals underwent a typical preliminary autumn moult which was followed by a final autumn moult to white. In one other case, the preliminary autumn moult was extremely light, but the final autumn moult which followed was heavy, though the hind feet did not develop the large snow shoes of the usual winter pelage. In three other cases the preliminary autumn moult was not yet complete over the back and sides when the feet began to turn white. Before the hair of the preliminary autumn moult had stopped growing, a new growth of white hair appeared on the lower hips, and the animals, if plucked on the shoulder, grew in white hair. Animals in this condition were therefore physiologically pure *white* though the follicles which formed the brown hairs had not yet ceased their activity. The final winter coat of these animals retained a few of the brown hairs of the preliminary autumn moult, giving the pelage a brownish tinge. No correlation between this telescoping, as it were, of the two moults and the environmental conditions, the previous history of the animal, or the time of year could be demonstrated. It is suggested that the telescoping is a result of the very sudden change from eighteen to nine hours of daily illumination, but why it happened only in certain animals remains unexplained.

It was not possible in any of these cases to produce hares with typical, pure white winter pelage. Animals with telescoped moults retained a slight brownish tinge, while others kept a small amount of brown on the face, or did not develop true snow shoes. It is extremely improbable that lower temperatures would cause the moult to be complete and typical. The animal which most nearly approached the true winter pelage underwent the final autumn moult during the hot days of late May and early June.

The speed with which the sudden reduction of illumination elicits the response of hair growth is remarkable. In one case, as soon as a week after moving the animal to the dark room, the skin became black, which indicated the development of the new follicles beneath it. When one considers that the follicles must undergo some growth before their effect on the skin color can be noted, one must conclude that the response to sudden reduction of lighting is extremely rapid.

Observations recorded above show that hair follicles which have started to grow brown hair complete this growth normally even though the animal has changed to the physiologically white condition. A similar situation is found in the hair follicles of animals which complete the growth of developing white hairs, although the animals have been changed to the physiologically brown condition by added illumination (p. 421). It is apparent, therefore, that once a hair follicle has begun to develop a hair of a given color, the change of the physiological color of the animal does not effect the normal development of this hair.

In the study of the normal autumn moults no test was made of the physiological color of the animal during the preliminary autumn moult. Evidence supplied by the induced autumn moults suggests, however, that the varying hare undergoes the change to the physiologically white condition before the preliminary autumn moult is completed.

Experiment 3. — Effect of Nine Hour Day on the Spring Change

In view of the striking effect of added daily illumination on the final autumn moult, it was expected that a constant nine hour day would inhibit both the spring moult and the physiological color change.

Accordingly, four hares were moved from outside pens to the dark room on December 27 — a time when the normal length of day was within three minutes of its minimum. A fifth hare which had been in the dark room since November 11 was included in these observations. Unfortunately, the difficulty of determining the color of hair which is intermediate between a true summer brown and a partial summer brown precluded any exact observations on the physiological color. It was an outstanding fact, however, that the animals did not remain in the physiological *white* condition, but without exception turned physiologically brown. Although this change was later than normal in two cases, it did not vary beyond the range observed in untreated animals.

Seven more hares were moved to the dark room on February 21, and an additional six on March 5. Since these animals had already been exposed to the natural increase of daily illumination, it was not expected that their physiological color would vary from that of the normal animal, and such proved to be the case.

On the other hand, these conditions did produce a definite inhibitory effect upon the spring moult. In all eighteen animals the shedding of the winter coat and growth of new hair was either late, (no animal had any spring hair growth until late March and three had none until June 20th) or the moult was so light that it made little difference in the general appearance of the pelage. In several animals the moult was both late and weak. There was no apparent relation between the delay or the intensity of the spring moult and the time when the various groups were moved to the dark room.

In six of the animals in this experiment it was noted that after reaching the physiologically brown condition, they lapsed for a short period into a lighter physiological color. Usually, but not invariably, this lighter condition occurred after the spring moult. In two of the observed cases, the replacement hair was only a lighter shade of brown than previously, in two others it contained a band of white, and in the remaining two it was almost pure white. A few animals have been held in 9 hour light room for nearly a year and it has been observed during that time that certain individuals periodically become physiologically lighter. This is a condition never observed in the 18 hour light room, with the exception of the single animal noted previously (p. 421).

Experiment 4. — Effect of Added Illumination in Spring

To test the effect of added daily illumination during the winter months, four hares were exposed in outdoor pens to ten hours of light per day beginning January 7, 1940. The light was increased each week until, by March 3, the total illumination was eighteen hours per day. On January 16, another animal was added to this experiment. Five animals kept in outdoor pens under normal conditions served as controls.

The animals exposed to extra light from January 7 all began the spring moult by February 14. The animal added to the experiment on January 16, started the moult on March 3. Among the control animals, the earliest moult was on March 3. This was the earliest recorded spring moult out of a series of nine normal hares exposed to natural conditions of light and temperature during two years of experimentation. The latest spring moult among the controls was on April 9th. The average date of the beginning of the five "night lighted" animals was February 18th, while the moult of the five controls was on March 27, or thirty-seven days later. Since all the experimental animals grew typical brown summer hair during this moult it is apparent that the change of physiological color was also precocious.

An experiment which illustrates more clearly the effect of added illumination was carried out in the following year. Two animals were moved from outdoor pens into the eighteen hour light room on January 29th. Two more hares which had been kept in the 9 hour light room to inhibit the spring moult were exposed to eighteen hours of daily illumination on March 5th, and another animal was moved from the 9 hour light room on March 19. All of these animals began the spring moult within ten days after exposure to the sudden increase of daily illumination.

The sudden increase of the length of day caused a much heavier shedding of white hair than was produced when the illumination was gradually increased (Fig. 29). Before any of the new brown hairs appeared over the tips of the fur, the white pile and guard hairs of winter had been almost completely shed. It is interesting to note that when these animals had completed the growth of the summer coat there remained on the shoulder of each a patch of white winter hair which was not shed or replaced by new hair until at least three months later (Fig. 1, adult and Fig. 29). These patches had grown in response to previous tests of the physiological color of the animals. Because the follicles had developed new hair more recently than the rest of the winter coat, they were apparently still in a refractory condition, so that they did not respond with the other hair follicles to the stimulus supplied by increased illumination. This suggests that a period of rest is necessary before follicles which have grown winter hair are capable of responding to the spring moulting stimulus.

Experiment 5. — Effect of Total Dark

To test the effect of total dark on varying hares during the months of winter and early spring, six animals were moved into a completely darkened cellar on December 22. A weak light was turned on for at most one half hour per day during feeding time. The temperature varied between 40° and 50° F.

Unfortunately, the animals did not thrive under these conditions and three died before any definite results concerning the pelage could be obtained. Two of the remaining animals showed an anomalous growth of light colored hair which began between February 21 and March 3. There was little shedding of the winter hair, and the growth itself was very slight, so that the general appearance of the pelage was not greatly changed. Apart from this, the animals reacted very similarly to those kept in the nine hour light room during the same period. In all three cases the moult to the summer pelage was both delayed and weak. More important than this was that all three hares turned physiologically *brown* as early or earlier than the animals kept in the nine hour light room.

Summary of Experiments with Light

These experiments illustrate that the length of daily illumination exercises a profound effect on the moults and physiological color of the varying hare, regardless of the temperature to which the animal is exposed. Artificial increase of the length of day after the preliminary autumn moult, stops the final moult to winter pelage and changes the animal to the physiologically brown condition. Increase of light above that normally found in the spring produces an early spring moult and an early change to the physiologically brown condition. Decrease of the daily light ration in animals which have been exposed to longer periods of illumination brings about preliminary and final autumn moults at any time of year that are very similar to those found in normal animals during the fall. Without the normal increase of light in the spring the varying hare undergoes a spring moult which is either weak or late.

Constant exposure to eighteen hours of illumination each day will keep the varying hare in the physiologically brown condition. On the other hand, neither constant exposure to nine hours of daily illumination nor exposure to total darkness will keep animals in the physiologically white condition. Evidently light supplies some stimulus which will keep the varying hare physiologically brown, but the animals are capable of reaching this condition without the aid of light.

Moults induced by the manipulation of light showed certain minor variations from the typical normal moults. These are to be expected under the abnormal conditions of experimentations and probably have no fundamental significance.

The experiments with light revealed that once a hair follicle has begun to grow a hair of a certain color, a change in the physiological color of the animal will not affect the active hair follicle. The fact that animals with induced preliminary autumn moults were physiologically white before the brown growth was complete serves as an example of this condition and also indicates the normal hares turn physiologically white during the time of the preliminary autumn moult. It was also shown that hair follicles become refractory to the stimulus of the spring moult if they have recently grown white winter hair.

Experiment 6. — The Eyes as Receptors

Experimentation with the effect of light on the sexual cycle of various animals has shown conclusively that the eyes are the main receptors for the stimulus supplied by light. Indications were that the same situation was to be found when examining the effect of light on the pelage changes of the varying hare. To test this, chamois masks were made, which fitted tightly over the head of the animals, and were fastened behind the ears (Fig. 30). Eyeholes were cut in the masks and stiff leather cups fastened over them which kept the chamois from rubbing on the eyelids and causing infection, and yet did not allow light to penetrate to the eyes.

The procedure was to use animals which had either been exposed to normal day light and were still in the pure white pelage, or else animals in the same condition whose spring moult had been inhibited by confining them in the nine hour light room. These hares were moved to the eighteen hour light room. One group of animals was used as controls, while the other group was masked from six at night until nine in the morning. Thus, in spite of being in the light for eighteen hours a day, the total time in which light could stimulate the eyes was only nine hours. A second group of controls consisted of the animals kept in the nine hour light room during the experiment.

The first experiment consisted of one masked hare and two controls, and was started on January 29th. Three more masked animals with two controls were added to the experiment on March 5th. A final masked animal was moved to the eighteen hour light room on April 1st. The only control for this animal was a hare which had been moved to the light room twelve days earlier.

Within twelve days after exposure to the eighteen hours of daily illumination all the controls had begun the moult to the spring pelage. (The history of the controls in this experiment has already been detailed in Exp. 4, p. 424.) One of the masked animals reacted in a similar manner. Examination showed beyond question of doubt that the mask was ill fitting, and allowed light to reach the eyes. At the end of fourteen days this mask was removed for good, and the animal proceeded with a spring moult like that of the controls.

The other masked animals reacted in the same manner as animals kept in the nine hour dark room. The spring moult was either completely inhibited, or else it was extremely weak. The animals were masked for a period of between forty-two and eighty-four days, during which time the respective controls completed their moult to the summer pelage, while the masked animals remained virtually unchanged.

As might be expected, the animal which was moved to the light room on January 29th provided the greatest contrast with its controls, for here the controls moulted much earlier than normal, while the masked animal showed no skin activity. (See Figs. 29 and 30.) At the termination of the experiment, the mask was removed from this animal and, within 20 days, the spring moult began. It is unfortunate that the whole series could not have been run at this time, when animals, unless stimulated by light, would have no tendency to moult. The experiment was so planned, but, as usual, fatalities reduced the number of experimental animals.

This experiment might be criticized on the ground that any masked animal which did not show an inhibition of the spring moult could be excluded from the data by stating that that particular mask did not exclude the light. Every effort was made to judge the unsuccessful mask without prejudice, and it is believed that there was no question about the decision in this case. The striking results obtained in the four other cases bear this out.

Experiment 7

Although the foregoing experiment indicates that light is received by the eyes and, via these receptors, can produce a precocious spring moult, it does not reveal the role of the eyes in the change of physiological color or in the induction of the preliminary or final autumn moults. To test this, two animals were used which had been kept in the eighteen hour light room for six months and were in the typical summer pelage. These animals were masked so that the eyes received only nine hours of light daily. Controls consisted of other animals kept in the light room.

Neither of the masked animals showed a heavy preliminary autumn moult, though a few brown hairs did appear on the back and sides. After two months of masking, the tips of white hairs appeared on the lower hips and a change to winter pelage as typical as those produced by moving animals to the nine hour light room was carried out. The controls in the light room remained in the summer pelage.

This demonstrated that both the moult to the winter pelage and the change to the physiologically white condition could be controlled by masking the eyes. A further discussion of these experiments will be undertaken later (p. 433), but it is believed that it has been shown here that the profound effect which the amount of daily illumination has on the coat color is in some manner transmitted by way of the eyes.

COMPARISON OF THE PELAGE CYCLE WITH THE SEXUAL CYCLE

With the first successful inhibition of the final autumn moult by increasing the daily illumination, it became obvious that there were certain parallels between the modifications of the sexual cycle in other animals, such as found by Rowan and Bissonnette, and the modifications of the pelage in the varying hare. Since 1925, when Rowan, working on the migration of birds, showed that juncos could be brought into an early oestrus by increasing the amount of daily illumination, a great number of experiments have been performed along these lines. Rowan's paper (1938) gives an excellent review of the literature on this subject and lists the animals upon which the experiments had been carried out up to this time. A later paper by Whitaker (1940) brings the list almost up to date. The experiments of Bissonnette and Csech (1939) with cotton-tail rabbits and of Bissonnette (1941) with domestic goats were not included in this list.

In brief, it has been shown that the reproductive cycle of various mammals and birds can be profoundly influenced by manipulation of the amount of light to which the animals are exposed each day. By increasing the length of day, animals which normally breed in the spring, may be brought into oestrus during the early winter months, while decrease of light will cause an early anoestrum. Among the mammals which have been found to react in this manner are the ferret, the cotton-tail rabbit, and the raccoon. The gonads of the female hedgehog show no definite response to increased light, but the male may be brought into early spermatogenesis by this method. (Allanson and Deansley, 1934). Bissonnette has shown that the domestic goat, which normally breeds in the autumn, can be brought into early oestrus by a decrease of light. The reproductive cycle of the thirteen-lined spermophile is apparently unaffected by the amount of daily illumination, but this is an exception to the general rule. (Johnson and Gann, 1933).

In view of these facts, it was obvious that the normal sexual cycle and the effect of light on that cycle should be observed concurrently with the study of the pelage changes of *Lepus americanus.*

METHODS

During periods of anoestrus, the testes of the varying hare are regressed. If the animal is immature, the testes are extremely small, and are so closely held to the pubic bones that palpitation fails to reveal their presence. In adult animals, which have undergone one sexual season, the testes can be discovered by palpitation, but they are small, and very soft to the touch. With the advent of the breeding season, both yearling and fully mature hares undergo a great enlargement of the testes. During this process the testes are firm, and feel swollen. The small, firm testes of an animal at the beginning of its first breeding season can always be distinguished from the larger, soft testes of an animal which has undergone sexual regression. Both biopses and epididymal punctures for spermatozoa checked in all cases with the results obtained by palpitation.

During routine examination of the pelage of male hares, tracings of the size of the testes as determined by palpitation were made, which, while of limited accuracy, serve at least to show the trend of gonadal development very well. In the graphs (Figs. 19–24), the area of the tracings are used as an index of the condition of the testes. These areas must not be regarded as absolute numerical figures, but rather as general indications of the degree of sexual activity. In the autumn, when the testes regress, the area of the tracing of an adult is naturally larger than that of a young animal which has never undergone spermatogenesis. Therefore, in the graphs, the testes which are in the regressed condition are so indicated. The regressed condition must be regarded as the same as an animal which has not yet started testicular development. The vulva of the female hare in the state of sexual receptivity, like that of the domestic rabbit, is swollen and red. Without operating on the animals, this was the only method available to indicate the sexual activity of the female. Its limitation is that it reveals a state of full oestrus, but does not show any intermediate stages between anoestrus and oestrus. It was therefore necessary to use the testes size almost exclusively to show the condition of the animals under observation.

Since the object of this study was not primarily the modification of the sexual cycle *per se*, no attempts to produce matings at abnormal times of year were made. One advantage of the method used here was that indications of a tendency toward the state of complete oestrus can be shown, even when the animal has not reached the full breeding condition.

Normal Breeding Season

In a list of more than eighty reports of litters and pregnancies in *Lepus americanus* based on personal observations and questionnaires, MacLulich (1937) has shown that, in the province of Ontario, the birth of young begins in April, reaches a maximum during the month of May, and declines during June and July, with only a single litter being reported in August. Allowing thirty-eight days for gestation, which is the average period observed in three successful matings during my experiments, it follows that the period of sexual receptivity may occur between mid-March and early August, with the great majority of matings occurring from the last week in March to the end of April. A single hare in MacLulich's report, taken on January 24th and not yet more than two thirds grown, was probably a stunted animal. Additional data, obtained solely from questionnaires, increase the length of breeding season of animals in regions outside of Ontario. This list is not considered here however, since it consists for the most part of records of exceptionally early or late broods, and is therefore of no value in fixing the normal sexual cycle. Criddle (1938) shows that the breeding season for hares in Manitoba is the same as that reported by MacLulich in Ontario.

Turning to personal observation, Fig. 19 gives a compilation of data on animals either kept in outdoor pens under natural conditions of light, or else newly arrived from Canada, where they had been trapped in the wild. As may be seen, these figures are in close agreement with those of MacLulich. Moreover, the sexual cycle roughly parallels the increase and decrease of daily illumination. Unfortunately, no observations could be made during July, August or September, but from evidence given later (p. 438) it is probable that regression toward the sexually quiescent stage normally takes place in late July or in August.

Experimental Modification of Sexual Cycle

The following results will be noted without reference to temperature, as animals in heated rooms and outdoors both responded in the same manner to increase or decrease of light. No fundamental difference such as observed by Bissonnette (1935B) could be detected between the results obtained when the light was gradually changed and when the length of day was suddenly increased or decreased. Therefore this detail will also be omitted from the data.

Experiment 1

Figure 20 shows the effect of increasing the length of day in the autumn (Hare 57 is included, not because it is typical, but because it reveals one interesting point to be discussed later, p. 439). In addition to the two typical cases shown here, one other animal, on which there was no exact data, also showed a great increase in the size of the testes. Numerous other animals also gave indications of testicular enlargement, but died before complete records could be made.

Experiment 4

Figure 21 shows the effect of increasing the normal day to eighteen hours during the winter months. When this is compared with the normal sexual cycle (Fig. 19), it is apparent that the mating period had been advanced at least thirty days. The case of 78 is interesting because it shows that the testes enlarged after the breeding condition was reached.

Figure 22 shows the effect of moving animals of both sexes from the nine hour light room into the eighteen hour light room. Again it is obvious that increased length of day resulted in bringing the animals into an oestrus condition.

Experiment 2

Figure 22 also shows the effect of decreasing the length of day from eighteen to nine hours. In all cases the testes underwent a rapid regression. The two animals which were masked daily (Experiment 7) after having been in the eighteen hour light room for six months, were females in an anoestrus condition, so that no result of the effect of masking could be recorded.

Slow regression of the testes always took place with animals which were constantly exposed to eighteen hours of light per day. Hare 28 in Figure 21 showed this effect after four months of "night lighting". Four other animals underwent regression of the testes after from five to eight months in the eighteen hour light room, though the regression was only transitory.

Experiment 3

Animals moved to the nine hour light room during the winter and early spring months showed, in general, an inhibition of the increase in the size of the testes which normally occurs during the spring. Figure 23 shows, however, that males moved to the nine hour room before the middle of January underwent an increase of testes size, which, though somewhat inhibited, is nevertheles comparable to the normal spring oestrus. On the other hand, animals which were moved from normal conditions to the nine hour room in late February through mid-March showed a very marked inhibition of testicular growth (Fig. 24). The significance of this difference will be discussed below (p. 434).

The two males which were exposed to eighteen hours of illumination, yet masked so that the eyes received only nine hours of light

(Experiment 6), reacted in the same manner as animals which were moved to the nine hour light room at the same time (Figs. 23 and 24). The two females which were masked in a similar manner did not come into oestrus, although unmasked females did.

Four males kept in complete darkness (Experiment 5) from December 22nd to February 8th showed no inhibition of the typical spring oestrus up to this time. Two animals died at this time, and the remaining two did not reach a condition of full oestrus during the three more months which they were kept in total darkness, though the testes remained larger than animals in an anoestrus condition.

From these observations it is apparent that the amount of daily illumination may greatly modify the sexual cycle in the varying hare. By increasing the length of day from a minimum of nine hours, animals may be brought into the oestrus condition. Conversely, animals will regress to the anoestrus condition when the daily light is reduced to this minimum. Constant exposure to long periods of daily illumination can not maintain the oestrus condition indefinitely, and indications of oestrus may appear in spite of a continued minimal ration of daily light.

Comparison of the Effect of Light on the Hare and the Ferret

A comparison between the modifications of the sexual cycle in the varying hare with the numerous reports on the effect of daily illumination in the sexual cycle of the ferret shows that both animals react to variations from the normal length of day in a very similar manner. Both animals respond to increased daily light by coming into the oestrus condition, though a gradual increase of light is apparently more important in the ferret. Both animals go into anoestrum when the length of day is reduced. The data on ferrets kept in constant darkness or exposed to daily illumination shorter than the shortest day of the year are conflicting. Because blinded ferrets showed a delay in reaching the oestrus condition, Bissonnette (1935A) believed that total darkness inhibited the normal sexual cycle. On the other hand, Hill and Parkes (1934) found little inhibition of the sexual cycle in ferrets kept in darkness for twenty-three and one half hours daily. Apparently, in *Lepus americanus*, total darkness does not inhibit the initial growth of testes in the spring, but the testes do not reach the fullest size under these conditions. There have been no experiments performed on the ferret comparable to the moving of hares into the nine hour dark room in the months of winter and early spring.

The results of masking male and female hares in the spring while exposing them to increased illumination agree with the results Bissonnette (1936) reported in ferrets, indicating that the eye is the receptor of the stimulation supplied by light. It may be argued that, in the case of the varying hare, it has not been demonstrated that the region about the head is not the receptor of the stimulus, since this region was covered in masking the eyes. Work by other authors indicate that this is not the case since Benoit (1935) showed that domestic ducks respond to light by sexual development when the whole body except the eyes was covered. In 1938, he showed that light produced no growth of the testes if the eyes were removed and rubber pads put in the sockets. Direct illumination of the pituitary through the roof of the mouth did produce growth of the testes, but this can hardly be regarded as a natural condition. Bissonnette (1936) showed that there was a delay of oestrus in ferrets exposed to 17 hours of light but masked so that this increase was not received by the eyes, while animals masked, but with holes cut in the masks so that the eyes were exposed, showed no such delay. No experiment to date has indicated that the eyes were not the main receptor of the stimulus from light. Because the results of masking the varying hare agreed so well with the experiments of previous authors, it did not seem necessary to mask the head region of animals, while leaving the eyes exposed.

Added Observations on the Sexual Cycle

Since variations in the amount of daily illumination produce effects on both the pelage and the sexual cycle, any additional data on the complex relationship between light and the sexual cycle may give indications of the manner by which light controls the change of pelage. Therefore two observations are included here which are concerned directly with the sexual cycle, but which may have an indirect bearing on the problem of pelage change in *Lepus americanus*.

Experiment 8. — Basic Sexual Cycle

In the experimentation on the effect of light on the reproductive cycle it has generally been agreed that the cycle has a basic rhythm which is established in the genetic organization of the animal. The function of light is apparently to modify this rhythm, and, in nature, to keep it in tune with the time of year. It is believed that a separation of the effect of light and the basic sexual cycle can be made in the case of the male hares which were moved from outdoors into the nine hour light room during the months of winter and early spring.

The four hares which were moved to the nine hour light room before January 14th underwent a considerable increase in the size of the testes before regression began (Fig. 23). On the other hand, animals moved to this room in late February or March showed a decrease in the size of the testes (Fig. 24). In the former case, one animal had received from natural sources a negligible increase over the minimum length of day (17 minutes) while the rest were exposed to no increase of daily illumination. In the latter case, all animals were exposed to at least one hour and forty minutes increase of daily illumination before the amount of light was suddenly reduced to its original minimum.

In view of the absence of any known environmental influence, it is reasonable to suppose that the animals with virtually no increase in daily illumination underwent a growth of the testes in response to the basic rhythm of the sexual cycle. Evidently this rhythm is strong enough to produce a marked growth of the testes, but will not increase the testicular size to the magnitude found in animals under normal conditions of oestrus. It also will not produce full oestrus in the female hare.

On the other hand, the testes of animals which were first exposed to an increase of daily illumination showed a tendency to regress rather than to increase in size when the animals were moved to the nine hour light room. Apparently, then, the basic sexual rhythm is capable of showing its effect on the testes if the daily illumination is kept at the lowest level found under natural conditions. The stimulus of any large increase of daily illumination in some manner disorganizes this basic rhythm, so that it is no longer capable of showing its influence when the animals are moved back to a condition where light is at its lowest natural level.

EXPERIMENT 9. — ACTIVITY AND THE SEXUAL CYCLE

The method by which light produces its effect on the sexual cycle has been the object of much debate. One school, which is led by Rowan believes that light induces a longer period of daily exercise, which in turn increases the general metabolism of the animal, and thus brings on activity of the pituitary and sexual development. On the other hand Bissonnette feels that light *per se* stimulates the pituitary via the eyes, and that this gland then stimulates the gonads. The arguments pro and con are reviewed by Rowan (1938). Recently Le Gros Clark *et al* (1939) by transection of various portions of the optic tracts in ferrets, concluded that the stimulus from light must reach the anterior pituitary via the ventral nucleus of the lateral geniculate body, or through the subthalamus. Jefferson (1940) showed that anatomically no such nervous connections could be demonstrated. Perry (1941) showed that injected adrenalin inhibited the growth of the gonads in the English sparrow by what he considered was an antagonism to the gonadotropic hormones, and advanced a theory which connected Rowan's "activity" hypothesis with this effect. Lyman (1942) suggested that the antagonistic action of adrenalin to the gonadotropic hormones was the result of a toxic effect from the adrenalin rather than a true physiological antagonism. Here the matter stands, with the exact manner in which light exerts its influence still a detabable subject.

Nearly all the data which Rowan presents in support of the "activity" theory is based on work with birds which are known to be diurnal. Bissonnette and Csech (1937) showed that the raccoon, which is nocturnal, could be brought into oestrus by increasing the length of day. Another nocturnal animal, *Peromyscus*, showed greater sexual activity under conditions of increased light, though the situation is not completely parallel since Peromyscus has apparently no basic anoestrus period. (Whitaker, 1940).

The varying hare is generally regarded as a nocturnal or crepuscular animal. Hares kept in the laboratory with illumination regulated by a time switch are obviously not under natural conditions. Nevertheless, it was considered of interest to discover at what periods such animals were active. Accordingly, a small cage was made with a loose floor which was so constructed that any change of position by the animal moved the floor. The movement of the floor was recorded on a twenty-four hour kymogram by means of a lever. The time when the lights were turned off and on was recorded on the kymogram by an electro-magnet attached to the light circuit.

A series of twenty-four hour runs were made with hares in the nine hour light room and in the eighteen hour light room. Figures 25 and 26 show typical results from each group. It is obvious that in the nine hour light room the hares were active chiefly during the period of darkness. In the eighteen hour light room also, the main activity occurred in the dark, but another burst of activity took place between about 5:30 and 7:30 in the morning. Presumably, during the short period of darkness afforded in the eighteen hour light room, the animals were unable to enjoy sufficient activity, hence another active period took place during the time of illumination. Whatever the explanation for this, it is apparent that the varying hare under laboratory conditions is active chiefly at night.

In the case of the raccoon and the varying hare, then, we have two animals which are less active in the light than in the dark. Under the terms of Rowan's "activity" theory it is difficult to see why animals which are active chiefly in the *absence* of light should be brought into oestrus by increasing the amount of illumination per day. Bissonette's suggestion that the effect of light is due to some direct nervous stimulation from the eyes is more in keeping with the facts observed here.

SEXUAL CONDITION AND PHYSIOLOGICAL COLOR

In the following pages a consideration of the relationship between the sexual cycle and the moults and color changes will be undertaken. This is done in order to discover if there is any correlation between the amount of gonadotropic hormones in the blood and the condition of the hair follicles.

It is a well established fact that the mammalian pituitary reacts to a stimulus such as supplied by increased illumination by liberating gonadotropic hormones into the blood stream. The effect of these hormones is reflected in the condition of the testes in the male, and in the ovaries in the female. The swollen condition of the vulva of the female is a secondary effect produced by the liberation of estrogen from the active ovary.

There are certain limitations, however, in using the condition of one end organ as an index of the presence of a certain stimulus, and then observing the effect of this stimulus on a totally different end organ. Every end organ has a definite threshold to stimuli. If a stimulus is not strong enough to pass this threshold, the organ fails to react. Moreover, after prolonged periods of stimulation, the end organ may develop a refractoriness to this stimulus, so that a greater stimulus is necessary to produce the same reaction. The pituitary-gonad relationship is no exception to this rule. For example, in the case of hare 28 (Fig. 21) the decrease in the size of the testes in May might be regarded as indicating either that there was less of the gonadotropic hormones in the blood, or else that the testes had developed a refractoriness to the hormones which were present in a constant amount, or that both these conditions existed at the same time.

In the comparison to follow, the hair follicles are regarded as definite end organs. It is always possible that one of two end organs may have a different threshold for a given stimulus, or develop a refractoriness to this stimulus which the other end organ does not develop. These facts make it necessary that only very definite and rapid increases and decreases in the size of the testes, and only complete changes of physiological color be regarded as positive indications of the physiological condition of the animal in question.

In the review given below, it will be shown that with normal, untreated varying hares there are certain parallels between the condition of the gonads, the physiological color, and the moults. By using light to alter the time of moult and color change, it is possible in some experiments to separate these parallels, while in other experiments the parallels hold in spite of the artificially induced changes. Separation of parallels show that these conditions are not mutually interdependent. Conversely, parallels which continue in spite of artificial conditions supply strong circumstantial evidence that they are in some way interrelated.

In normal hares, the testes increase in size as the animals approach the physiologically brown condition, and, when the testes are greatly enlarged, the spring moult begins. After the spring moult, the animals remain physiologically brown, and the testes remain enlarged. The lack of data on testicular size during the summer months does not permit the parallelism to be carried through this period. It is certain, however, that by the time of the preliminary autumn moult, the testes have regressed. Out of six recorded cases of preliminary autumn moults in the male hare (of which two were produced normally and four were induced by reduction of light), this change of pelage always occurred with the testes in a completely regressed condition. Moreover in thirteen autopsies made between late October and mid-February on males less than a year old, it was found that the testes had never undergone an increase in size. Therefore, though the preliminary autumn moult was not observed in these animals, it is certain that they were not in an oestrus condition during the time of this moult. No female was ever found to be in oestrus during the preliminary autumn moult. These facts, coupled with the breeding data of MacLulich and Criddle, (p. 430) show without question that the varying hare is in a condition of anoestrus during this period.

At the end of the preliminary autumn moult the animals are still in an anoestrus condition and are now physiologically white. They remain both anoestrus and physiologically white throughout the final autumn moult, and not until the early months of the new year, as the cycle starts again, do they show signs of changing both conditions.

If normal animals are exposed to added illumination starting in the month of January, they reach an oestrus condition, become physiologically brown, and undergo the spring moult all earlier than under natural conditions (Experiment 4 and Fig. 21). In this case the condition of the animals is parallel with that of the normal hare and added illumination has merely served to speed up the usual spring changes.

If, on the other hand, animals which have concluded their preliminary autumn moult are exposed to added illumination, only two of the above results hold true. The testes increase in size and the animals become physiologically brown, but *no* shedding of the old brown coat and growth of a new one takes place (Experiment 1 and Fig. 20). In this case the brown physiological color and the enlarged condition of the testes run parallel, but the spring moulting phenomenon does not.

It may be argued that the hair follicles, having but recently completed the preliminary autumn moult, would be refractory to the moulting stimulus which accompanies the enlargement of the gonads in the spring, while the testes, because of a longer priod of inactivity, would not be refractory. However, it is known that the hair follicles are not refractory, because it is only by increasing the amount of light that the heavy final autumn moult is stopped. Moreover, animals which are exposed to additional illumination for long periods of time may maintain enlarged testes, but, when they undergo moults from time to time, the moults are of the preliminary autumn type rather than the spring type, (i. e. the new hair is well grown before the old hair is shed.) It is therefore apparent that the enlargement of the testes and the early spring moult do not always run concurrently.

An interesting comparison of reactions occurred in two hares exposed to increased illumination in the autumn (Fig. 20). Hares 57 and 28 were both moved to the eighteen hour light room when the final autumn moult was well under way. Because the follicles had started the growth of white hair, the animals became totally white except for a mask of brown on the face. The physiological color of both animals was tested within a month after the completion of this moult. Hare 57 was found to be physiologically a light grey-brown, (as were two female hares under the same conditions. See p. 420 and p. 419), while hare 28 was very nearly a typical summer brown. A glance at Figure 20 shows that the darker physiological color of 28 compared to 57 is closely paralleled by the greater testicular growth in the former animal.

The reduction of daily illumination after prolonged night lighting causes a reaction similar to that found during the normal preliminary and final autumn moults. With the reduction of light, the testes begin a quick regression and the preliminary autumn moult starts at once, though occasionally this moult is extremely light. The testes quickly become fully regressed; the animal turns physiologically white, and in due course the final autumn moult is carried out. The sudden reduction of light probably causes a more rapid regression of the testes than takes place under natural conditions, but otherwise the parallel between the normal and the induced autumn moults is very close.

The case of hare 64 is of interest also, for it was this animal which turned physiologically white in the eighteen hour light room, (p. 421). The animal had been held in this room for four months, during which time the testes remained at 3.3 sq. cm., which was maximum for this small hare. Between November 3rd and December 1st, the testes underwent a rapid decrease in size so that on the latter date they were completely regressed. At some time between these two dates, the animal grew a large patch of pure white hair to replace some hair which had been removed from the lower back at the mid-dorsal line. It is certain, therefore, that the animal was physiologically white at this time. A few days later, a light growth of brown hair appeared on the back and sides which was in all ways similar to some weak moults observed in other animals kept in this room. This showed that the hare had returned to the physiologically brown condition. There was no apparent reason for this sudden reduction of testicular size and change of physiological color, so that the experiment could not be deliberately repeated. It is interesting, however, in that it again demonstrates that the sudden regression of the testes from the enlarged condition is closely paralleled by the change of physiological color, even though the change in this case was of a transitory nature.

A consideration of the parallels between the size of the testes, physiological color and time of moult, must be made with caution when reviewing the effects of moving normal animals into the nine hour light room during the winter months. (See Experiment 3 and Figs. 23 and 24.) The variations in size of testes are not of the magnitudes heretofore considered, and the relationship between these changes and the changes in the pelage can not be clearly drawn.

In the case of the four animals (including one masked hare) moved to the nine hour dark room before the middle of January, it is certain that the change to the physiologically brown condition was parallel to the enlargement of the testes. Moreover, the animals began their weak moult as the testicular increase reached its peak. The drop in the size of the testes and the change of the physiological color to a lighter shade appear to be concurrent, but, since only one male hare in this group showed a change to the pure white physiological condition, no definite parallel can be drawn.

The animals moved to the dark room during the late days of February or after this time, and those kept in total darkness, showed only indefinitely the parallels which are so clearly seen in other experiments.

To sum up, it was found in both natural and artificially produced conditions that a complete regression of the testes was always paralleled by a change to the physiologically white condition, preceded by a preliminary autumn moult of varying intensity and followed by a final autumn moult to the winter pelage. On the other hand, an increase in the size of the testes to maximum was always accompanied by a change to the brown physiological color, but not invariably by a spring moult. Less obvious increases and decreases in testicular size parallel the physiological color as well as could be expected. Relatively small increases in the size of the testes are accompanied by weak spring moults.

Evidently, then, there is good evidence that, whenever there are large amounts of the gonadotropic hormones in the blood of the varying hare, the animal is physiologically brown, while, when these hormones are absent or present only in small quantities, the animal is physiologically white. It is also apparent that the gonadotropic hormones are present in large amounts at the time of the spring moult, but that an increase of the gonadotropic hormones in the fall is not paralleled by a moulting of the pelage at this time of year.

OTHER ENDOCRINES

Before considering further the possible role of the gonadotropic hormones of the pituitary it is necessary to discuss the possibility of other endocrine organs as factors in controlling the color change of *Lepus americanus*. In this study, particular emphasis was put upon the physiological color of the animals, for, apart from the fact that both could be controlled by light, there were no available clues to the cause of the preliminary and final autumn moults. The original purpose of the undertaking was not to discover what caused the moults, but rather what caused the change of color. Therefore, the most profitable course to pursue was this aspect of the problem.

It has been demonstrated previously that a change of the physiological color of the animal had no apparent effect on the color of a hair being produced by a follicle which had begun its growth before this change had taken place. It therefore seemed probable that the hair follicle, when once formed, could produce only one type of hair. This was in contrast to the banding of feathers produced by the injection of various hormones. (Allen, 1939, p. 301). Because of this, in experiments involving injection of hormones, the hair was plucked after the injections had begun, and, in ablation experiments, the test of physiological color was not applied until at least a day after the endocrine organ had been removed.

The Gonads

In view of the parallels between the condition of the gonads and the physiological color in the varying hare, the omission of an early consideration of the sex hormones would be inexcusable, especially since they play such an important part in plumage and bill color of certain birds. (Allen, 1939, Ch. V).

If the sex hormones were influential in the change of physiological color, it was to be expected that castrated animals would not turn physiologically brown in the spring, at the time when the normal animal showed gonadal activity. Accordingly, four hares, two males and two females, were castrated on December 21, 1940. Immediately after castration all animals were still physiologically white, which was normal for that time of year. All the animals were kept in outdoor pens and one male and one female castrate were exposed to the increased illumination described in Experiment 4. The pelage change of these two animals exactly paralleled normal animals under the same conditions, although in both cases the spring moult was heavier than the average. The increased illumination produced both a precocious moult and a precocious change of physiological color. The two animals not exposed to added illumination, were slightly slower than the average normal animal in reaching the physiological brown condition, and the spring moult was not a heavy one, but the significant fact is that they did not vary beyond the average established for normal animals.

It was not to be expected that castration would effect the final autumn moult, for at that time the testes are in the regressed condition. Nevertheless, a single male was castrated on November 10th as a check. On October 28th, this animal had just started a growth of white hair on the hips, and was therefore exposed to increased illumination for five days to hold this growth in check until the operation could be performed. It was then placed in an outdoor pen under normal conditions. The moult to the white winter coat did not begin again until December 5th, but proceeded from that time in the normal manner. The delay in the normal time of moult is considered directly attributable to the short period of increased illumination, so that castration produced no apparent effect on the time of moult or the physiological color change.

Evidently, then, the change of physiological color either to white or to brown, and the spring and final autumn moults can be carried out in the complete absence of the sex hormones.

The Thyroid

It has been shown that injections of thyroxin have a definite effect on the plumage color in some birds (Allen, 1939, Ch. V) and a definite annual rhythm of activity in this gland has been demonstrated in certain mammals, e.g. Zalaskey (1935). Wright's work (1940) indicates that the thyroid is the important endocrine organ in controlling the coat color of the weasel. Therefore, the possibilities of the secretions of the thyroid gland as a factor in the control of pelage color must be considered.

A histological study was made of eighteen thyroid glands obtained from normal animals in various conditions of moult and physiological color. Although the series was not complete, no correlation could be made with the condition of the pelage and physiological color and the condition of the glands themselves. This was very obvious in the case of animals which were undergoing a typical final autumn moult and animals in which this moult had been stopped by increased illumination. The glands were similar in spite of the very different condition of the hair follicles (Figs. 27 and 28). Since the presence of the thyrotropic hormone should be reflected in the condition of the thyroid gland, the histological study indicates that this substance also is not involved in the moulting or change of physiological color.

Feeding desiccated thyroid (U.S.P.) to varying hares proved to have a lethal effect even in small doses. The only successful experiment using this method was performed on an animal which was moved into the nine hour light room on March 5th, and on May 3rd had not yet undergone a spring moult. On the latter date the equivalent of 1.25 gr. of fresh thyroid was given orally to the animal, and this dose was repeated every three days for two weeks. (Any dose above this amount had already proved itself fatal.) The feeding of thyroid in this case produced no moult up to the time of the death of the animal on June 3rd.

Thyroidectomy of the varying hare presented a problem not found in the domestic rabbit, which possesses one pair of parathyroid glands anatomically not associated with the thyroids. In the hare, the bulk of the parathyroid tissue is found on the anterior portion of the ventral surface of each lobe of the thyroid. If the thyroids were removed without first carefully disassociating this tissue, the animal died in parathyroid tetany, for there is apparently none or an insufficient amount of accessory parathyroid tissue.

Three successful thyroidectomies were performed on varying hares. One animal was thyroidectomized on April 13th, after being in the nine hour light room for three weeks. It underwent a light spring moult similar to other animals in the same room and showed no pelage changes which were atypical when compared with controls. Another animal which was physiologically brown and was kept in the eighteen hour light room was thyroidectomized on August 18th. The animal remained physiologically brown with no sign of moulting until September 10th, when it died suddenly of pneumonia.[1] A third animal was moved from the eighteen hour to the nine hour light room on November 19th. It underwent a typical preliminary autumn moult and started a "telescoped" final autumn moult. The tips of white hair had appeared high on the hips and well up the back when the animal was thyroidectomized. The operation in no way disturbed the final autumn moult, which was one of the most complete observed under induced conditions. The animal was physiologically white after the completion of this moult. Later this hare returned to the brown physiological condition in the normal manner, and underwent a spring moult when exposed again to 18 hours of daily light.

These results show that the presence of added thyroid hormone will not produce a spring moult in an animal kept in the nine hour light room, and that the absence of this hormone under the same conditions has likewise no effect. The absence of the thyroid hormone has no effect on the physiological color of an animal in the eighteen hour light room, and does not cause a preliminary autumn moult under these conditions. Moreover, the absence of the thyroid hormone will not impede the completion of the final autumn moult, and the thyroid hormone is not necessary to produce the physiologically white condition.

---

[1] To check the technique of operating, all the tissue from the locality of the thyroids in this animal was examined histologically. No thyroid tissue was found.

Evidence is lacking to show whether the thyroid provides the stimulus which starts the preliminary or final autumn moults. If it has such an effect, it can be safely said that the activity of the thyroid is not reflected in the histological condition of the glands during the final autumn moults. As has been demonstrated, animals which have just begun this moult show the same conditions of the thyroids as animals in which the final autumn moult has been arrested by increased illumination (Figs. 27 and 28).

However this may be, it is evident that the physiological color of the varying hare is not dependent upon the thyroid gland.

The Adrenal Cortex

The heavy pigmentation of the human skin often observed in a patient suffering from Addison's disease is apparently related to the condition of the adrenal cortex rather than the medulla. (Grollman, 1936, p. 305–306). In the normal mammal or bird, there is no work which demonstrates that the adrenal plays a role in the color of the hair or feather.

The study of the effect of the adrenals on pigmentation was hampered because, with a limited supply of hares, it was not practical to attempt the dangerous operation of adrenalectomy with its attendant difficulty of maintaining the adrenalectomized animals. A cytological study of the adrenals was not undertaken because, in mammals, the adrenals and gonads are mutually interdependent (Grollman, ch. XIII, 1936) and because, in the varying hare, the sexual cycle and the physiological color are parallel. The separation of these two factors in the cytological picture would be extremely difficult.

If hypersecretion of the adrenals caused either the physiologically brown or physiologically white condition, it was hoped that injection of an extract of adrenal cortex would demonstrate this relationship. Therefore, 10 rat units per day of Parke-Davis adrenal cortical extract were injected subcutaneously into a pair of varying hares. According to the body surface of the hare, and the table given by Grollman (p. 243, 1936) for other animals, this amount should be sufficient to maintain an adrenalectomized hare. One animal which had been moved to the nine hour light room on December 27th and was physiologically almost pure white at the beginning of the injections, showed no pelage change resulting from injections which lasted twenty-five days. The other animal had been moved to the eighteen hour light room on November 2nd. The final autumn moult had been suppressed so that the back of the animal was still brown. It was physiologically brown when the injections were begun on January 30th, and remained unchanged during twenty-seven days of treatment.

It is therefore apparent that, at the dosage given, adrenal cortex extract has no effect on the pelage change of *Lepus americanus.* This can not be regarded as positive proof that the adrenal cortex is not associated with the change of pelage, but at least it is an indication that such is the case.

The Pars Intermedia

The hormone intermedin, secreted by the pars intermedia of the pituitary body, has been shown to control or modify the color change of animals in classes of vertebrates as high as the reptiles. (Kleinholz, 1938). The common source for extraction of intermedin is the mammalian pituitary and the presence of intermedin in the blood of mammals has been reported by Jores (1933) and Levinson (1940).

In collaboration with Dr. L. H. Kleinholz, an attempt was made to repeat the results reported by Levinson. Instead of the normal pale frog, which Levinson used as a test animal, the hypophysectomized lizard, *Anolis*, was employed. This animal provides a more delicate and specific test than the pale frog. Blood was obtained from hares in both the white and the brown physiological condition, and from two series of rats, one exposed to eighteen hours of daily illumination, the other kept in total darkness.

After a complete series of tests, no confirmation of Levinson's results could be obtained. Therefore it is not to be expected that intermedin plays a part in the color change of *Lepus americanus.*

This completes the list of endocrine glands, other than the anterior pituitary, which were known to be associated with pigmentation in various vertebrates. No positive evidence of any relationship between the color change of *Lepus americanus* and these organs was demonstrated. Apart from the adrenal cortex, it is believed that it has been conclusively shown that there is no direct connection between the physiological color of the varying hare and the endocrine organs which have been considered here.

Hormones of the Anterior Pituitary

Having shown that some of the other hormones which were considered as possible factors in the physiological color change, actually had no influence on this phenomenon, attention was again turned to the hormones of the anterior pituitary, with the purpose of testing whether the parallels between the physiological color and the amount of the gonadotropic hormones in the blood were in any way interrelated. That such a relationship exists in certain birds had already been proved by Witschii (1936) when he showed that injections of pregnant mare serum produced the cocky type of plumage in sexually quiescent male weaver finches, and in both male and female castrates.

The ideal method of testing the effect of the gonadotropic pituitary hormones would be to inject purified extracts into hypophysectomized animals, for by this method the reaction of the animals own pituitary would be avoided. Unfortunately, hypophysectomy even in domestic rabbits has proved rarely successful, so that this procedure was not practical in a long term experiment. It was therefore necessary to inject extracts into unoperated animals.

In the following experiment, an extract of fresh whole sheep pituitary was used on one series of animals. It was prepared in Dr. Hisaw's laboratory and given to me through his kindness. The tissue was finely ground in a frozen condition and extracted in a solution of sodium hydroxide and water adjusted to a pH of 8.0. The supernatant liquor was removed, the precipitate again extracted in the same manner, and this supernatant liquor added to the previous one. To this liquor was added .25 molar ammonium hydroxide and enough sulphuric acid to reach a pH of 5.4. The supernatant liquor from the resulting precipitate was removed, the precipitate was again exposed to extraction with sodium hydroxide at pH 8, and this extract again treated with ammonium hydroxide. The supernatant liquor was added to that previously obtained, and the pooled preparations were neutralized and evaporated to an amount convenient for injection. This extract probably contained all the pituitary hormones except the adrenalotropic.

Animals newly trapped in New Brunswick were moved to the nine hour light room on January 14th, a time when they were expected to be still physiologically white or just turning to the physiologically brown condition. It is unfortunate that the experiment could not have been started earlier, but a lack of snow in New Brunswick made trapping extremely difficult and caused an unavoidable delay.

Injections were started on the day of arrival, and a test of the physiological color of all animals was made two days later. Two males and two females were injected with five rat units[1] of the pituitary extract

---

[1] A rat unit of pituitary extract is defined as the minimal total amount which, when injected into twenty-one day old female rats as three doses over a period of three days, will produce a 100% increase over the normal weight of the ovaries.

daily for twenty-four days. One animal of each sex served as controls in this experiment. Injections were given subcutaneously in the region of the hips. The extract produced a slight local reaction, but otherwise no harmful results from the injections were noted.

The injected animals began to shed the winter coat within four days after the beginning of the experiment. The shedding was copious in all four cases, and in one animal of each sex it was nearly as complete as a spring moult induced by increased illumination (Figs. 2, 29 and 31). Some inhibition of shedding was shown in the local area of injection, apparently caused by the toxic effect of the extract. No well defined growth of hair such as found in the normal spring moult occurred. The testes of one male showed a definite increase in size during the experiment and both females reached a condition of oestrus for a short period. The controls showed no signs of shedding and gave no indication of a change in the condition of the gonads.

When the patches of replacement hair were compared at the end of the injection period, it was found that one of the control animals had reached a condition of physiological color intermediate between the white and the brown phase. The other control was physiologically almost pure white. The replacement hair of one of the animals injected with pituitary extract was no darker than that of the darkest control, but the other three animals proved to be physiologically darker than any normal animals observed at this time of year (Fig. 32). Although the replacement hair of these animals was not typical of the normal banded summer hair, it was clear that injections of pituitary extract had resulted in a physiological condition that was definitely darker than normal. It was not to be expected that random doses of whole sheep pituitary would produce the exact replica of the typical summer hair. The single animal which showed no great darkening of the physiological color in spite of the treatment with pituitary extract also maintained testes in a completely regressed condition. It is therefore possible that the action of the injected hormones was partially inhibited in this animal by some unknown means.

Pregnant Mare Serum

The injection of pregnant mare serum was also employed on a series of animals under the same conditions as the previous experiment. This substance was used because, in contrast to even highly purified extracts of whole pituitary, it contains only a gonadotropic principle. The hormone is of placental origin and is apparently neither the same as the follicle stimulating or the luteinizing hormone of the pituitary, nor is it a mixture of the two. (Cole *et al*, 1940).

In this experiment one castrate and one normal hare of each sex was injected with twenty-five rat units (as defined by Cole *et al*, 1940) of pregnant mare serum every other day for twenty-four days. The test of the physiological color was applied at the same time as in the previous experiment. During the experiment the testes of the normal male increased greatly in size, and the normal female quickly reached a state of oestrus and remained in that condition. The injections produced no shedding of the winter hair.

When the replacement hair was examined, it was found that these animals had just begun the normal change to the physiologically brown condition. The replacement hair of one was white except for a short black tip, and the others were slightly darker. Comparison with the two controls described in the previous experiment showed that none of the injected animals were as far advanced toward the brown phase as the exceptionally dark control. Apparently, then, injection of pregnant mare serum in quantities sufficient to produce a very definite oestrus, has no effect on the physiological color of the varying hare (Fig. 32).

These two experiments show that, whereas pregnant mare serum will not alter the physiological color of varying hares which have just begun to change to the physiologically brown condition, injection of whole pituitary extract definitely darkens the physiological color of similar animals and causes a copious shedding of the white winter coat. The possibilities, then, are either that some other pituitary hormone or hormones directly or indirectly cause the darkening of the physiological color, or else that the gonadotropic hormones of the pituitary cause this change. Because pregnant mare serum is apparently not identical to the gonadotropic hormones of the pituitary, the failure of the former substance to produce a darker physiological condition can in no way be regarded as proof against the hypothesis that the gonadotropic hormones of the pituitary cause the physiologically brown condition. On the other hand, the fact that an extract of the whole pituitary produces this change is not proof that it is the presence of the gonadotropic principle which controls the physiological color. Of the numerous hormones present in this pituitary extract, only the thyrotropic may be ruled out as probably having no effect, because histological evidence (p. 443) has shown that there is no parallel between the condition of the thyroid and the physiological color.

SUMMARY OF RESULTS

A summary of the previous observations and experiments shows that *Lepus americanus struthopus* normally undergoes three moults a year. One moult takes place in the spring and results in a shedding of the winter pelage and a growth of the brown summer coat. Two moults occur in the autumn; the first replaces the summer coat with a new and heavier brown pelage, and the second replaces this coat with the typical white winter pelage. The process of the spring moult is different from that of the two autumn moults. In the former the shedding of the winter hair and growth of the new brown summer coat takes place gradually, while in the latter, growth of the new pelage is confined to a short period of time. In the spring moult, the old hair is shed as the new hair begins its growth, while in the autumn moults the new hair displaces the old as the former reaches its full length.

The physiological or potential color of the animals was observed throughout the experiments. The hares begin to turn physiologically brown at least two months before the spring moult occurs and remain in the brown condition until the preliminary autumn moult is under way. At this time, they turn suddenly to the physiologically white phase. When in the physiologically white condition, the melanoblasts of the regenerating guard and pile hair follicles contain no melanin-forming enzyme (dopa-oxidase), which may be the reason for the lack of pigment.

By increasing the daily illumination in the autumn, the final moult to white is completely arrested and the animals are changed to the physiologically brown condition. When this condition has been induced, animals will undergo a preliminary and final autumn moult if the amount of light received daily is reduced to that found in the shortest days of winter. If the amount of light in January is greatly increased, animals in the white winter pelage undergo an early spring moult and a precocious change to the physiologically brown condition. If animals in the white physiological condition and in the white winter pelage are exposed to no increase of daily illumination longer than the shortest winter day, there is an inhibition of the usual spring moult, but the change to the physiologically brown condition takes place normally. Since animals under these conditions also show a tendency toward normal spring oestrus, it is believed that these two changes take place in response to a basic internal rhythm.

Apparently the effects which are produced by changing the length of day are in no way dependent on the temperature to which the animals are exposed. That the effect of light is received through the eyes, was demonstrated by masking the animals. Since longer periods of illumination produce shorter periods of activity, it is believed that the effect of light is not dependent on the activity of the animal.

The sexual cycle was studied concurrently with the pelage changes. Using the size of the testes in the male and the condition of the vulva in the female as indices of the amount of gonadotropic hormones in the blood, it was found that these hormones are present in large quantities during the spring and summer, but reach a minimum at the start of the preliminary autumn moult. Under both natural conditions and conditions induced artificially by the manipulation of light, the varying hare is always physiologically brown when there are large amounts of the gonadotropic hormones in the blood stream, and is physiologically white when the concentration of these substances is low. In the spring, the increased concentration of the gonadotropic hormones is accompanied by shedding of the winter coat and growth of a new brown pelage, but this is not the case if the gonadotropic hormones are increased in the fall.

Because the amount of gonadotropic principle and the physiological condition of the animals is always parallel, and because both these factors could be controlled by the amount of daily illumination, it was thought that the gonadotropic principle caused the brown physiological condition. Injection of whole pituitary extract containing the gonadotropic hormones changed animals which were physiologically nearly pure white to a much darker physiological condition, and caused copious shedding of the winter hair. Excluding the anterior pituitary, no evidence could be found that any endocrine organ which was known to have some effect on the pigmentation of other vertebrates was in any way connected with the control of the physiological color of *Lepus americanus*.

Injection of a pure extract of the anterior pituitary containing only the gonadotropic hormones into physiologically white hares would show more definitely whether the gonadotropic principle caused the change to physiologically brown condition and the spring shedding. Unfortunately, the supply of animals in this condition is, for the present, unavailable, so that this experiment must wait until a more auspicious time.

Although all evidence points to the gonadotropic hormones of the pituitary as the cause of the physiologically brown color of the varying hare, the role of these hormones as a causative factor in the spring moult is not so clear. When the two autumn moults are considered, it is apparent that no information on the internal cause of these moults is available. The stimulus for the preliminary autumn moult can be brought about by a reduction of the daily illumination, but moults of the preliminary autumn type take place from time to time for no apparent reason. The final autumn moult, preceded by a preliminary autumn moult, can also be induced by reduction of the daily illumination, but a moult of this type can be arrested indefinitely by increasing the daily ration of light.

Because all three moults respond to various changes in the amount of daily illumination, the natural tendency is to consider them as originating from the same internal physiological stimulus. However, because the spring moult differs morphologically from the other two and because each moult reacts in a different manner to the manipulation of the amount of daily light, a more reasonable course is to suppose that there are three separate types of stimuli, each one of which is responsible for one of the three moults.

THEORETICAL CONSIDERATIONS

Moults and Color Changes

Taking the problem as a whole, the normal cycle is visualized to be in the following manner: In the early winter months the animal is physiologically white. In response to reception by the eyes of the increased illumination of spring combined with the rhythm inherent in the animal, the amount of the gonadotropic hormones increase in the blood. This increase causes the hair follicle to become physiologically brown, and brings the animals to the oestrus condition. It is also possible that the gonadotropic hormones cause the spring moult. If this last is the true case, the time of the spring moult depends, not only on the concentration of the gonadotropic hormones in the blood, but also on the sensitivity to the growth stimulus which the hair follicles have developed since their last active period of growth. That this sensitivity becomes more acute as time progresses is shown by the fact that patches of hair which have grown since the final autumn moult (in response to plucking) do not respond as readily to the stimulus of the spring moult. The sensitivity of the hair follicles and the concentration of the gonadotropic hormones can both vary in the individual animal, which may well be the cause of the wide variation found in the time and the intensity of the spring moult.

During the spring and summer months, the concentration of the gonadotropic hormones remains high. The decrease in the size of the testes which apparently takes place in late July is probably due in part to a decline in the amount of gonadotropic principle, but also may be due to a refractoriness developed in the testes themselves. With the rapid decrease of daily illumination in August, the amount of gonadotropic principle in the blood falls suddenly, causing a quick regression of the testes. At some time near the end of this month, the stimulus for the preliminary fall moult occurs, brought about by the decrease of illumination. By the time the preliminary autumn moult is well under way, the amount of gonadotropic principle in the blood is at a minimum, the testes are completely regressed, and the animal is physiologically white. Shortly after the completion of the preliminary autumn moult, the stimulus for the final autumn moult occurs, and the animal changes to the winter pelage.

When in the physiologically white condition, the active guard and pile hair follicles have no melanin-forming enzyme in their melanoblasts, but the relation between this lack and the absence of the gonadotropic principle is not understood.

This study of the pelage cycle in the varying hare has at least served to show that the factors involved in this phenomenon are extremely complex. One of the most interesting fields of study would be an attempt to discover why the change from white in winter to brown in summer was of such vital importance that the development of this complex mechanism came about. However, this, and many other interesting problems in the field of protective coloration, are beyond the scope of this paper.

Function of Light

Since the amount of daily illumination has been shown to have such striking effects on the pelage changes and the sexual cycle of *Lepus americanus*, the exact function of light in these cycles is of great interest. It has been shown that under constant conditions of short daily illumination certain fluctuations, such as signs of oestrus, shedding of the winter coat, and variations between the pure brown and lighter physiological colors take place. Likewise, animals under constant conditions of eighteen hours of daily illumination, although they do remain physiologically brown, show periodic regressions of the testes and periodic moults. These changes are taken to be indications of a basic rhythm or rhythms.

It is only with the increase or decrease of daily illumination that light may be said to produce a completely positive or a completely negative effect, for in these cases the changes of illumination cause very definite results in the moults, physiological color, and sexual condition. Variations in the length of day can therefore cause certain organized results, but these results can take place in a disorganized manner without any variation in daily illumination. The natural change in daily illumination is, therefore, regarded as a factor which has been adopted as a regulatory device to control and time certain basic cycles which must reach certain stages at definite times of year in order to be of any effective aid to the survival of the race of animals as a whole.

Such timing or regulatory systems are often found in the animal body. For example, it is known that the denervated heart will maintain a moderately constant beat, and that the blood sugar of an animal with no pancreas or pituitary returns to a fairly constant level, yet the system of checks and controls which these regulatory devices provide are of undeniable value. The manner in which an exterior environmental fluctuation became so deeply incorporated in the autogenous organization of the animal itself would be an extremely interesting study.

BIBLIOGRAPHY

ALLANSON, M. and R. DEANESLY
1934. The reaction of anoestrus hedgehogs to experimental conditions. Proc. Roy. Soc. Lon., *B* **116**, pp. 170–185, 4 figs., 4 tables.

ALLEN, E.
1939. Sex and Internal Secretions. Second edition. I-XXXVI, pp. 1–1346. The Williams and Wilkins Co., Baltimore.

ALLEN, J. A.
1894. On the seasonal change of color in the varying hare (Lepus americanus, Erxl.) Bull. Am. Mus. Nat. Hist., **6**, Art. IV, pp. 107–128.

ANTHONY, H. E.
1928. Field book of North American mammals. I-XXV, pp. 1–625, 32 pls. G. P. Putnam's Sons, N. Y.

BARRETT-HAMILTON, G. E. H.
1903. Abstract of a physiological hypothesis to explain the winter whitening of mammals. . . . Proc. Roy. Irish Acad., **24**, Sect. B, pp. 303–314.

BENOIT, J.
1935. Rôle des yeux dans l'action stimulante de la lumière. . . . C. R. Soc. Biol., **118**, pp. 669–671, 1 Fig.
1938. Action de divers éclairements localisés dans la region orbitaire sur la gonadostimulation chez le canard male impubère. . . . C. R. Soc. Biol., **127**, pp. 909–914, 1 Fig.

BISSONNETTE, T. H.
1935A. Relation of hair cycles in ferrets to changes in the anterior hypophysis and to light cycles. Anat. Rec., **63**, pp. 159–167.
1935B. Modifications of mammalian sexual cycles. II. Biol. Bull., **68**, pp. 300–313, one pl.
1936. Modification of mammalian sexual cycles. V. Jour. of Comp. Psychol., **22**, pp. 93–103.
1941. Experimental modification of breeding cycles in goats. Physiol. Zool., **14**, pp. 379–383.

BISSONNETTE, T. H. and A. G. CSECH
1937. Modification of mammalian sexual cycles. VII. (Racoons). Proc. Roy. Soc. Lon., B **122**, pp. 246–254.
1939. Modified sexual photoperiodicity in cottontail rabbits. Biol. Bull., Woods Hole, **77**, pp. 364–367.

BISSONNETTE, T. H. and E. WILSON
1939. Shortening daylight periods between May 15 and September 12 and the pelt cycle of the mink. Science, **89**, pp. 418–419.

BLOCH, B.

1927. Das pigment. Handb. d. haupt-und geschlechtskrankheiten. Bd 1, Teil 1, Berlin. (From Frank, F. 1939).

1929. The problem of pigment formation. (Harvard Lecture) Am. Journ. Med. Sci., **177**, pp. 609–618, 4 Figs.

BOGART, R. and H. L. IBSEN.

1937. The relation of hair and skin pigmentation to colour inheritance, with some notes on guinea-pig hair pigmentation. Journ. of Gen., **35**, pp. 31–59, 4 pls., 48 figs.

BOYD, E.

1932. Pigmentary system and the dopa reaction. Proc. Roy. Soc. Edinburgh, **52**, pp. 218–235, 4 pls.

COLE, H. H., R. I. PENCHARTZ and H. GOSS

1940. On the biological properties of highly purified gonadotropin from pregnant mare serum. Endocrinology, **27**, pp. 548–553, 8 figs.

CONNER, C. L.

1928. Studies on lipochromes. IV. The nature of pigments in certain organs. Am. Jour. Path., **4**, pp. 235–244.

COWDRY, E. V.

1932. Special cytology. II Ed., Vol. 1, I-XXIII, pp. 1–552, 757 illust. Paul B. Hoeber Inc., N. Y.

GRIDDLE, S.

1938. A study of the snow shoe rabbit. Can. Field Nat., **52**, pp. 31–40.

DAKIN, H. D.

1922. Oxidations and reductions in the animal body. II ed., pp. 1–176. Longman Green & Co., London, New York, Toronto, Bombay, Calcutta and Madra.

DEJUSTE, M. L. H.

1927. Pigments mélanique et ferments de la peau humaine. Bull. Soc. de Chim. Biol., **9**, pp. 1165–1232.

EDWARDS, E. A. and S. Q. DUNTLEY

1939. The pigments and color of living human skin. Am. Journ. Anat., **65**, pp. 1–34, 31 figs.

FIGGE, F. H. J.

1938. Inhibition of tyrosinase melanin formation by sodium benzenone-indophenol. Proc. Soc. Exp. Biol. & Med., **39**, pp. 569–571.

1939. Melanin: A natural reversible oxidation reduction system and indicator. Proc. Soc. Exp. Biol. & Med., **41**, pp. 127.

1940. Pigment metabolic studies. The regulation of tyrosinase melanin formation by oxidation reduction systems. Journ. Cell & Comp. Physiol., **15**, pp. 233–244, 4 figs.

1941. The effect of glutathione on tyrosinase and the significance of the dopa reaction. Proc. Soc. Exp. Biol. & Med., **46**, pp. 269–272.

Fox, D. L.
1936. Structural and chemical aspects of animal coloration. Am. Nat., **70**, pp. 477–493, 1 fig.

Frank, F.
1939. Die Färbung der Vogelfeder durch Pigment und Struktur. Journ. f. Ornith., **87**, pp. 426–523, 24 figs., 8 pls.

Görnitz, K.
1923. Versuch einer Klassifikation der häufigsten Federfärbungen. Journ. f. Ornith., **71**, pp. 127–131.

Gortner, R. A.
1910. Spiegler's "white melanin" as related to dominant or recessive white. Amer. Nat., **44**, pp. 497–502.
1911. On Melanin. Biochem. Bull., I, 1–4, pp. 207–215.

Grange, W. B.
1932. The pelages and color changes of the snow-shoe hare Lepus americanus phaeonotus, Allen. Journ. Mamm., **13**, pp. 99–116, pl. 6–8.

Grollman, A.
1936. The adrenals. i-xii, pp. 1–409, 17 illus., Williams and Wilkins Co., Baltimore.

Gunn, C. K.
1932. Color and primeness in variable mammals. Am. Nat., **66**, pp. 546–559.

György, P. and C. E. Poling
1940. Pantothenic acid and nutritional achromotrichia in rats. Science, **92**, pp. 202–203.

Hadwen, S.
1929. Color changes in Lepus americanus and other animals. Can. Journ. Research, **1**, pp. 189–200, 4 pls., 36 figs.
1934. Color changes in snowshoe hares. Can. Journ. Research, **10**, pp. 539–556, 5 pls., 46 figs.

Hill M. and A. S. Parkes
1934. Effect of absence of light on the breeding season of the ferret. Proc. Roy. Soc. Lon., *B*, **115**, pp. 14–17, 1 pl.

Jacobsen, V. C.
1934. Melanin. II. A Review of the chemical aspects of the melanin problem. Arch. Path., **17**, pp. 391–403.

JEFFERSON, J. M.
1940. A study of the subcortical connexions of the optic tract system of the ferret, with special reference to gonadal activation by retinal stimulation. Journ. Anat., **75**, pp. 106–134, 2 pls. 4 text figs.

JOHNSON, G. E. and E. L. GANN
1933. Light in relation to the sexual cycle and hibernation in the thirteen-lined ground squirrel. Anat. Rec., **57**, abstr. pp. 28.

JORES, A.
1933. Untersuchen über das Melanophorenhormon und seinen Nachweis im Menschlichen Blut. Zeitsch. f. d. ges. exper. Med., **87**, pp. 266–282.

KLEINHOLZ, L. H.
1938. Studies in Reptilian colour changes II. . . . Journ. Exp. Biol., **15**, pp, 474–491, 4 pls. 3 text figs.

KOLLER, P.
1930. On pigment production in the D-black rabbit. Journ. of Gen., **22**, pp. 103–07.

LAIDLOW, G. F.
1932. (A) Melanoma Studies. I. The dopa reaction in general pathology. Am. Journ. Path., **8**, pp. 477–490, 5 pls., 13 figs.
1932. (B) The dopa reaction in normal histology. Anat. Rec., **53**, pp. 399–413 3 pls.

LAIDLOW, G. F. and S. N. BLACKBERG
1932. Melanoma Studies. II. A simple technique for the dopa reaction. Am. Journ. Path., **8**, pp. 491–498.

LEE, A. B.
1937. The microtomist's vade-mecum. pp. 1–748, 11 illus., P. Blakiston's Son and Co. Inc., Phila. Pa.

LE GROS CLARK, W. E., T. MCKEOWN and S. ZUCKERMAN
1939. Visual pathways concerned in gonadal stimulation in ferrets. Proc. Roy. Soc. Lon., *B* **126**, pp. 449–69, 6 figs.

LEVINSON, L.
1940. Diurnal variation of intermedin in the blood of the albino rat. Proc. Nat. Acad. Sci., **26**, pp. 257–258.

LILLIE, F. R. and M. JUHN
1932. The physiology of development of feathers. 1) Growth rate and pattern in the individual feather. Physiol. Zool., **5**, pp. 124–184, 8 pls. 30 figs.

LYMAN, C. P.
1942. Toxic effect of adrenalin on young pigeons. Auk. **59**, pp. 322–325.

MacLulich, D. A.
1937. Fluctuations in the numbers of varying hare. (Lepus americanus). University Toronto Studies, Biol. Series, **43**, pp. 1–136, 18 figs.

Merriam, C. H.
1884. The vertebrates of the Adirondack region of northeastern New York. Trans. Linn. Soc. of N. Y., **2**, pp. 1–214.

Metchnikoff, E.
1901–02. On the process of hair turning white. Proc. Roy. Soc. Lon., **69**, pp. 156.
1906. Recherches sur le blanchissement hivernal des poils et des plumes. Comptes rendus, Académie des Sciences, Paris, **142**, pp. 1024–1028.
1903. Etudes sur la nature humaine. Pp. i-vi, 1–397, 19 figs., Masson & Cie, Paris.

Morgan, A. H.
1939. Field book of animals in winter. Pp. i-xv, 1–527, 283 illus. G. P. Putnam's Sons, New York.

Nelson, E. W.
1909. The rabbits of North America. U. S. Biol. Surv., North American fauna, no. 29, pp. 1–287, 13 pls., Washington, D. C.

Onslow, H.
1915. A contribution to our knowledge of the chemistry of coat color in animals and of dominant and recessive whiteness. Proc. Roy. Soc. Lon., *B* **89**, pp. 36–58.

Orr, R. T.
1940. The rabbits of California. Occ. papers Calif. Acad. Sci. no. XIX, pp. 1–227, 10 pls.

Peck, S. M.
1931. The melanotic pigment in the skin, hair and eye of the grey rabbit. Its embryological development and the question of the mesodermal origin of epidermal melanoblasts. Arch. Dermatol. and Syphilol., **23**, pp. 705–729, 14 figs., 4 colored.

Pennant, Thomas
1784. Arctic Zoology, Vol. 1, Cl. 1, Quadrupeds. Pp. i-cc, 1–185, 8 pls., Henry Hughs, London.

Percival, G. H. and C. P. Stewart
1930. Melanogenesis: a review. Edinburgh. Med. Journal, **37**, pp. 497-523, 3 pls., 12 figs.

Perry, J. C.
1941. The antagonistic action of adrenalin on the reproductive cycle of the English Sparrow, Passer domesticus (Linnaeus). Anat. Rec., **79**, pp. 57–72, 3 pls., 25 figs.

POULTON, E. B.

1890. The colours of animals and their meaning. Second Ed., pp. 1–360, 66 figs. Kegan, Paul, Trench, Trüber and Co. London.

PRZIBRAM, H., J. DEMBOWSKY and L. BRECKER

1921. Einwirkung der tyrosinase auf dopa. Arch. Entwmchk., **48**, pp. 140–165.

RAPER, H. S.

1926. The tyrosinase-tyrosine reaction. V. Production of L–3–4 dioxyphenylalanine from tyrosine. Biochem. Journ., **20**, pp. 735–42.

RENSCH, B.

1925. Recent investigations in the colours of birds' feathers. The Ibis, **12**, pp. 856–868, 5 text figs.

RICHARDSON, JOHN

1829. Fauna Boreali-Americana, pt. 1. The Quadrupeds., pp. I-XLVI, 1–300, 24 pls. John Murray, London.

RIS, HANS

1941. An experimental study on the origin of melanophores in birds. Physiol. Zool., **14**, pp. 1–48, 4 figs.

ROWAN, W.

1925. Relation of light to bird migration and developmental changes. Nature, **115**, pp. 494–495.

1938. Light and seasonal reproduction in animals. Biol. Reviews, **13** pp. 374–402.

SACCARDI, P.

1922. Melanine aus Pyrrolderivaten. Biochem. Ztschr., **132**, pp. 443–456.

SALMONSEN, F.

1939. Moults and sequences of plumages in the rock ptarmigan (Lagopus mutus — [Montin]). Pp. 1–491, 57 figs., 7 diagrams. P. Haase and Son, Copenhagen. Reprinted from Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening. Vol. 103.

SETON, E. T.

1909. Life histories of northern animals. Vol. I, pp. I-XXX, 1–673, 45, pls., 182 figs. Chas. Scribner's Sons, N. Y.

SPIEGLER

1904. Hofmeisters Beitrage zur chem. Physiol. u. Pathol., Vol. 4, pp. 40. (Taken from Onslow, 1915.)

TROUESSART, M. E.

1906. Sur la décoloration hivernale du pelage des mammifères. C. R. des Séances et Memoires de la Soc. de Biologie, T. **1**, p. 271.

WELCH, F. H.

1869. Observations on Lepus americanus . . . Proc. Zool. Soc. Lon. for 1869, pp. 228–236.

WELLS, H. GIDEON

1925. Chemical pathology. 5th Ed., W. B. Saunders Co. Philadelphia.

WHITAKER, W. L.

1940. Some effects of artificial illumination on reproduction in the white footed-mouse, Peromyscus leucopus noveboracensis. Journ. Exp. Zool., **83**, pp. 33–60, 4 figs.

WITSCHI, E.

1936. Effect of gonadotrpoic and oestrogenic hormones on regenerating feathers of weaver finches (Pyromelana franciscana). Soc. Exp. Biol. & Med., **35**, pp. 484–489, 4 figs.

WRIGHT, P. L.

1940. Experimental studies of the process of moulting and reproduction in the weasel. Ph.D. Thesis. Graduate School, Univ. of Wisconsin.

ZALASKY, M.

1934. A study of the seasonal changes in the adrenal gland of the thirteen-lined ground squirrel (Citellus tridecemlineatus) with particular reference to its sexual cycle. Anat. Rec., **60**, pp. 291–321, 2 pls.

1935. A study of the seasonal changes in the thyroid gland of the thirteen-lined ground squirrel (Citellus tridecemlineatus) with particular reference to its sexual cycle. Anat. Rec., **62**, pp. 109–137, 1 pl.

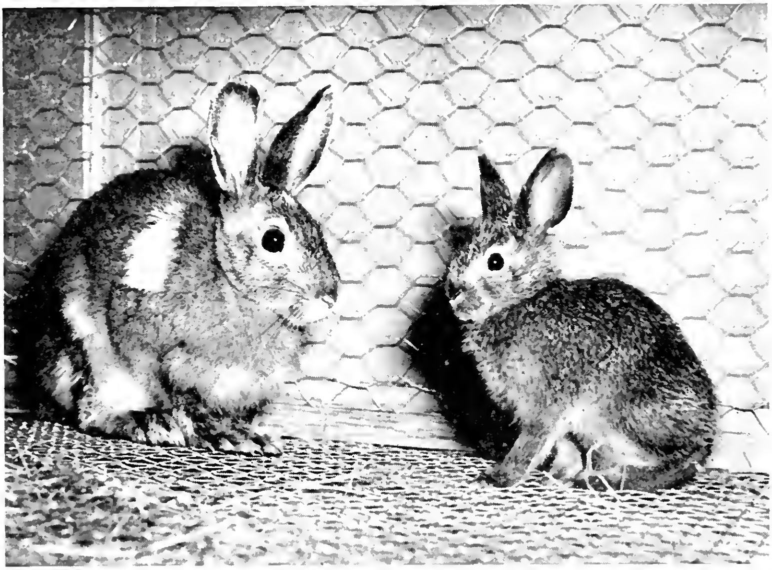
PLATES

PLATE 1

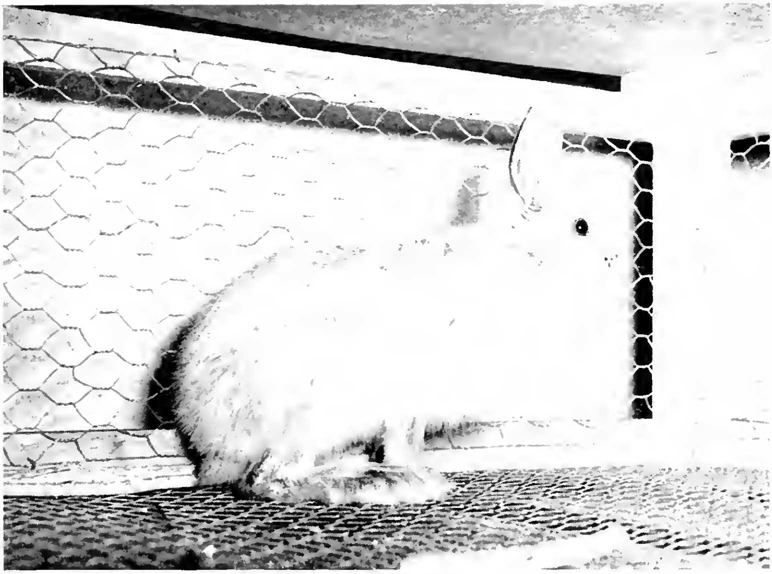
PLATE 1

Fig. 1. Adult and young in summer pelage. The white patch on the shoulder of the adult is not typical.

Fig. 2. Adult in winter pelage.



1



2

PLATE **2**

PLATE 2

Fig. 3. Longitudinal section. Inactive winter skin. 100X.
G = winter guard hair
F = Base of fur or pile hair

Fig. 4. Cross-section. Inactive winter skin. 100X.
B = fur and pile hair "bunch"
G = winter guard hair
F = Base of fur or pile hair

Fig. 5. Longitudinal section. Start of spring moult. 120X.
A = Bud of new summer hair
G = old, loosened winter guard hair

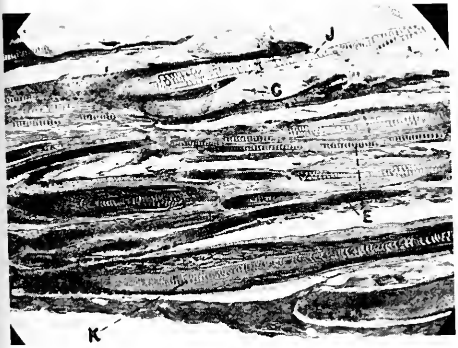
Fig. 6. Longitudinal section. Final fall moult. 100X.
C = inactive, anchored, colored guard hair
J = part of new, growing, white guard hair
E = growing fur hairs
K = growing guard hairs

Fig. 7. Longitudinal section. Preliminary fall moult near completion. 100X.
C = colored guard hair about to become inactive
E = growing fur hairs
H = site of shed summer guard hair

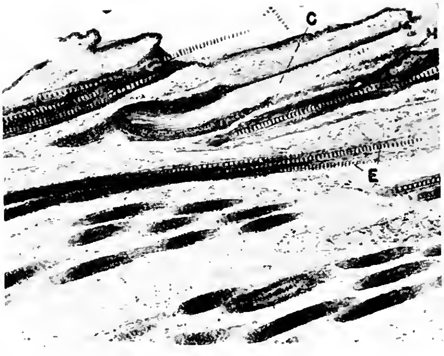
3

4

5



6



7

PLATE 3

PLATE 3

Fig. 8. Longitudinal section. Bulb of the follicle of a small black guard hair and section of the hair further up the shaft. 320X.

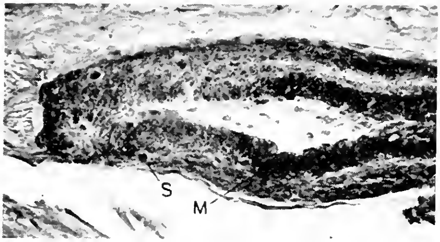
M = melanoblasts
S = mitotic figure
M_1 = massed melanin granules capping the nucleus of the melanoblast.
N = location of the nucleus of a melanoblast

Fig. 9. Split section from the brown portion of a summer guard hair. 320X. Note absence of massed pigment granules.

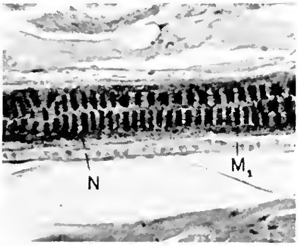
Fig. 10. Split section from the black portion of a summer guard hair. 320X. Note massed pigment granules.

Fig. 11. Split section from the black portion of a summer guard hair. Bleached with hydrogen peroxide. 320X.

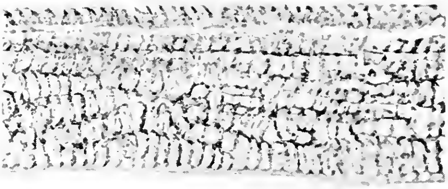
Note similarity with Figure 9. Both appear yellow under the microscope.



8



8



9

10

11

PLATE 4

PLATE 4

Fig. 12. Untreated follicle forming brown portion of summer guard hair. 140X.

Note absence of formed melanin.
BF = brown follicle

Fig. 13. Follicles forming brown portion of summer hair, treated with dopa. 140X.

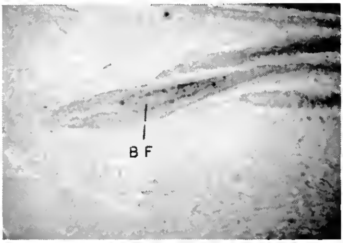
D = dopa positive guard hair bulb.
Note absence of formed melanin further up the shaft.

Fig. 14. Follicle forming white winter guard hair, treated with dopa. 140X.
W = dopa negative white hair
The pigmented follicles in the upper right corner are fur-hair follicles.

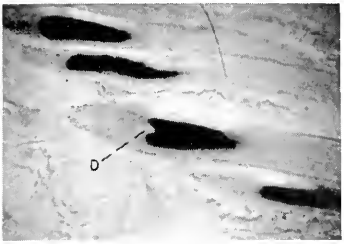
Fig. 15. Follicle forming white winter guard hair, treated with dopa. 140X.
M = single dopa positive melanoblast

Fig. 16. Hare with winter pelage stopped before completion by increased daily illumination. Animal remained in this pelage until its death in May.

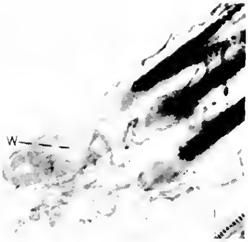
Fig. 17. Hare with induced winter pelage, white coat fully grown in July. Brown spots on shoulder and hip are replacement hair. Picture taken in September.



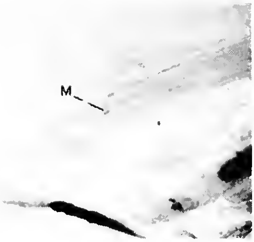
12



13



14



15

16

17

PLATE 5

PLATE 5

Fig. 18. Diagrammatic chart of the time of the moults and physiological color change in the normal hare.

Heavy black line = time of moults
Stipple = brown condition of physiological color
White = white condition of physiological color

Fig. 19. Normal sexual cycle.

Left ordinate = Area of tracing of testes in sq. cm.
Right ordinate = Hours between sunrise and sunset, Boston, Mass.

○ = testes measurement of one animal
◎ = testes measurement of two animals
R = testes completely regressed
☆ = oestrus in female
✡ = oestrus in two females
⚲ = series of measurements of individual male
╱ = hours between sunrise and sunset

FIG. 18

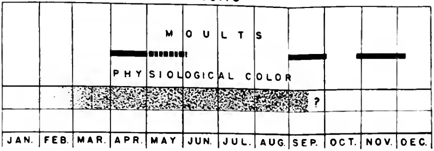

MOULTS
PHYSIOLOGICAL COLOR
?
JAN.
FEB.
MAR.
APR.
MAY
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.

FIG 19

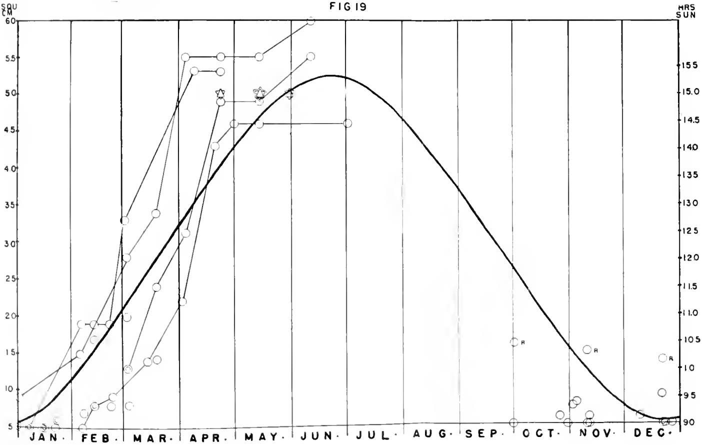

SQU CM
60
55
50
45
40
35
30
25
20
15
10
5
HRS SUN
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10
9.5
9.0
R
R
R
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.

PLATE 6

PLATE 6

Fig. 20. Effect of increased daily illumination on sexual cycle in the autumn. Lowest left hand circle = date male was exposed to increased illumination

intermediate data lacking

● animal moved to nine hour light room

Other symbols same as figures above.

FIG. 20

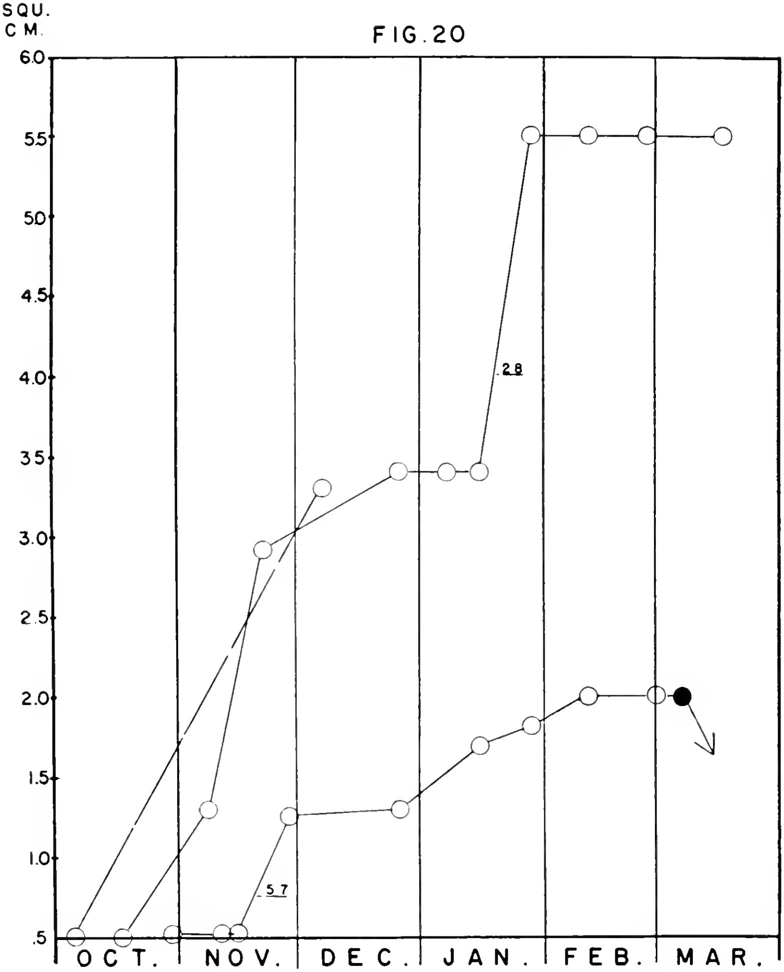

SQU. CM.
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
2.8
5.7
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.

PLATE 7

PLATE 7

Fig. 21. Effect of exposing animals to eighteen hours of illumination in January.

△ = Female exposed to eighteen hours of illumination, anoestrus
Other symbols same as figures above.

Fig. 22. Effect of moving animals from nine hour light room to eighteen hour light room and vice versa.

Symbols same as above.

FIG. 21

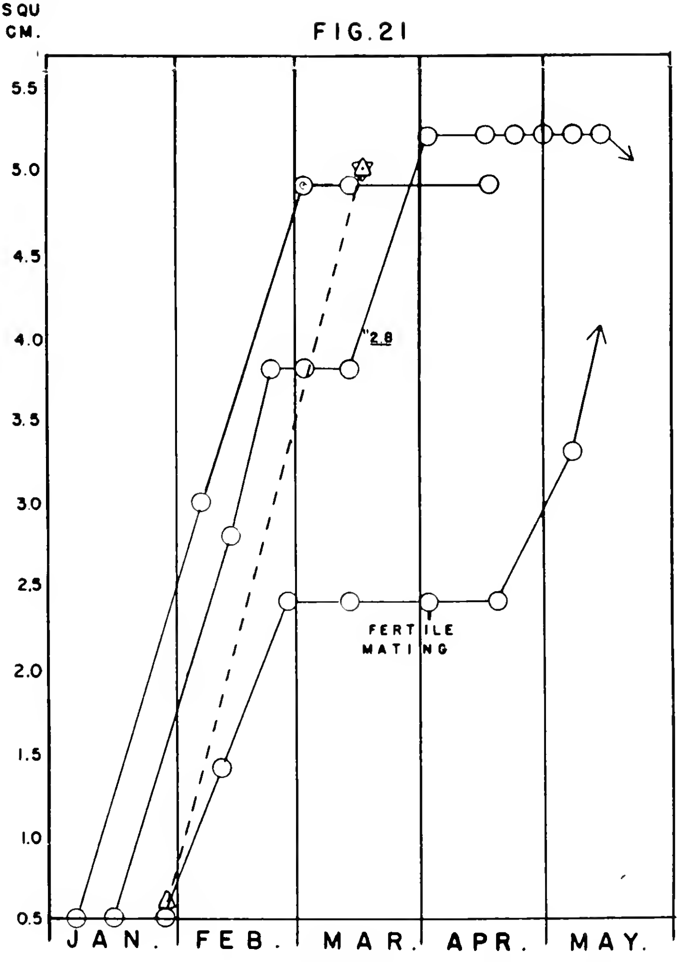

SQU CM.
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
2.8
FERTILE MATING
JAN.
FEB.
MAR.
APR.
MAY.

FIG 22

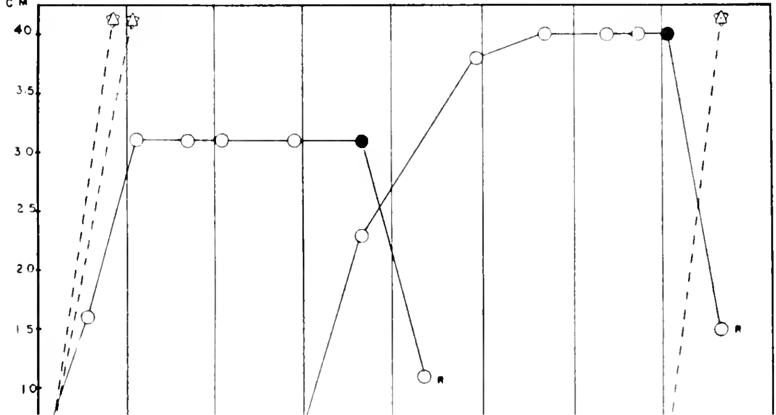

SQU CM
4.0
3.5
3.0
2.5
2.0
1.5
1.0
R
R

PLATE 8

PLATE 8

Fig. 23. Effect of moving animals into nine hour light room on or before January fourteenth.

Lowest left hand circle = date male was moved from natural illumination into nine hour light room.

Other symbols same as figures above.

Masked animals in Figures 23 and 24 were in the eighteen hour light room, but received only nine hours daily illumination via the eyes.

Fig. 24. Effect of moving animals into nine hour light room in late February or in March.

Symbols as in Figure 23.

FIG 23

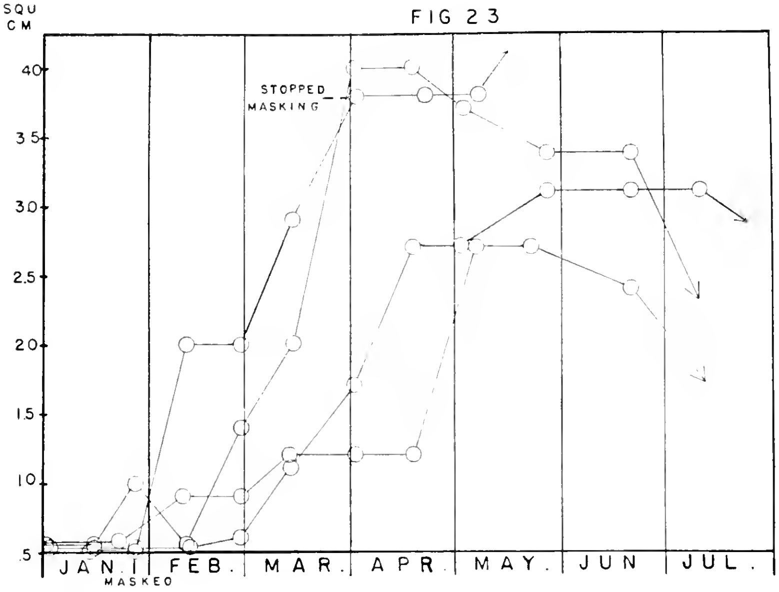

SQU
CM
40
3.5
3.0
2.5
2.0
1.5
1.0
.5
STOPPED MASKING
JAN. FEB. MAR. APR. MAY. JUN JUL.
MASKED

FIG. 24

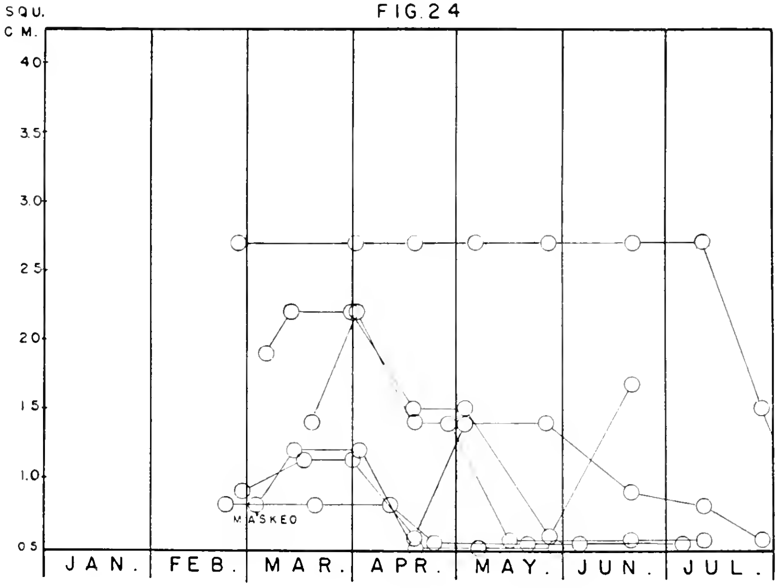

SQU.
CM.
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
MASKED
JAN. FEB. MAR. APR. MAY. JUN. JUL.

PLATE 9

PLATE 9

Fig. 25. Single twenty-four hour record of activity of animal in nine hour light room.

Fig. 26. Two superimposed twenty-four hour records of activity of animal in eighteen hour light room.

FIG 25

FIG 26

PLATE 10

PLATE 10

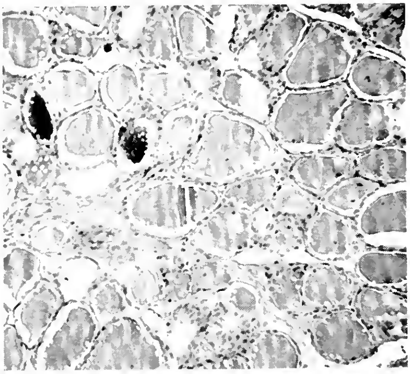
Fig. 27. Thyroid of animal with final autumn moult completely stopped by twenty-four days of eighteen hours illumination. Tissue fixed November 19, 1940. 140X.

Fig. 28. Thyroid of animal just starting typical final autumn moult. Tissue fixed October 26, 1940. 140X. Both animals were exposed to normal outdoor temperatures.

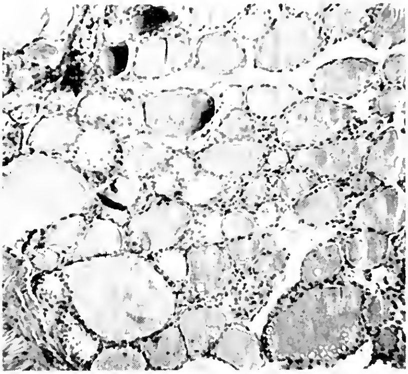
Fig. 29. Animal exposed to eighteen hours of daily illumination from January 29. Picture taken March 7. Note patch of white replacement hair remaining on shoulder.

Fig. 30. Animal exposed to eighteen hours of daily illumination from January 29, but masked so that only nine hours of daily illumination reached the eyes. Picture taken March 7.

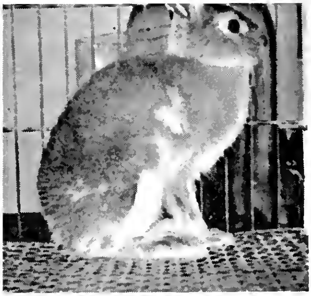
Fig. 31. Animal injected with pituitary extract starting January 14. Picture taken March 2. Control of this animal is shown in Figure 2.



27

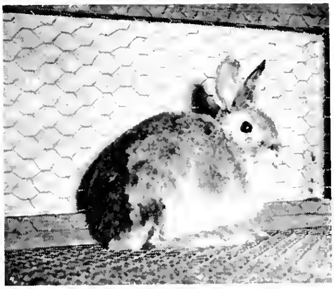


28



29

30



31

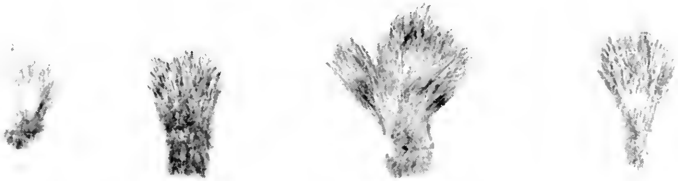
PLATE 11

PLATE 11

Fig. 32. Patches of replacement hair from animals injected beginning January 14.

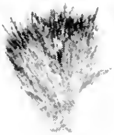
FIG. 32

PITUITARY EXTRACT



PREGNANT MARE SERUM

CONTROLS



NORMAL BROWN

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
Vol. XCIII, No. 4

STAHLECKERIA LENZII, A GIANT TRIASSIC BRAZILIAN DICYNODONT

By Alfred S. Romer and Llewellyn I. Price

CAMBRIDGE, MASS. U. S. A.
PRINTED FOR THE MUSEUM
March, 1944

No. 4.—*Stahleckeria lenzii, a giant Triassic Brazilian Dicynodont*

By Alfred S. Romer and Llewellyn I. Price

The Harvard collection of Triassic reptiles from southern Brazil contrasts strongly with that of von Huene (1935) in the nature of the contained dicynodont material. His finds from Chiniqua included only a small amount of dicynodont remains of which the greater part belonged to the giant form *Stahleckeria potens.* Our materials from a similar faunal horizon at Candelaria include a great variety of complete and partial skeletons of more modest size. Of remains of large animals, we have but a partial skeleton, which is described below. While comparable with *S. potens* in size and certain general characteristics, our specimen, as will be seen, differs in a number of features suggesting that it is specifically if not generically distinct, and it is therefore described below as *Stahleckeria lenzii,* sp. nov. The specimen (M. C. Z. no. 1688) comes from the Municipio de Candelaria, State of Rio Grande do Sul, Brazil, and from an Upper Triassic formation.

SKULL

Of the skull, the portion preserved (Figs. 1–4) is essentially the right posterior quadrant, relatively little crushed and for the most part well preserved and showing good surface detail in many areas. Anteriorly the zygomatic arch is broken off across the squamosal-jugal suture. Medially the anterior termination is roughly through the pituitary region; dorsally however, the broken surface slants backward so that the "sagittal crest" is incomplete. Medially the portion preserved extends well beyond the mid-line for much of the height of the braincase. In occipital view may be seen the occipital plate, well preserved on the right side and complete except for a small portion of the supraoccipital. Presumably the normal elements—basi-, ex- and supraoccipitals and opisthotic—are present, but sutures are not discernible. The plate is relatively much narrower than that of *S. potens* figured by von Huene. The foramen magnum as preserved is quite narrow, but this is probably due to transverse compression. Below this opening is the condyle, gently convex, with a notochordal depression, subcircular in outline but with dorso-lateral expansions in the presumed exoccipital areas. The dorsal portions of the exoccipitals are poorly preserved. The vagus foramen is present, continued latero-ventrally by a well marked groove, but data on the hypoglossal is lacking. Just anterior to the condyle are the heavy and pronounced ventral tubera, characteristic of dicynodonts, which descend to surround the median and posterior borders of the fenestra ovalis. Certainly these processes are formed in great measure by the basioccipital; von Huene indicates a suture which suggests that they are entirely formed by that element.

The paroccipital process, presumably formed on its posterior aspect by the opisthotic is short but very broad distally and much thickened ventrally. The ventral portion of the distal end abuts against a broad medially directed flange of the squamosal. The ventro-lateral corner of the process approaches the quadrate closely just above the inner portion of the articular surface of that bone and at the same point is close to the distal end of the stapes. The thinner upper portion of the paroccipital process is applied to the posterior surface of the squamosal. At the upper end of the paroccipital process there is a small notch in the lateral border of the occipital plate which forms the medial margin of the posterior opening of the posttemporal fenestra. This opening lies at the bottom of a deep triangular pocket. The outer margin of this pocket is formed by a vertical flange on the squamosal, the upper wall by a strong ridge on the conjoined supraoccipital and squamosal, while the paroccipital forms the more gently sloping medial boundary.

Von Huene's figure indicates a somewhat different build of the paroccipital region in *S. potens* (See our Fig. 6). The thicker portion of the distal end shows in our specimen an incipient subdivision into two portions. In von Huene's figured specimen there appears to be a sharp subdivision of these two areas, with the upper subdivision flaring widely backward at its distal end. The thin upper portion appears not to extend so far laterally below the posttemporal fenestra in his figured specimen as in ours.

The supraoccipital extends far dorsally and laterally as a relatively thin sheet of bone which gains contact at its outer margins with the adjacent dermal elements. The more lateral portion is ensheathed by the squamosal, which covers the posterior (as well as the anterior) surface of the bone, a feature not shown in von Huene's illustrated specimen. A pronounced ridge runs from the exoccipital region outward and upward above the posttemporal fenestra; this ridge is continued outward by the ensheathing portion of the squamosal. Dorsally the supraoccipital is in contact with the interparietal. The dorsal margin is imperfect and details are uncertain, although presumably of normal dicynodont type.

An anterior view of the temporal region (Fig. 1) shows the considerable extent to which the lateral portion of the occipital and otic regions are overlapped anteriorly by the squamosal. Above the posttemporal fenestra the squamosal appears to be closely attached to the braincase, although an irregular sutural line marks the most anteromedial extension of that bone. The squamosal curves away from the surface of the braincase for a short distance to form the lateral wall of the anterior opening of the posttemporal fenestra. Below the fenestra the squamosal extends downward to sheath completely the anterior face of the distal end of the paroccipital process. The con-

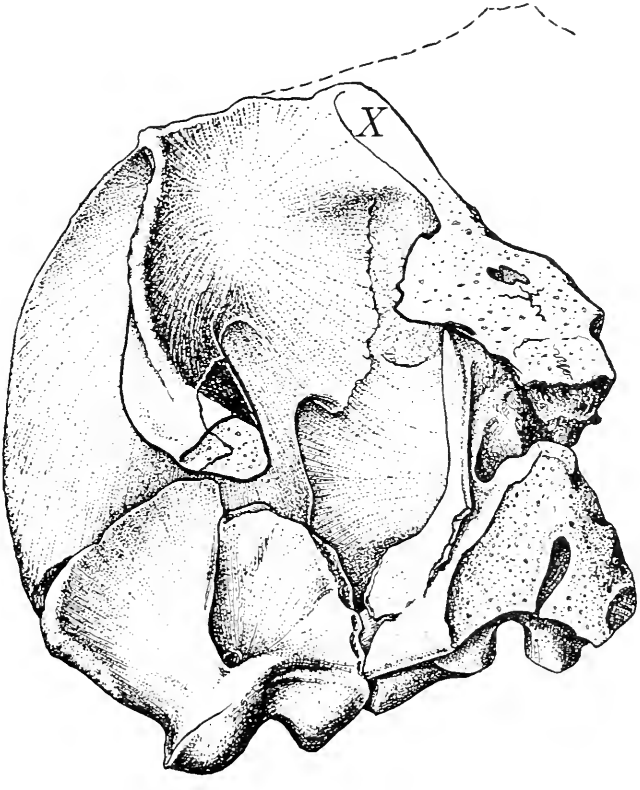


Fig. 1. *Stahleckeria lenzii*, anterior view of right temporal region. x 1/4.

nection here, however, was obviously less firm, and the paroccipital appears to have had some slight amount of "play" on the squamosal.

As regards the composition of the lateral or anterior aspect of the otic region, it seems reasonable to assume that the lower and middle portions are formed, in normal fashion, by the proötic. On this aspect, rather far ventrally (and concealed in the figures by the lower end of the epipterygoid) is a foramen, presumably for the facial nerve, leading into a backwardly directed groove. Up to a point well above the supratemporal the region is well ossified, the surface a smooth perichondral layer. Above this point, in an area bounded posteriorly by the squamosal and dorsally by the parietal, the braincase wall is filled out by a loose spongy ossification, obviously laid down in cartilage. This area is an open one in primitive synapsids; here, as in other progressive therapsids, there has occurred a new growth of otic cartilage, followed by a feeble ossification. Whether this ossification proceeds from the proötic center or that of the supraoccipital cannot be determined here. In this feebly ossified area there is some indication of a foramen, presumably venous, near the ventro-lateral corner and continuous with a broad groove on the proötic leading downward and outward toward the posttemporal fenestra. Anteriorly there is some indication of an anterior termination of this feeble ossification in the region of the presumed incisure for the trigeminal nerve, medial to the ascending ramus of the epipterygoid.

Our interpretation of this lateral aspect of the otic region differs in a few regards from that of von Huene for *S. potens* (his Fig. 4). He indicates a definite suture between pro- and opisthotic which we have failed to find, and includes the problematical spongy region seen in our skull in the opisthotic area. On the ventral surface of the braincase the basioccipital continues forward in a deep groove between the tubera for the fenestrae ovales to a distinct suture with an element which appears to be dermal in nature and interpretable as the parasphenoid.

The fenestra ovalis is, as typically in the group, at the end of a prominent ventrally directed bony funnel, and opens almost directly downward. The fenestra, as preserved, is oval in shape, with the long axis antero-posterior. As noted above, the medial and posterior margins are formed by a very thick wall of bone of crescentic outline, formed in part, if not entirely, by the basioccipital. The lateral margin is formed by a much thinner ventral extension from the otic region, but whether opisthotic or proötic cannot be said. The anterior surface of the otic region slopes smoothly down and back toward this rim, but in addition there is a short diagonal ridge connecting the rim with the ventral edge of the base of the paroccipital process. The anterior margins of the fenestrae are closed by the parasphenoid which forms "tubera basisphenoidales" closely comparable with those of more primitive reptiles. The exposed (posterior) portion of the parasphenoid is triangular in outline ventrally, with a broad posterior base including the tubera and the intervening valley, and a convergence anteriorly to a point where the bone disappears between the pterygoids.

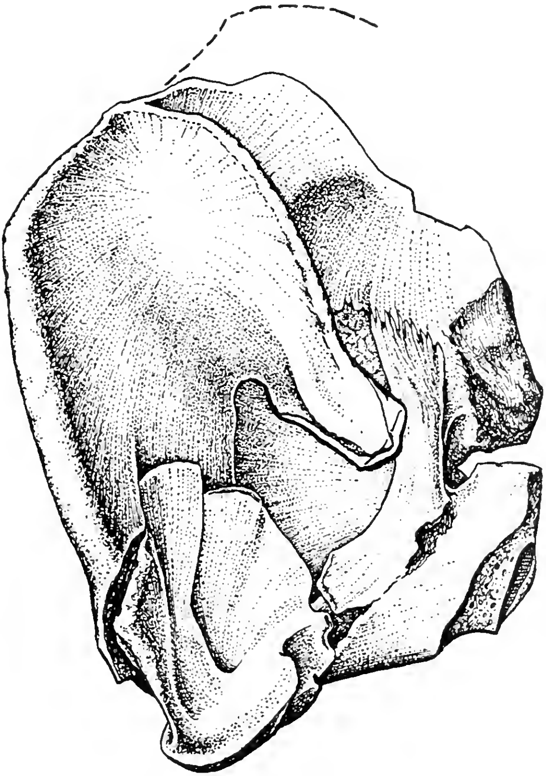


Fig. 2. As Figure 1, lateral view, x 1/4.

The preserved portion of the braincase terminates anteriorly at an irregular fracture through the general level of the pituitary. Little can be definitely determined concerning the structure here. An unossified incisure obviously indicates the position of the sella turcica. Ventral to this the basisphenoid presumably is included centrally in a mass of bone of which the pterygoids contribute the lateral portions. Dorsal to the incisure is a thick mass of spongy bone which probably includes a posterior extension of the "ethmoid" although presumably for the most part composed of descending processes of the parietals.

Since our skull is incomplete dorsally in the mid-line, the parietal region cannot be fully described. The contours in the otic region suggest strongly that there was a relatively narrow "sagittal crest" between the temporal fossae rather than the relatively broad parietal region seen in *S. potens.*

The broad mass of bone lying above the epipterygoid region appears to pertain, in great measure at least, to the parietals. It is perforated by the "shaft" descending from the pineal opening and there is evidence of a median suture. The bone is, however, quite spongy in texture, suggesting that the parietal has not simply sent down a dermal flange but has invaded the more dorsal portion of the chondrocranium. Curving around the anterior side of the pineal "shaft" is a more or less distinct crescentic area of bone which may possibly represent a deep portion of a preparietal. The most anterior part of this same mass of bone is more difficult of interpretation. It consists of paired areas of spongy bone which most probably represent posterior lateral extensions from the "ethmoid".

The ventral boundary of the parietal can be traced for some distance along the upper margin of the lateral surface of the braincase. This boundary extends from a contact with the upper end of the epipterygoid backward and upward around the poorly ossified area of the otic region discussed earlier. The exact extent of the postero-lateral development of the parietal along the "occipital crest" is somewhat uncertain. On the anterior surface of this region the parietal tapers out to a point above an antero-medial projection of the squamosal and below a mass of bone of uncertain nature, discussed below. The posterior face of this postero-lateral extension of the parietal is applied closely to the anterior surface of the supraoccipital.

Due to lack of preservation along the mid-line dorsally, only the lateral termination of the interparietal is preserved. This is a thin sheet of bone overlapping the most medial and dorsal corner of the squamosal and in contact below with the supraoccipital. The contours of this region suggest that the interparietal took part in the formation of a median crest, as is the case in many other dicynodonts. Von

Huene, however, figures the interparietal in *S. potens* as occupying a markedly depressed median area, above a depressed and grooved central portion of the supraoccipital. This depression is, however, highly comparable to that which in other forms in our collections receives the interparietal, an element which tends to be fairly readily separable from the occipital plate. It is perhaps possible that von Huene's figured specimen has lost the interparietal, and that the outlines given by him for this bone are in reality the impressions of its margins left upon the underlying elements.

A tabular is frequently recorded in dicynodonts and von Huene has indicated one in *S. potens*. A careful examination of the appropriate area, very well preserved in our specimen, fails to reveal any indication of its presence, or former presence.

The squamosal is of the large and characteristic dicynodont type, essentially triradiate in structure, with zygomatic, quadrate, and median rami; the convergent, ridged, upper or external surfaces of all three rami are highly rugose. Much of the structure of the median ramus has been noted in the description of the braincase. It consists for the most part of a vertical plate of bone applied to the anterior surface of the occipital plate. Dorsally this plate reaches forward around the upper border of the otic region below the lateral tip of the parietal. Above this region, close to the summit of the "occipital crest", is an area of bone of uncertain nature (marked "X" on Fig. 1), the surface of which is eroded. One possible interpretation is that it is a dorsal terminal prong of the squamosal with the tip of the parietal wedged between it and the main body of the bone. But a fracture across this region appears to show a definite separation between this region and the squamosal. This problematical area is applied to the anterior surface of the interparietal. but apparently a suture is present between them. Several alternative interpretations are still more unsatisfactory.

On its posterior aspect the medial ramus of the squamosal has ventrally a pronounced excavation into which is received the thickened distal end of the paroccipital process. More dorsally, the supraoccipital is ensheathed posteriorly, as well as anteriorly, by the squamosal, which has taken over many of the functions of the pelycosaur tabular. From the paroccipital buttress a pronounced ridge runs upward on the squamosal and curves medially above with more rounded contours. This ridge cannot have been developed for purely skeletal functions, and may mark the boundary of the area of insertion of the neck musculature. At the lower end this plate is applied anteriorly to the end of the pterygoid as well as the adjacent region of the quadrate.

The zygomatic ramus of the squamosal tapers rapidly to become triangular in section near the point where the zygoma ends in our specimen at a transverse fracture. The anterior tip of the bone is missing, but there is preserved the most posterior extremity of the jugal.

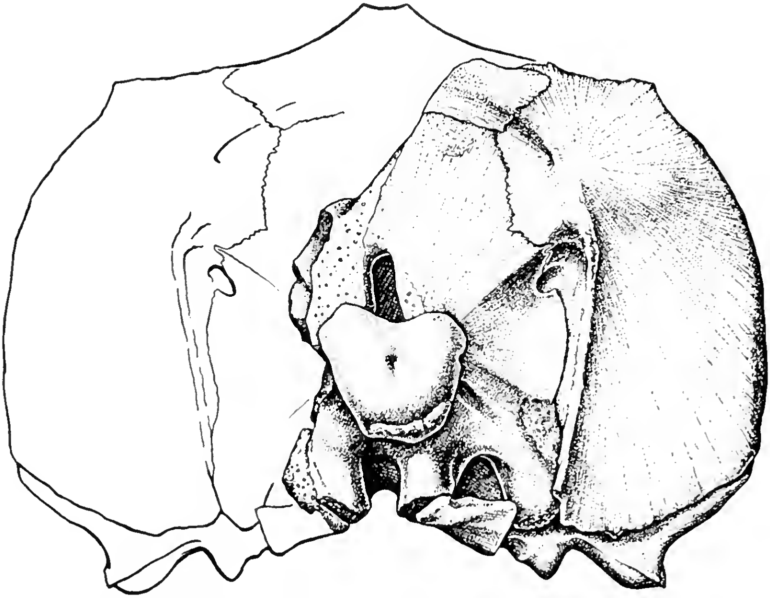


Fig. 3. As Figures 1–2, posterior view of right portion of skull; left side restored in outline. x 1/5.

The quadrate ramus of the squamosal as viewed from the posterior side is a flaring sheet of bone bounded medially by the vertical ridge adjacent to the occipital plate and with a thick and rugose lateral margin. In transverse section, this surface is concave near the medial margin; laterally the bone curves somewhat forward. It has been suggested that the corresponding posterior concave area of the squamosal in cynodonts is a groove for the external auditory meatus, but obviously such an explanation cannot fully account for the broad and high expanse of this region in dicynodonts. The ventral end of the plate becomes thin at its margin, which nearly reaches the articular surface of the quadrate, but does not occlude the quadrate foramen.

On the anterior surface the thick upper portion of this division of the squamosal forms, together with the base of the zygomatic ramus, a deep excavation which leads downward and forward toward the lower jaw. This fossa is suggestively similar to the temporal fossa lying on the opposite side of the zygomatic arch. Although the development of the quadrate ramus of the dicynodont squamosal may be explained functionally as due entirely to the necessity for support of the quadrate in its rotated position, it is not impossible that the fossa formed by its construction contained a specialized superficial division of the adductor musculature, comparable in mode of origin to the mammalian masseter, although radically different in function.

The ventral portion of the anterior surface of this ramus of the squamosal is cut into a distinct step in which is lodged the upper part of the quadratojugal. The smooth surface of the anterior face of the squamosal is continued downward without a break by the quadratojugal, and this bone laterally assists in the ventral prolongation of the lateral ridge on the squamosal. In our specimen, as apparently in von Huene's specimen of *S. potens* and various other described dicynodonts, the quadratojugal is slightly displaced, suggesting that the connection between squamosal and quadratojugal was not a close one; possibly a pad of connective tissue intervened. More medially the anterior face of the squamosal is in contact with the posterior surface of the quadrate. The situation is different here, however, from that concerned with the quadratojugal, for there is no "step" in the squamosal, but on the contrary a slight thickening, the quadrate being set out anteriorly beyond the plane of the squamosal.

The quadratojugal is a large element including a basal portion fused with the quadrate and a fan-shaped dorsal expansion which we have noted to be set into a step in the squamosal. The medial (morphologically posterior) border of the "fan" is apposed to the lateral margin of the quadrate for most of its length. Near the base the two bones separate to permit the formation of the quadrate foramen, which passes diagonally forward and inward between the two bones. No evidence of the suture between the base of the quadratojugal and quadrate described by Sushkin (1927, fig. 30) is visible in the specimen; presumably the quadratojugal terminates in a buttress above the lateral portion of the articular surface. Von Huene figures (1935, pl. 2) a ridge near the base of the bone which is not present in our skull, and a much greater lateral flaring above the neck region of that element.

The quadrate includes the articular region and a low rounded fan of bone extending upward above the medial portion of the articular area. As in synapsids generally the articular area consists of two convex portions. Separated by a diagonal groove, the lateral convexity is larger, but not markedly convex and faces rather medially, while the medial portion is smaller and more convex in section. Much of the "fan", ("otic process") rests, as we have noted, against the squamosal. Antero-ventrally, however, the distal end of the pterygoid is applied to its posterior surface in primitive fashion. The posterior portion only of the pterygoid is preserved. A distinct fissure, the primitive cranio-quadrate passage, is present between pterygoid and braincase. The distal end of the pterygoid ramus is slender and of no great height, but extends back to be clasped between the medio-ventral margin of the quadrate and the lower end of the squamosal. Anteriorly the pterygoids increase in height and thickness and the

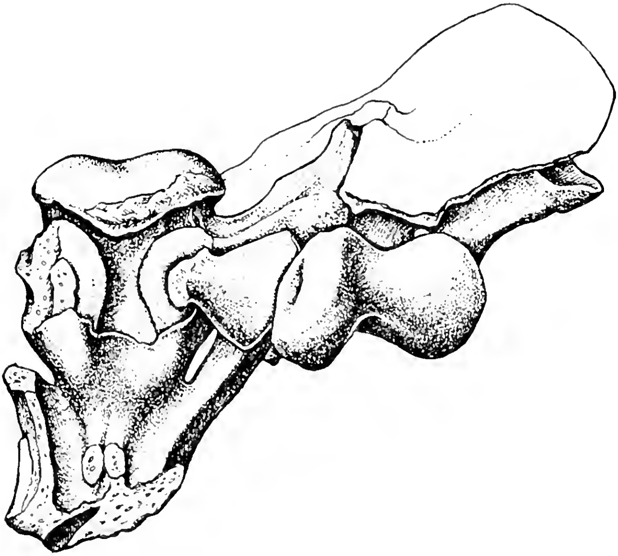


Fig. 4. As Figures 1–3, ventral view of braincase as preserved; right squamosal shown in outline only. x 1/4.

elements of the two sides are obviously applied in therapsid fashion to the sides of the basisphenoid. Ventrally in the pituitary region the two are separated by a cavity which represents the hollow primitively present between the basipterygoid processes. Ventral again to this the two bones are in apposition and appear to send back a pair of short posterior extensions. Details of construction are none too clear here and the more anterior extensions of the pterygoids are missing.

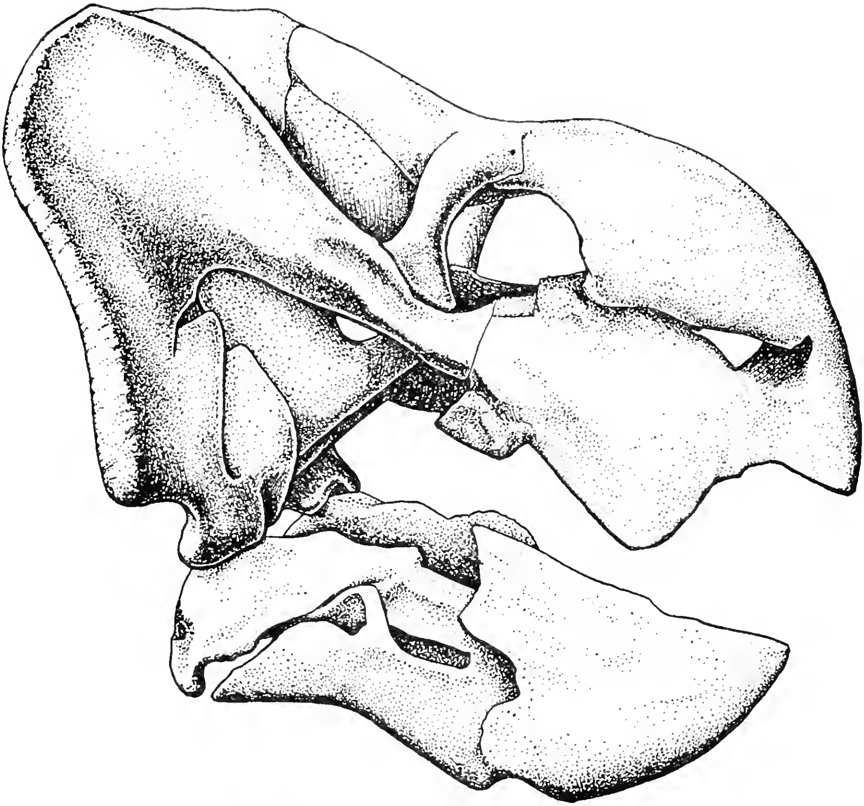


Fig. 5. *Stahleckeria potens*, lateral view of skull. x 1/6 approx. After von Huene.

The ascending process of the epipterygoid is well preserved. It is thin and moderately expanded antero-posteriorly. Dorsally there is a well-defined suture with the parietal; below this point the anterior and posterior margins are free to stand well out from the level of the braincase wall. From the base of the "columella" a well-ossified posterior extension of the epipterygoid runs back above and lateral to the pterygoid in the direction of the quadrate. As preserved, the bone does not quite reach the latter element, but a connection may have been present in life. There appears to have been a considerable extension of the epipterygoid over the lateral surface of the pterygoid below the "columella", but the ossification is feeble. However there is a distinct groove on the lateral surface of the pterygoid for the posterior extension of the foot. Anteriorly the foot is broken off as is frequently the case in dicynodont material. The right stapes is present in natural position in our specimen, as well as a fragment of the left. It is very short but stout. The oval footplate is present nearly in proper position covering the fenestra ovalis. Thence the bone runs laterally and expands distally to abut (as preserved) on to the medial margin of the articular region of the quadrate, to touch dorsally the lower edge of the tip of the paroccipital process, and to lie close behind the distal end of the pterygoid. A groove crosses the dorsal surface just lateral to the footplate; there is no evidence of a foramen.

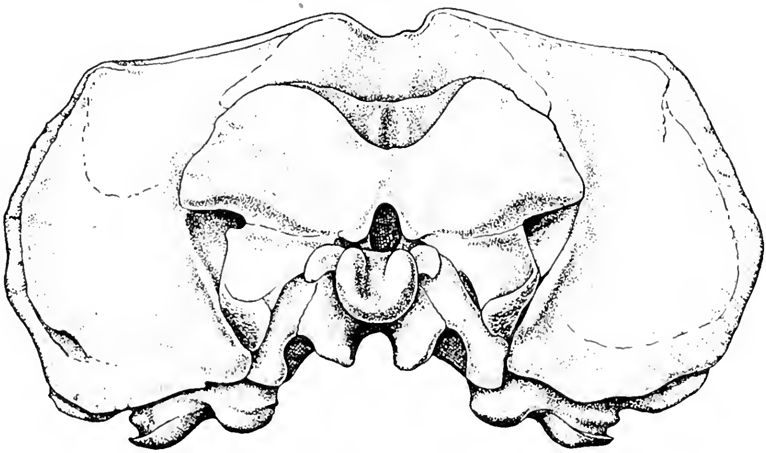


Fig. 6. *Stahleckeria potens*, posterior view of skull. x 1 6 approx. After von Huene.

The partial skull described above is obviously comparable in many regards with the material described by von Huene as pertaining to *S. potens*.[1] We have, however, noted a number of features in which our specimen appears to differ. Many of these are probably to be attributed to varied imperfections in the material in both cases and consequent differences of interpretation. In a few regards, however, differences seem to be more concrete. The complete skull figured by von Huene (his Pls. 2, 3) is definitely much broader than ours. Using the width of the condyle as a basis for comparison, this measurement is contained in the estimated total width only 5½ times in our specimen; 9 times in his skull. Some part of this difference might be attributed to differential crushing, but certainly not all. With this contrast in total proportions are associated differences in the proportions of the component elements of the occiput. In addition, *S. potens* appears to have a relatively broad and flat area between the temporal vacuities. Our specimen appears to have had a more sharply developed "sagittal crest"; however, the evidence for this is indirect and none too positive.

POSTCRANIAL SKELETON

The remains of the postcranial skeleton pertaining to this individual include a single vertebra; a tibia; and much of the left front leg and shoulder, including a nearly complete scapula and the lower end of the humerus in natural articulation with the forearm and foot.

Vertebra (Fig. 7). The single vertebra preserved has a length of centrum of 95 mm., a width of 133 mm. across the posterior face of the centrum and a total height to the tip of the neural spine of approximately 420 mm. These figures compare with maximum measurements given by von Huene of 74 mm., 102 mm. and 300 mm.; our vertebra exceeds any cited by him by one-third. It will be seen that the limb material of our specimen exceeds in size any of the elements in von Huene's collection, but the differences are of a smaller order. It is possible, however, to reconcile this situation by calling to attention the fact that the vertebrae and limb bones measured by him, many of which form part of his mounted skeleton, may have been associated with his skulls nos. 1 and 2. His skull no. 3 is about 20% larger than the others and may well have been carried by a larger column. We may further note that while our vertebra probably comes from the

---

[1] Since von Huene's work is not generally available, we give here modified reproductions of two of his figures (Figs. 5, 6).

same individual as the other material here described, it was not actually articulated.

Rib (Fig. 7). Of the rib system, only a single fragment was preserved. This is the proximal part of a posterior cervical or anterior dorsal of the right side. Distinct capitular and tubercular attachments are present. The capitular facet is essentially circular, with a diameter of about 40 mm.; the tubercular facet is elongate; length of the articular face is 84 mm. and the total breadth of the proximal end of the rib 132 mm.

Scapula (Fig. 8). A nearly complete right scapula is present. The lower margin is somewhat imperfect and eroded. The blade has been subjected to some antero-posterior pressure so that a longitudinal fold, obviously post-mortem, extends along it for some distance. Otherwise the element is well preserved and shows good surface detail in many regions. The specimen is of large size. Despite the fact that it is incomplete ventrally, the length along the convex surface is 555 mm. and the length by direct measurement 505 mm. If the bone were complete, these measurements would have been on the order of 600 and 540 mm. Comparable figures for two complete and presumably adult specimens in von Huene's possession are 600 and 555 mm. for the convex length, 540 and 500 mm. for the direct measurement.

The general proportions agree well with von Huene's figures of his "specimen 2". The acromion is thick, with a rounded massive terminus for clavicular articulation, and is not as distinctly set off from the spine as in his "specimen 1". On the latter von Huene notes a deep groove at the thick upper end of the anterior margin of the scapula which he suggests may have lodged a cleithrum. Our specimen is well preserved in this area; the edge is thin and shows no indication of such a groove. This is also the case with von Huene's two remaining specimens, and we are thus inclined to believe that this furrow is a post-mortem effect; his figures suggest that the whole anterior edge of "specimen 1" has been subjected to considerable crushing and distortion. A groove for cleithral articulation is noted by Pearson (1924a, pp. 832–833) in *Kannemeyeria*, but this was for the lower end of the cleithrum; the area corresponding to von Huene's groove is a convex surface in *Kannemeyeria*. The upper edge of the scapula is a diagonal line slanting downward from back to front, with a sharp postero-dorsal corner and an obtuse antero-dorsal corner. This is in pronounced contrast with von Huene's specimens where the upper edge is essentially horizontal. Our specimen suggests (but by no means proves) a more posteriorly inclined position for the scapula than is advocated by von

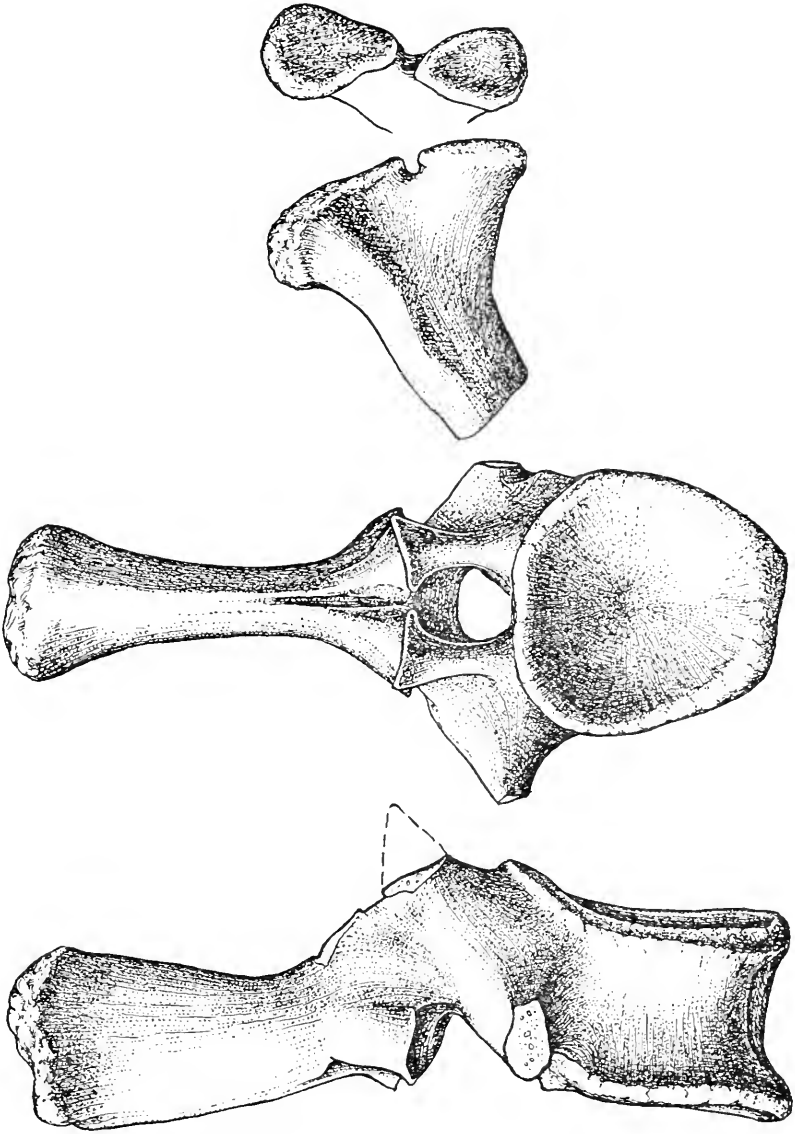


Fig. 7. *Stahleckeria lenzii.* Left, vertebra, right lateral and posterior views. Right, proximal portion of a right cervical rib. x 1/4.

Huene for *Stahleckeria* or by Watson and Pearson in other genera. This upper margin is gently convex in outline and is apparently an "unfinished" surface; presumably there was a small cartilaginous suprascapular area.

The posterior margin of the blade is quite thick. The spine is high and well developed. It is rugose along the summit for its entire length. This rugose area is broader proximally, narrower distally, and obviously was the area of attachment of the scapular portion of the deltoid muscle. Presumably the trapezius muscle attached, as usual, to the original line of the cleithrum rather than to the anterior face of the spine; here, as first pointed out by Watson, we would expect a muscle comparable to the mammalian supraspinatus. This anterior surface of the spine passes down smoothly beneath the acromion and out ventrally to the external surface of the girdle in a fashion appropriate to the supraspinatus channel. This surface is stated by von Huene to be interrupted by a sharp cross-ridge in his "specimen 1" and by a process higher up in his "specimen 2". Nothing of the sort is present in our specimen (the surface here is well preserved) and the effects noted by von Huene may be post-mortem.

Our specimen appears to exhibit a foramen entering the bone from the external surface somewhat anterior and ventral to the acromion. Von Huene's figures of "specimen 1" suggest a similar structure. It is not impossible that this is a surviving supraglenoid foramen, but nothing of this sort is known in other dicynodonts and it may be a nutrient foramen or (since the surface is not too well preserved in this area) an artifact.

Humerus. The distal end only was preserved, this being found in natural articulation with radius and ulna. It measures about 30 cm. across the condyles and is thus about the size of von Huene's largest specimens. As far as preserved it appears to agree well with his descriptions of the *Stahleckeria* material.

Radius (Fig. 9). A right radius is present and nearly complete, lacking only a few chips from the proximal end. The length is approximately 29 cm. Von Huene figures an incomplete and considerably restored specimen of *Stahleckeria* with an estimated length of 22 cm. He believed that his specimen was that of the left side, and that the aspect figured was the dorsal surface. Our complete specimen suggests that his interpretation was in part correct, but that the orientation of the distal end was reversed, his supposed ventral surface being actually the dorsal aspect.

The proximal articular surface is well cupped, and flares widely

Fig. 8. *Stahleckeria lenzii*, right scapula. x 1/4.

toward the medial side. This medial expansion is incomplete in our specimen; as preserved the width of the head is 15 cm., as contrasted with 14 cm. in von Huene's specimen. The shaft is flattened dorsoventrally, the breadth at the narrowest portion being 75 mm. and the thickness only about 50 mm. The distal end is greatly expanded toward the medial side, extending far beyond the radiale and having a width of 18 cm. (as compared with von Huene's estimate of 12 cm.). In its distal portion the bone is relatively thin toward the medial margin and thicker laterally, so that the shaft here presents a distinct, flattened, ventro-lateral aspect as well as extensor and flexor surfaces.

Ulna (Fig. 9). The complete right ulna has a total length of 56 cm.; from the bottom of the sigmoid notch to the distal end measures 32 cm. These figures indicate a size considerably in excess of the largest of von Huene's specimens, in which the comparable measurements were 49 cm. and 25 cm. respectively. Apart from differences due to variation in preservation and crushing, our specimen agrees rather well with that of von Huene. This is described as a left, but as seen from his plate 7, fig. 8, it is very similar to ours which is part of an articulated right limb.

In most described dicynodont material the olecranon is undeveloped in ossified form and hence perhaps none too large in life. In contrast is the enormous development seen in our specimen and that figured by von Huene, in which the olecranon and sigmoid notch occupy nearly half the length of the bone. The olecranon is completely ossified here, the bone terminating dorsally in a relatively narrow ridge. This ridge curves ventrally toward the outer margin, so that the flexor aspect of the olecranon is concave, in general primitive reptilian fashion. Opposite the sigmoid notch region the lateral margin of the shaft is thick and rounded; more distally this margin is sharper. On the extensor aspect the bone is convex both in the olecranon region and distally; opposite the sigmoid notch lies a concavity. This last may be due to crushing, as is surely the longitudinal furrow seen on the extensor aspect of von Huene's specimen. A deep concavity on the flexor aspect of the shaft of our specimen opposite the lower end of the sigmoid notch is surely due to crushing. Little can be said with certainty of the details of the sigmoid notch because of the poor surface present here. There is a distinct area for articulation with the head of the radius; this area is well seen also in von Huene's specimen.

Manus (Figs. 9, 10). Von Huene's specimens included almost no foot material. Our specimen includes a right manus, articulated and nearly complete except for the terminal phalanges. As would be expected, this foot is of enormous size, with an estimated length of 47 cm. and an estimated spread across the toes of about 45 cm.

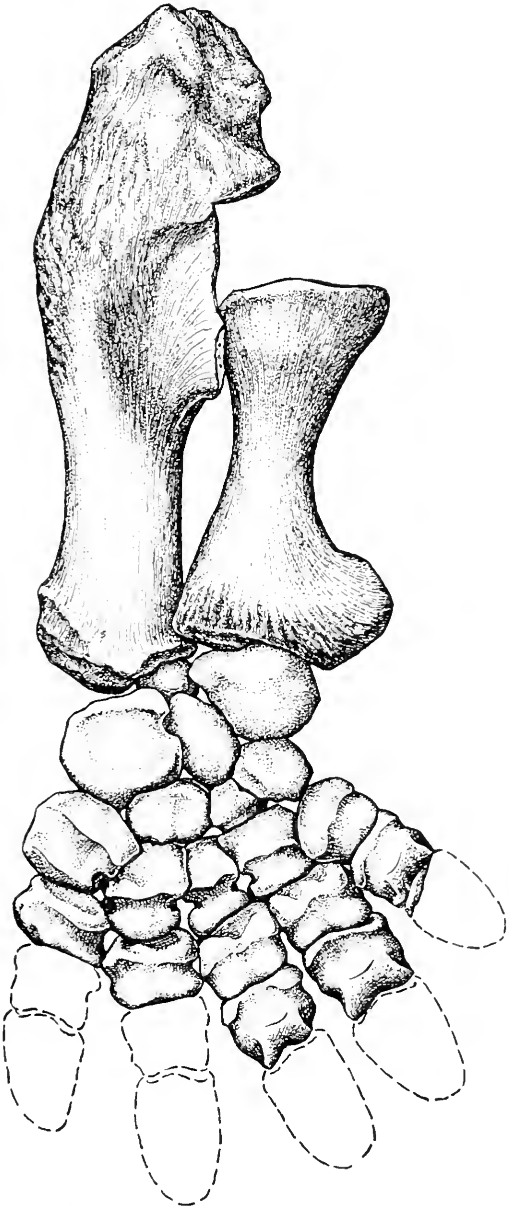


Fig. 9. *Stahleckeria lenzii*, right radius, ulna, and foot. x 1/6 approx.

The structure of the dicynodont foot is none too adequately known and it is hoped that a study of the foot material of the various dicynodonts in the Museum's Brazilian collection may aid in its interpretation. For the present we shall, for the most part, confine ourselves to a description of the specimen at hand.

The proximal row of carpals is present. The radiale is somewhat triangular in dorsal and ventral aspects, with the apex of the triangle toward the lateral side and the base of the triangle the rounded medial margin. The bone is thin medially but becomes increasingly thick laterally. The proximal margin is in contact with the distal end of the radius. Distally there is a broad face which may be presumed to have been in contact with a cartilaginous medial centrale.

The outlines of the intermedium are poorly preserved. The bone appears to have been subquadrate in shape, with a longitudinal hollow along the ventral surface.

The ulnare is essentially rectangular, with a width half again as great as the length. The proximal end is much thickened medially, becoming thin laterally. The same is true of the distal end, and the entire lateral margin is thin. Most of the distal surface was surely in contact in life with the fourth distal carpal. As preserved the fibulare appears to abut to a considerable extent on the fifth metacarpal. But it is probable that the carpals are somewhat displaced laterally on the digits and that little, if any, contact of this sort was present in life. On the medial aspect of the ulnare there is a well-developed notch which presumably served, as in early reptiles generally, for the passage of the perforating artery.

No pisiform is present; it might have been present in cartilage.

A lateral centrale is present in its typical position, below the intermedium and between radiale and ulnare. Little can be said of the details of its structure. No medial centrale is preserved, but it is reasonable to assume that it was present in cartilage.

Of the distal carpals, three are present. There is no evidence of a fifth member of the series, although it may have been present as a small cartilage. The fourth is, as usual, a large element, seen nearly in proper position beneath ulnare and lateral centrale. Distally, presumably owing to displacement, it appears to articulate to a considerable extent with metacarpal 3 as well as the more lateral elements with which it normally articulates. Distal carpal 3 is a relatively small element and, like the fourth, is displaced medially so that as preserved it is opposite metacarpal 2. Adjacent medially to metacarpal 3 is a large element. We suggest that distal carpal 2 was present in cartilage only or has been lost and that this large element is the first distal carpal. Distal carpal 1 would tend to be better ossified because of the fact that it partakes in great measure of the functions of a metacarpal. Its surfaces are poorly preserved and hence detailed description is impossible.

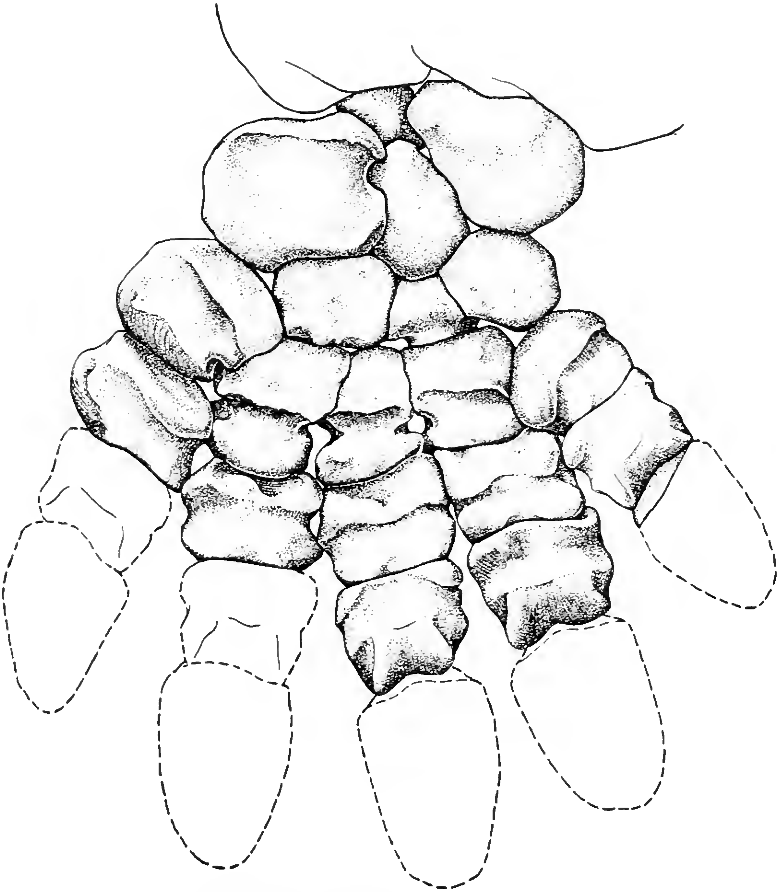


Fig. 10. *Stahleckeria lenzii*, right manus, dorsal view. x 2/9.

The carpal structure, as described above, is not dissimilar to that which appears to have been present in earlier Karroo dicynodonts. There is considerable variation in the degree of ossification of the more distal elements in the few forms described in this regard from South Africa.

The metacarpals and phalanges are exceedingly broad and short. A strong tendency in this direction is general in dicynodonts, and would be expected to be emphasized in a graviportal type such as the present one. The phalangeal formula is obviously, as usual, 2·3·3·3·3.

The general description of these elements which follows applies to digits 2–5. The proximal articular surfaces of the metacarpals are very broad and nearly flat. On the sides of the heads of each are well-developed articular areas which are apposed to the adjacent metacarpals, making for solidity of structure and relative immobility of the individual digits. Beyond a markedly constricted "waist" the typical metacarpals exhibit an oval and almost uniformly convex, distal, articular area.

The non-terminal phalanges are shorter than the metacarpals and with a less constricted "waist". The proximal articular surfaces of the first phalanges are concave in dorsoventral section. In horizontal section the surface is in general likewise concave, but consists essentially of paired swellings, separated by a median groove. The distal articular surfaces of the first phalanges are convex in both dimensions and consist of paired elevations with a slight depression between them.

The proximal articular surfaces of the second phalanges are paired concavities with a median ridge between them. The distal surfaces, articulating with the unguals, extend far on to both dorsal and ventral surfaces of the phalanges. On each phalanx the distal articulating surface consists of a pair of keels which form practically a semicircle; they are separated by a deep median groove. A circular pit is present within the surface enclosed laterally by the lateral keel. In contrast to the more proximal joints, that connecting the unguals was obviously one permitting considerable freedom of motion.

Almost no remains of the unguals are preserved; isolated elements noted by von Huene show that they were of the typical broad and flattened dicynodont type.

The first digit here, as in primitive reptiles generally is peculiar in that there is a proximal shift in the nature of the elements, which may be of importance in the history of the foot (a point which we may discuss on some future occasion). The metacarpal partakes in considerable measure of the nature of a "normal" first phalanx, and the first phalanx is comparable to the second phalanx of the more lateral digits.

Tibia (Fig. 11). A complete right tibia has a length of 38 cm., as compared with a length of 34 cm. in the single tibia available to von Huene. As he notes, his specimen is obviously pathological in structure; ours is more normal in build. The head is a massive subcircular structure, slightly concave, from the general contours of which the cnemial crest projects but little; the transverse width is 21 cm. The distal articular surface is likewise concave and is subcircular in outline, with a transverse width of 15 cm.; this surface is tilted somewhat toward the lateral aspect.

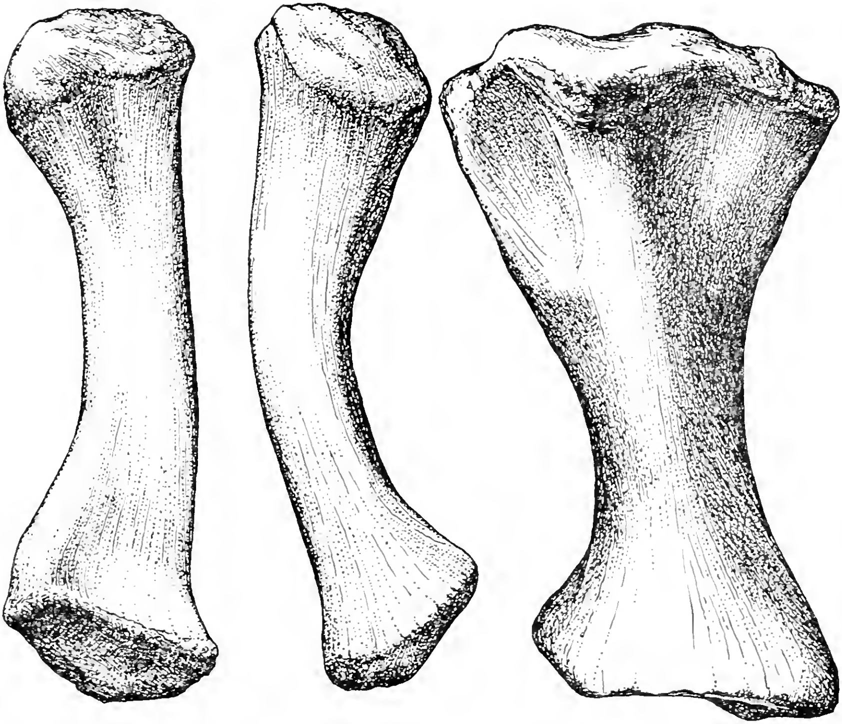


Fig. 11. *Stahleckeria lenzii.* Left, right fibula, flexor and extensor aspects. Right, right tibia, extensor aspect. x 1/4.

Fibula (Fig. 11). The fibula described by von Huene has a most abnormal appearance and, like the tibia, is probably pathological in its proximal portion. There is available to us a single right fibula, from the same locality as the specimen from which our other materials are derived, but not definitely associated with it. The two ends are preserved but there is no contact in the middle of the shaft. Obviously, however, little is missing for the total length of the two portions present is 35 cm., as compared with but 32 cm. in von Huene's complete specimen. The greatest diameter of both proximal and distal articulations is 11 cm., as compared with 10 cm. and 9 cm. in von Huene's specimen. The proximal articular area is of a general, primitive, reptilian shape, an oval with a somewhat curved axis, and is moderately convex. The distal articular surface is subcircular and convex. In its lower part the shaft exhibits an extensor surface strongly convex in section. The lower portion of the flexor surface is flattened, but the bone here flares strongly outward at the distal end.

DISCUSSION

The specimen described above obviously represents a gigantic dicynodont, similar in size to the individuals described by von Huene as *Stahleckeria potens*, and similar also in many anatomical features. We were at first inclined to attribute our material to von Huene's species, particularly since it comes from the same general region and from a horizon which is not improbably the same. However, detailed study shows a number of differences, particularly in the skull, as noted earlier, and many of the resemblances are simply features which might be expected in any dicynodont of large size. The differences may be in part individual and sexual, in part due to imperfections and differences in mode of preservation of the material. Nevertheless they are considerable, and lead us to believe that our specimen is specifically and quite possibly generically distinct. As the more conservative course we shall, until further data is available, consider it as pertaining to *Stahleckeria*, and describe it as *Stahleckeria lenzii*, sp. nov., distinguished from the genotype by such cranial features as the relatively narrower occiput and more compressed parietal region. The specific name is given in honor of Colonel Albino Lenz, of Candelaria, to whom we are grateful for many favors done the Harvard Expedition.

In a consideration of the relationships of *Stahleckeria*, one tends primarily to compare the genus with other large Triassic dicynodonts. Several forms of this sort are known, *Kannemeyeria*, (Pearson, 1924 1924a, Case 1934) of the early Triassic of South Africa, *Placerias* o the western United States, and *Sinokannemeyeria* of China (Young, 1937). Von Huene suggests that *Stahleckeria* is a "modified" *Kannemeyeria*, that the two are quite similar in structural features, but differ in cranial proportions, and implies that the skull type seen in *Kannemeyeria* is a relatively primitive one, from which that of *Stahleckeria* may have been derived.

We find it difficult, however, to accept this point of view. A few similarities between the two genera, such as the apparent absence of the preparietal, may be cited; but the contrasts are great:

(1) *Kannemeyeria* is slender-snouted, with an elongate, ridged, premaxillary region; *Stahleckeria* has a broad, short snout.

(2) *Kannemeyeria* has well-developed tusks; *Stahleckeria* appears to lack them, but has instead a prominent bony boss in the canine region.

(3) In *Kannemeyeria* the squamosal region is very strongly produced posteriorly, resulting in an exaggeration of the V-shaped contours of the lower margin of the skull and in a strongly concave occipital plate; in *Stahleckeria* the squamosal has relatively little extension backward and the occiput is nearly vertical.

Certain of these features do not, of course, bar *Kannemeyeria* from the ancestry of *Stahleckeria;* a tusked condition is obviously more primitive than a tuskless one, and although broad-snouted dicynodonts appear early in the history of the group, a slender-snouted stage may well have been an antecedent one.

As regards the posterior portion of the skull, however, we find it difficult to believe that *Stahleckeria* can have been derived from a *Kannemeyeria*-like form. The curvature of the lower border of the skull in the squamosal-quadrate region is a development seen in therapsids in general and related to the nature of the jaw-closing apparatus. It is much more marked in dicynodonts than in other groups, producing here the characteristic V-shaped lower margin of the zygomatic arch. The modest development of this peculiarity in *Stahleckeria* is a relatively primitive condition which contrasts strongly with the exaggerated development seen in *Kannemeyeria*. It is possible that a reversal of this evolutionary trend occurred, but it is not at all probable.

All in all, it seems probable that the two genera merely represent two independent "phyla" of large Triassic dicynodonts, which may have quite different relationships.

It would be of interest to be able to compare *Stahleckeria* with *Placerias* of North America. However, described remains of the latter genus include only the single limb bone forming the type and possibly, certain isolated elements described by Williston from Wyoming. Camp (1934) has recently discovered an abundance of material of *Placerias*, and attempts at comparison must be postponed until this is described. It is possible that *Placerias* is related to either *Kannemeyeria* or *Stahleckeria*, but equally possible that it may prove to represent still a third end-form expressive of a tendency toward gigantism in the late survivors of the dicynodont group.

Although the phylogenetic relationships of the multitudinous Karroo dicynodonts are as yet poorly understood, certain of the described South African Permian types are apparently rather more suggestive of *Stahleckeria* than is *Kannemeyeria*. Of interest is the genus *Aulacocephalodon*, as interpreted by Broom to include "*Dicynodon*" *tigriceps* and a number of other species. These forms were already of considerable size; a skull of *A. pearoti* in the University of Chicago collections measures 470 cm. in length (Olson and Byrne 1938) and is thus not far below that of *Stahleckeria* in size. In this genus the preparietal is still present, tusks are present in many specimens and there is a tendency for the development of rugose areas on the nasals and prefrontals. In other respects, however, such a form as *A. pearoti* appears to agree well with *Stahleckeria*. Common, and perhaps significant, features include the short, broad muzzle, the lack of marked posterior extension of the squamosal and the nearly vertical occiput.

Still more probable, however, is the supposition that *Stahleckeria* is a "local product". There exists in the same beds a considerable fauna of dicynodonts of smaller size, which for the most part are as yet undescribed. *Stahleckeria* appears to resemble these forms in many regards. The genus may be merely a development of gigantism in a regional fauna and lack any intimate genetic connection with "giants" of other continental areas.

BIBLIOGRAPHY

CAMP, C. L.
1934. New Reptile Fauna from the Chinle Triassic of Arizona. (Abstract). Proc. Geol. Soc. Amer., for 1933, pp. 392–393.

CASE, E. C.
1934. Description of a Skull of *Kannemeyeria erithrea* Haughton. Contr. Mus. Paleont., Univ. Michigan, **4**, no. 7, pp. 115–127.

HUENE, F. VON.
1935. Die fossilen Reptilien des Südamerikanischen Gondwanalandes an der Zeitenwende, Ergebnisse der Sauriergrabungen in Südbrasilien 1928–29, Lief. 1, pp. 1–92.

HUENE, F. VON.
1936. Ein *Stahleckeria*-Schädel. Zentralblatt. f. Min. etc. Jahrg. 1936, abt. B, No. 11, pp. 507–509.

OLSON, E. C. and BYRNE, F.
1938. The Osteology of *Aulacocephalodon peavoti* Broom. Jour. Geol., **46**, no. 2, pp. 177–190.

PEARSON, H.
1924. The Skull of the Dicynodont Reptile *Kannemeyeria*. Proc. Zool. Soc. London, 1924, pp. 793–826.
1924a. A Dicynodont Reptile Reconstructed. Proc. Zool. Soc. London, 1924, pp. 827–856.

SUSHKIN, P. P.
1927. On the Modifications of the Mandibular and Hyoid Arches and their Relations to the Brain-case in the early Tetrapoda. Palaeont. Zeitschr., **8**, Heft 4, pp. 263–321.

YOUNG, C. C.
1937. On the Triassic Dicynodonts from Shansi. Bull. Geol. Soc. China, **17**, nos. 3 and 4, pp. 393–411.